98

RESTRICTED (ADMINISTRATION)

PUBLIC WORKS PROGRAMME

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR

HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER AND REMAINING WORKS

Highways/New Territories Region
Highways Department
Hong Kong

Binnie Consultants Limited

April 1997

CONTENTS

	Name	Signature	Date
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Reviewed	L.S. Lam		28th April 97.

CONTENTS
(cont'd)

1 INTRODUCTION

Project Background

Existing Road Network

1.1 The rapid growth of the towns in the New Territories and the closer ties with the mainland China since 1970 have given rise to a pressing need for improving roads in the New Territories. Since 1980, the following trunk roads which form Routes 1 and 2 have been commissioned:

(i) New Territories Circular Road (NTCR) which includes Tolo Highway between Sha Tin and Tai Po, and the trunk road from Tai Po to Au Tau via Fanling, Sheung Shui, Mai Po and Fairview Park.

(ii) Lok Ma Chau Border Link with its southern end connected to the NTCR near San Tin Village.

(iii) Tuen Mun-Yuen Long Eastern Corridor (Yuen Long Highway) from Tuen Mun to Long Tin Road in Yuen Long.

(iv) Yuen Long Southern Bypass (ie. part of Yuen Long Highway) which is to connect Castle Peak Road in the east at the Pok Oi Interchange to Yuen Long Eastern Corridor in the west. To date, only the section of Yuen Long Highway from its western junction with Tuen Mun Highway to the Shap Pat Heung Interchange has been completed. The Shap Pat Heung Interchange is currently connected to the Pok Oi Interchange by two district distributor roads, DR-1 and DR-2.

Figure 1.1 shows the layout of these trunk roads in the North West New Territories.

Traffic Congestion

1.2 The commission of the completed section of Yuen Long Highway in November 1994 has enabled the trunk road traffic between Tuen Mun and San Tin Village to avoid the busy section of Castle Peak Road in Yuen Long Town. However, rapid growth of traffic volume in recent years and the rapid flow of traffic on the new highways in the North West New Territories have rendered the capacity of the old Au Tau Roundabout at the junction of Castle Peak Road and Kam Tin Road insufficient.

1.3 This 'bottleneck' has led to traffic congestion along Route 2 (the NTCR and Yuen Long Highway). In an effort to mitigate the situation, local widening along Castle Peak Road at approaches to the old roundabout and a temporary single lane Yuen Long-bound flyover were implemented in August 1996.

1.4 The Route 3 Country Park Section (CPS), including its links with the Pok Oi Interchange by two slip roads on the northern side of the Interchange, has been scheduled for commission in July 1998. Figure 1.2 shows the general layout of the roadworks to be constructed by the Route 3 Franchisee, Route 3 (CPS) Co. Ltd., at the Pok Oi Interchange.

1.5 Originally, the construction of the Yuen Long Highway (ie. 'the Highway') between Shap Pat Heung Interchange and Pok Oi Interchange was scheduled to start in early 1999 for completion in late 2001. However, with Route 3 CPS commissioned in mid 1998, this would mean that all the south-bound traffic heading for Yuen Long and Tuen Mun, and all the traffic along Yuen Long Highway heading for Route 3 CPS would have to pass through the existing roundabout at grade at the Pok Oi Interchange. This would inevitably lead to serious traffic congestion and major delays on the roads leading to the roundabout.[1]

1.6 The configuration of the Pok Oi Interchange is currently imposing a constraint to the achievement of Housing Branch's targets for housing in the Yuen Long area. This is because the approval of several major housing/residential developments in Yuen Long Town depends largely on whether the interchange is able to absorb additional traffic generated from these developments.

1.7 In view of the imminent completion of Route 3 CPS, the pressing housing demand and the projected undercapacity of the existing Pok Oi Interchange, Housing Branch, Transport Department and Highways Department have recognised the urgent need to complete part of the remaining section of Yuen Long Highway (ie. 'the Highway') between Shap Pat Heung Interchange and Pok Oi Interchange (see Figure 1.3).

[1] This is confirmed by recent traffic studies which indicate that the Design to Flow Capacity of Pok Oi Roundabout would increase to 2.37 in 2001.

1.8 The part of the programme that Housing Branch, Transport Department and Highways Department are considering advancing is the construction of a flyover over the existing roundabout at Pok Oi Interchange to provide a direct link between Route 3 CPS and the Yuen Long Highway. Implementation of the Pok Oi Flyover project is the most practicable means available to facilitate the free flow of traffic in the area.

1.9 The purpose of this report is to provide information about the potential environmental impacts of the proposed Pok Oi Flyover project and the Remaining Works project, which together comprise the works required to complete the Yuen Long Highway between Shap Pat Heung Interchange and Pok Oi Interchange.

Preliminary Project Feasibility Study

1.10 Binnie Consultants Ltd was commissioned in December 1996 to carry out a Preliminary Project Feasibility Study (PPFS) for early implementation of the Pok Oi Flyover Project. BCL was commissioned at the same time to carry out a PPFS for the remaining section of the Highway between Shap Pat Heung Interchange and Pok Oi Interchange (ie. the Remaining Works project).

1.11 As indicated in the Preliminary Environmental Review Reports[2], the scale of the potential environmental impacts, particularly construction-related impacts, are expected to be minor.

1.12 Section 9 (Page 10 of the Pok Oi Flyover PPFS report and Page 15 of the Remaining Works PPFS report) is a page long Environmental Review summarising the results of preliminary investigations into the environmental impacts of the projects.

1.13 The section summarised the key findings of the review as follows:

> *"Noise impact*
>
> *During both construction and operation stage, the proposed flyover will give rise to noise impact on nearby noise sensitive receivers and further noise assessment is required to address the problems and to devise necessary mitigation measures to comply*

[2] *Preliminary Project Feasibility Study (PPFS) Report (Final) for Highway between Shap Pat Heung Interchange and Pok Oi Interchange - Pok Oi Flyover* (December 1996) Binnie Consultants Ltd for Highways Department; *(PPFS) Report (Final) for Highway between Shap Pat Heung Interchange and Pok Oi Interchange - Remaining Works* (February 1997) Binnie Consultants Ltd for Highways Department

with Hong Kong Planning Standards & Guidelines (HKPSG) requirements.

Air impact

Vehicular emissions will affect nearby air sensitive receivers and further study is required to identify affected areas and to formulate constraints for future developments in the areas. The Environmental Protection Department (EPD)'s standard dust suppression measures should be implemented through relevant contract to avoid dust nuisance arising from construction activities.

Waste disposal and water quality impacts

Further waste disposal and water quality impact assessments will not be required. However, standard contractual clauses and engineering conditions on water quality protection and waste disposal should be stipulated in the works contracts. These clauses/conditions should include a requirement for the Works Agency to follow EPD's relevant ProPECC papers on construction site management.

Environmental Impact/Risk Assessments needed in Later Stages:

It is concluded that an Environmental Impact Assessment (EIA) is required for the proposed works to further address the potential air and noise impacts and to recommend necessary mitigation measures."

Purpose of EIA Report

1.14 Subsequent to the issue of the PPFS report for the Pok Oi Flyover, Binnie Consultants Ltd was commissioned to carry out the necessary Environmental Impact Assessment for the Pok Oi Flyover project. Although the Remaining Works project is to be commissioned about three years after the commission of the Pok Oi Flyover, this EIA Report will address the impacts of the two projects together.

Structure of EIA Report

1.15 The structure of this draft EIA Report is as follows:

Section 1: provides a general introduction to the projects and EIA Study

Section 2: details the projects and proposed planning/implementation programmes and the specific objectives of the EIA Study

Section 3: describes the applicable environmental legislation

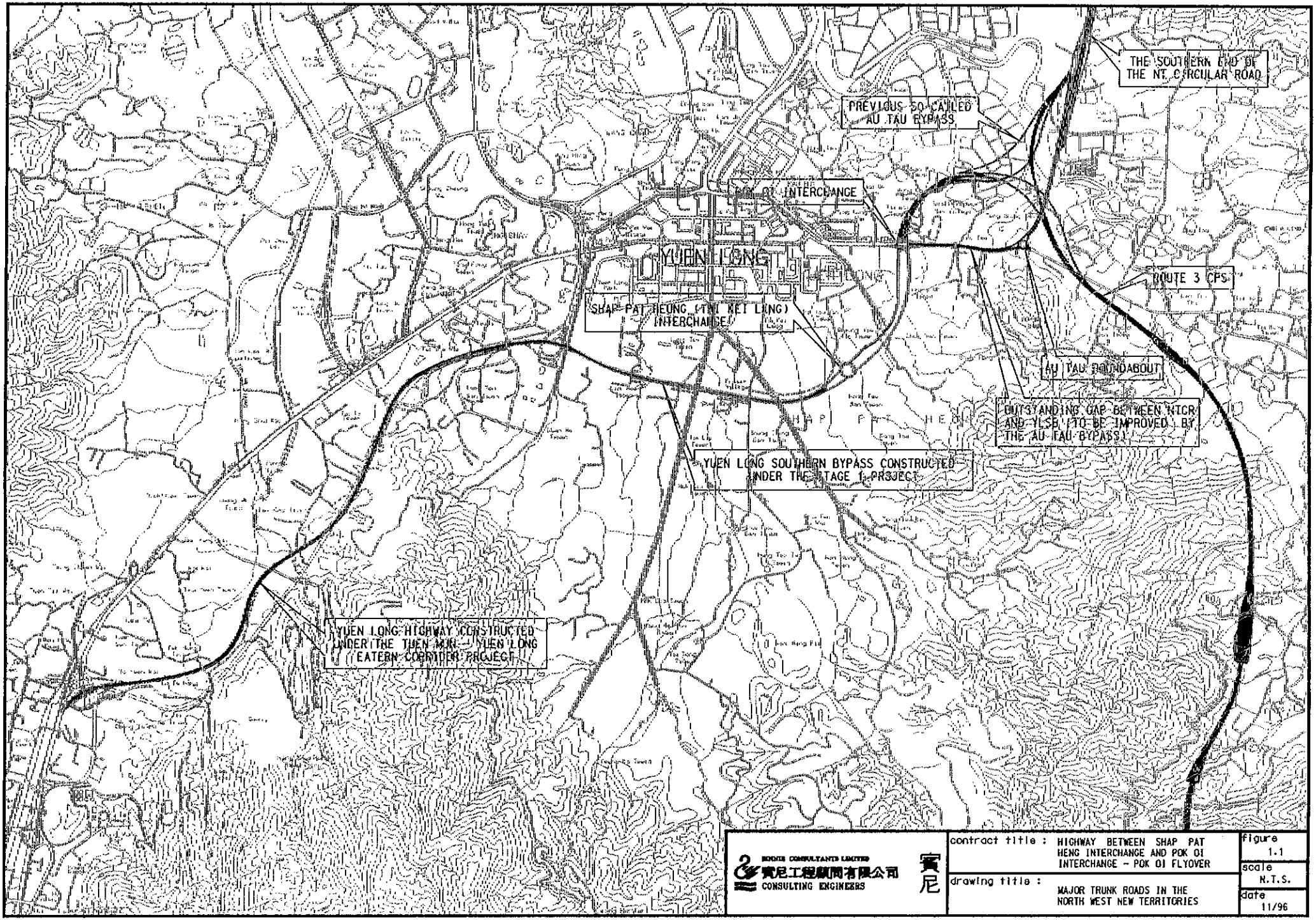
Section 4: describes the existing environment within the Study Area including the ecology; existing and future sensitive receivers are identified

Section 5: presents the results of the traffic noise assessment

Section 6: presents the results of the operation phase air quality assessment

Section 7: presents the results of the construction noise and air studies and the findings of the PPFS review of general construction impacts

Section 8: provides a summary of environmental impacts identified in Sections 5-7



ROUSE CONSULTANTS LIMITED
寶尼工程顧問有限公司
CONSULTING ENGINEERS
寶尼

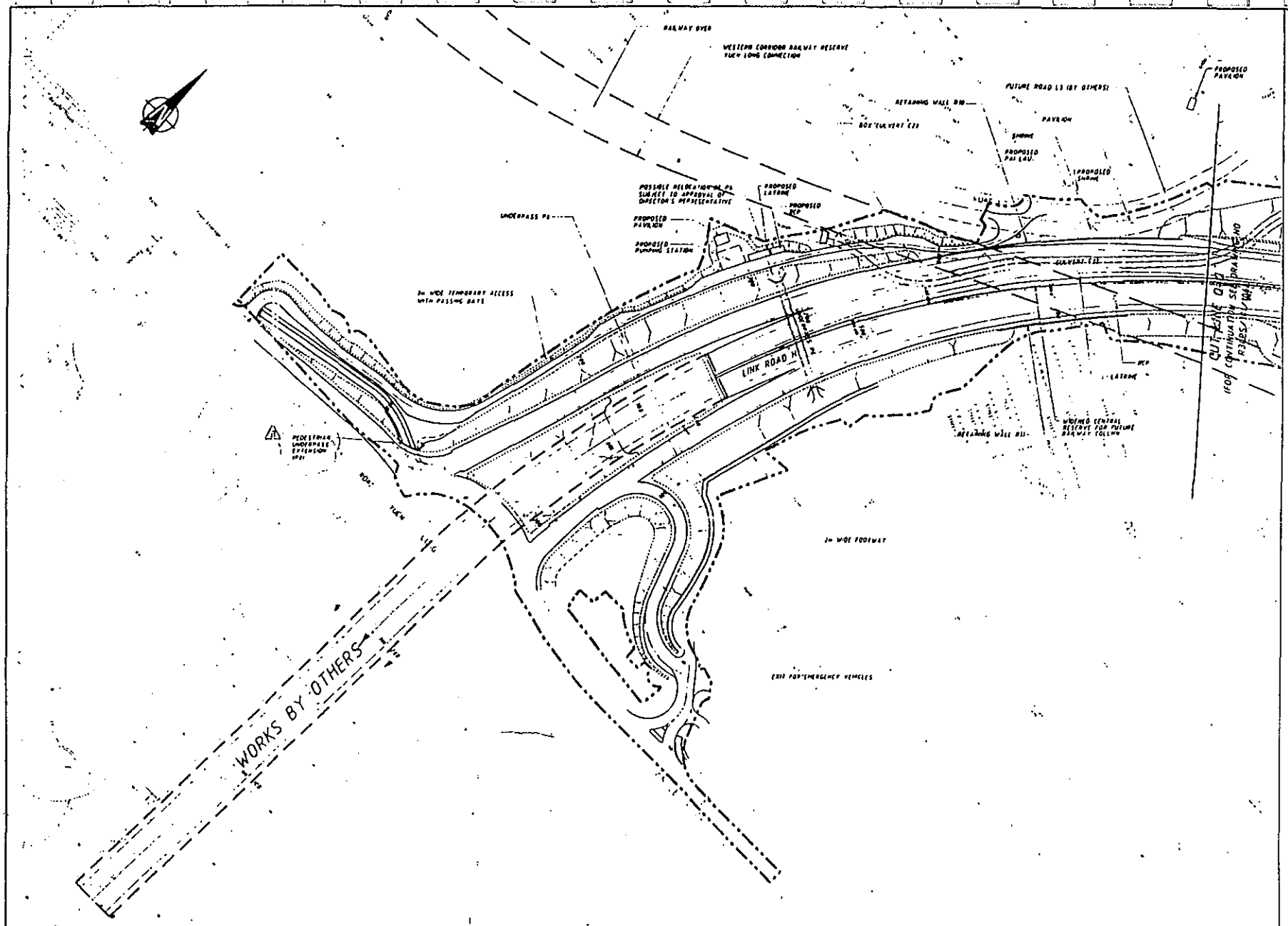
contract title : HIGHWAY BETWEEN SHAP PAT HENG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER

drawing title : MAJOR TRUNK ROADS IN THE NORTH WEST NEW TERRITORIES

figure 1.1

scale N.T.S.

date 11/96



NOTES:

1. CO-ORDINATES RELATE TO HONG KONG METRIC GRID (1994)
2. DIMENSIONS ARE IN MILLIMETRES AND CHAINAGES ARE IN METRES UNLESS OTHERWISE SHOWN
3. LEVELS ARE IN METRES AND REFER TO PRINCIPAL DATUM (P.D.)
4. CUT SLOPES SHOWN THUS
5. FILL SLOPES SHOWN THUS
6. REFER EARTHWORKS DRAWINGS FOR SLOPE DETAILS
7. LEGEND
   - BRIDGE PIER
   - PROJECT LIMIT
8. WESTERN CORRIDOR RAILWAY RESERVE SLOPES ARE NOT SHOWN

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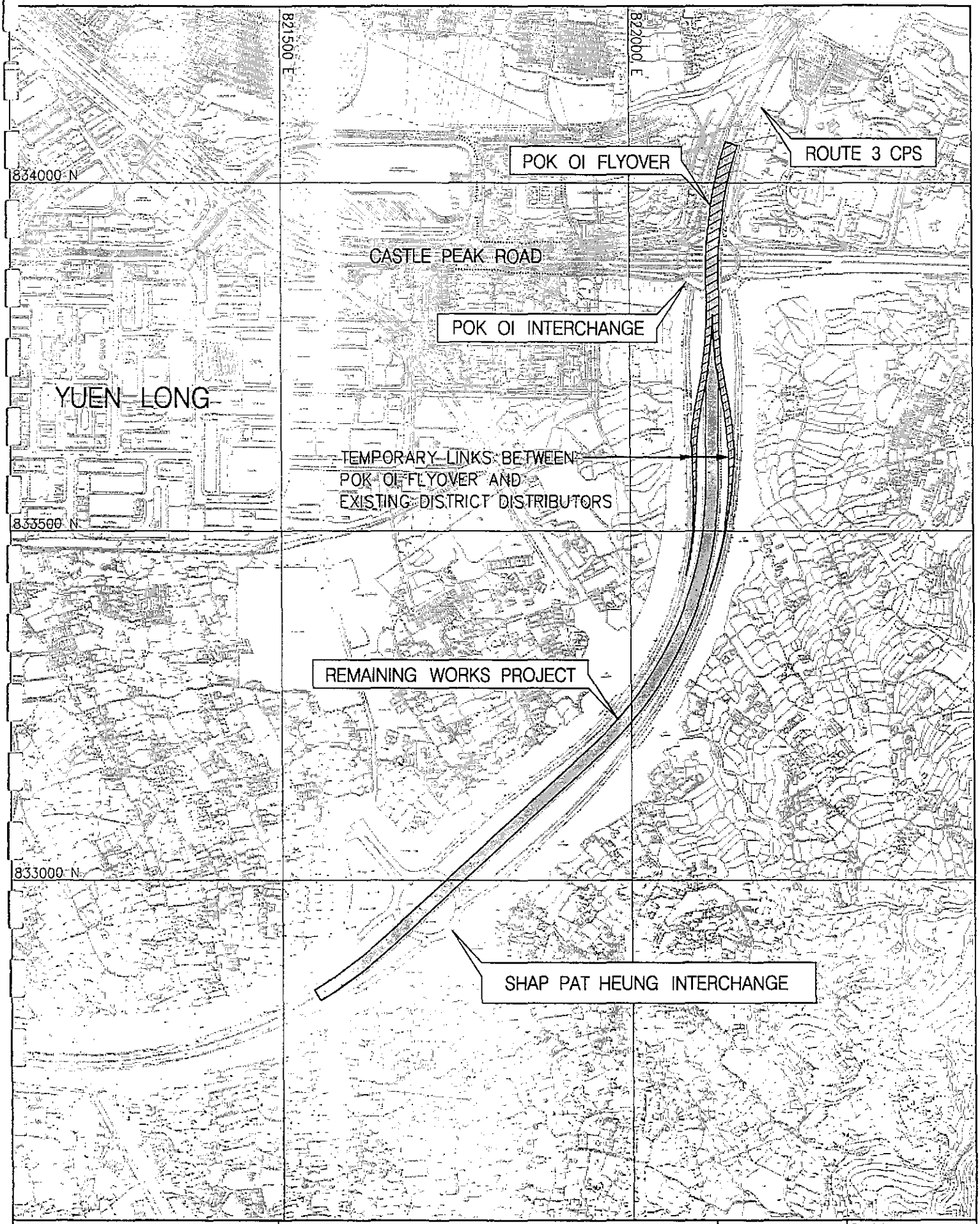
contract title :	HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER	figure 1.2
drawing title	ROADWORKS TO BE CONSTRUCTED BY ROUTE 3 (CPS) CO. LTD. AT THE POK OI INTERCHANGE	scale N.T.S.
		date 11/96



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HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER AND REMAINING WORKS

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ENGINEERS AND SCIENTISTS
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Title :

EXTENT OF THE POK OI FLYOVER AND REMAINING WORKS PROJECT

Figure No.	Revision
1.3	0
Reference	File Name
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Date	Scale
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2 PROJECT DESCRIPTION AND EIA STUDY OBJECTIVES

Introduction

2.1 This section briefly describes the major components of the projects and the overall planning and EIA Study objectives.

Project Components

Pok Oi Flyover

2.2 The proposed Pok Oi Flyover includes construction of a dual two-lane road linking Yuen Long Highway to Route 3 CPS via a dual two lane flyover at Pok Oi Interchange. In addition, two single two-lane temporary roads of about 200 m each will be constructed, connecting the trunk road to the existing district distributors of Yuen Long Highway. The layout of the Pok Oi Flyover is shown in Figure 2.1.

2.3 The approach roads to the flyover will be formed on embankments. The total length of road embankment is about 550 m, which includes the span of the flyover. These 550 m of road embankments are located inside the embankments of the district distributor roads formed under the Yuen Long Southern Bypass project and the Route 3 CPS project. The height of the embankments of the district distributors in the northern and southern sides of the Pok Oi Interchange is about 5-7 m above the adjacent ground level. The height of the proposed trunk road at these locations range from approximately 0-7 m above the road surface of the district distributors.

2.4 The flyover, which rises to approximately 17 mPD (the local ground level is at around 5.5 mPD) is to be formed on a piled foundation. Two alternative structures have been proposed: an asymmetric design using 37-37-37 m spans (total span 111 m) and a symmetrical design using 40-49-40 m spans (total span 129 m). The option to be adopted will be required to obtain approval by ACABAS.

2.5 Like the rest of Route 3 CPS and Yuen Long Highway, the flyover will be designed to accommodate a free flow of traffic with minimum braking and acceleration and for no stopping, except under emergency conditions.

2.6 Noise barriers will be installed on the embankment and flyover sections to protect local noise sensitive receivers.

2.7 The works also include the installation of all associated drainage, street lighting, traffic aids, landscaping and utilities.

Remaining Works

2.8 The Remaining Works involve the construction of the remaining approximately 1,100 metres of trunk road between the Pok Oi Flyover and Shap Pat Heung (SPH) Interchange. This will include the construction of two two-lane bridges of around 30 metres length at the SPH Interchange; a combined vehicular/pedestrian underpass of some 25 metres long by 11 metres wide at Sheung Yau Tin Tsuen; a pedestrian underpass of approximately 55 metres long by 4 metres wide at Tai Kei Leng; a pedestrian underpass of around 35 metres long by 4 metres wide at Sheung Yau Tin Tsuen. The layout of the Remaining Works is shown in Figure 2.1.

2.9 Most of the trunk road will be formed on embankments with a final level higher than the existing district distributor at the Pok Oi Flyover but lower than the existing distributor roads at the SPH end. The bridges at SPH Interchange, which at approximately 10-11 metres mPD will be some 6 metres above the trunk road, will be founded on a piled foundation. Like the Pok Oi Flyover embankments, the location of the road embankment of the Remaining Works is bounded by the district distributors constructed under the Yuen Long Southern Bypass Contract.

2.10 All the proposed underpasses will be connected to underpasses underneath the existing district distributors. For efficient maintenance and for aesthetic reasons, the construction of the proposed underpasses will be similar to the existing structures. The combined vehicular/pedestrian underpass at Sheung Yan Tin Tsuen will be founded on driven friction piles. The other pedestrian underpasses will be founded on raft footings.

2.11 The works will also involve the removal of the two existing temporary roads between the Pok Oi Flyover and the district distributors, including the reversion of the two temporary road junctions, so as to enable the district distributors to resume their function solely as district distributors.

2.12 The works also include the installation of all associated drainage, street lighting, traffic aids, landscaping, utilities and the erection of noise barriers, if required.

Planning/Implementation Programmes

2.13 The planning/implementation programmes for the Pok Oi Flyover and the Remaining Works are presented in Figures 2.2 and 2.3.

Development Planning Objectives

2.14 The Territorial Development Strategy (TDS), first promulgated in 1984, which forms the basis of development planning in Hong Kong is based on the six principal objectives listed in Table 2.1. These objectives are assumed to be given equal importance in the TDS Review[1].

Table 2.1
Principal Objectives of the Territory Development Strategy

No.	Objective
Objective 1	To enhance the role of Hong Kong as an international city and a regional centre for business, finance, information, tourism, entrepot activities and manufacturing.
Objective 2	To ensure that adequate provision is made to satisfy the land use and infrastructure needs arising from sectoral policies on industry, housing, commercial, rural, recreation and other major socio-economic activities.
Objective 3	To conserve and enhance significant landscape and ecological attributes, and important heritage features.
Objective 4	To enhance and protect the quality of the environment with regard to air quality, water quality, noise, solid waste disposal and potentially hazardous installations by minimizing net environment impacts on the community and maximising opportunities to resolve existing environmental problems.
Objective 5	To provide a framework within which to develop a multi-choice, high capacity transport system that is financially viable, environmentally acceptable, energy efficient and make provision for the safe and convenient movement of people and goods.
Objective 6	To formulate a strategy that can be carried out both by the public and private sectors under variable circumstances, particularly with respect to the availability of resources and significant changes of demand.

2.15 The EIA Study is designed to ensure that Objectives 4 and 5 are fully taken into account during the design and construction of the Project.

[1] *Consolidated Technical Report on the Territorial Development Strategy Review* (1996) Planning Department.

Purpose of EIA Study

2.16 The purpose of the EIA Study is to provide information on the nature and extent of environmental impacts arising from the projects and all related activities taking place concurrently. This information will contribute to decisions on:

(i) the overall acceptability of any adverse environmental consequences that are likely to arise as a result of the projects;

(ii) the conditions and requirements for the detailed design, construction and operation of the projects;

(iii) the acceptability of residual impacts after the proposed mitigation measures are implemented.

2.17 In the EIA Study, we will seek to identify practicable means to reduce any potentially adverse environmental impacts to levels which will meet the current environmental standards set by Hong Kong Government, in order to ensure that these essential works can progress to schedule as required by the Client.

Objectives of EIA Study

2.18 In order to achieve the purpose of the EIA Study, our studies must achieve the following objectives:

(i) to describe the projects and associated works together with the requirements for carrying out the projects;

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

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

(iv) to propose the provision of practical and cost-effective infrastructure or mitigation measures so as to minimize pollution, environmental disturbance and nuisance arising during construction and operation of the projects;

(v) to identify, predict and evaluate the residual (ie. after practicable mitigation) environmental impacts and cumulative effects expected to arise during the construction and operational phases of the projects in relation to the sensitive receivers and potential affected uses;

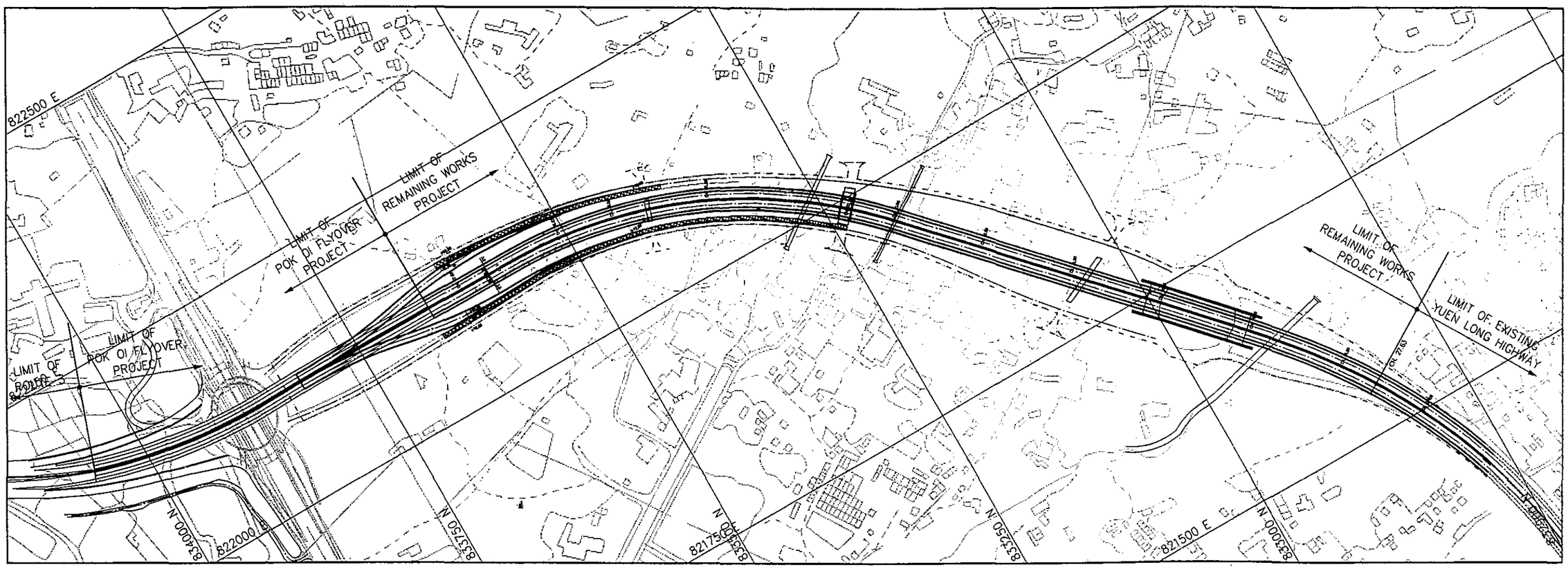
(vi) to identify, assess and specify methods, measures and standards, to be included in the detailed design, construction and operation of the projects which are necessary to mitigate these impacts and reduce them to acceptable levels;

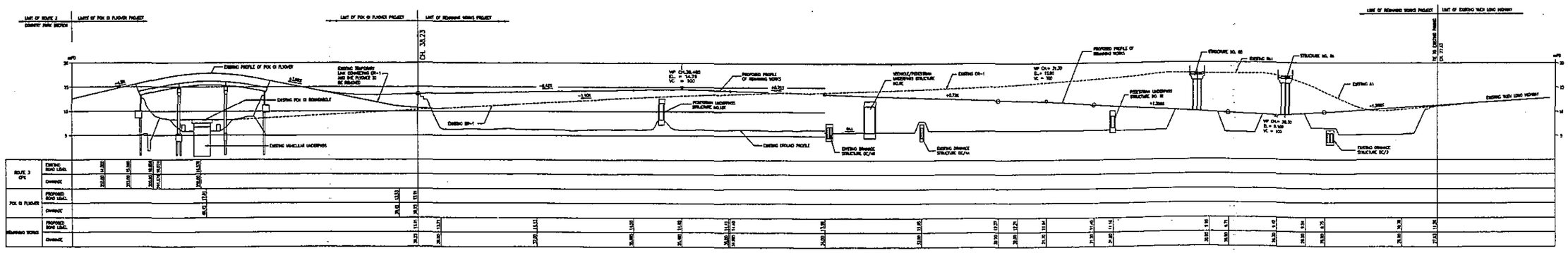
(vii) to investigate the extent of side-effects of proposed mitigation measures that may lead to other forms of impacts;

(viii) to identify constraints associated with the mitigation measures recommended in the EIA Study;

(ix) to identify any additional studies necessary to fulfil the objectives to the requirements of the EIA Study;

(x) to design and specify the environmental monitoring and audit (EM&A) requirements including Action and Limit Levels and Event/Action Plan to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted.





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Contract Title :
HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER AND REMAINING WORKS

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賓尼

Title :

PLAN AND PROFILES

Figure No. 2.1	Revision 0
Reference	File Name 00240088.B04
Prepared	Checked
Date APR. 97	Scale N.T.S.

Highway between Shap Pat Heung Interchange and Pok Oi Interchange
Pok Oi Flyover
PROJECT IMPLEMENTATION PROGRAMME

Task Name	Start Date	Duration (Weeks)	End Date
PPFS	**11/10/96**	**14.71**	**21/01/97**
Client Project Brief	11/10/96	8.00	05/12/96
Approval to employ consultants	06/12/96	0.70	10/12/96
Instruct consultants	03/12/96	0.00	03/12/96
Prepare PPFS report	03/12/96	2.00	16/12/96
Circulate PPFS report	17/12/96	0.00	17/12/96
Respond to comments	18/12/96	1.00	24/12/96
Submit signed PPFS report	25/12/96	2.00	07/01/97
Upgrade to Cat C	08/01/97	1.00	14/01/97
Upgrade to Cat B	15/01/97	1.00	21/01/97
EIA study	**03/12/96**	**10.50**	**14/02/97**
EIA by consultants	03/12/96	6.00	13/01/97
Endorse EIA by EPD	14/01/97	4.50	14/02/97
Roads Ordinance Gazette	**19/12/96**	**21.26**	**16/05/97**
Initial consult DB	19/12/96	0.00	19/12/96
Consult DB	07/01/97	0.00	07/01/97
Prepare gazette documents	01/01/97	2.00	14/01/97
Circulate gazette plan	15/01/97	4.40	14/02/97
Gazette the project	14/02/97	0.00	14/02/97
Objection period ("no objection" scenario)	14/02/97	8.50	15/04/97
Authorize the project	15/04/97	4.50	16/05/97
Gazette authorization	16/05/97	0.00	16/05/97
PWSC & Entrustment	**14/02/97**	**20.71**	**08/07/97**
Draft PWSC paper	14/02/97	3.14	07/03/97
Finalize PWSC paper	07/03/97	12.14	30/05/97
PWSC meeting	04/06/97	0.00	04/06/97
Upgrade to Cat A	04/06/97	2.50	21/06/97
Entrustment agreement	15/04/97	12.14	08/07/97
Possess site	21/06/97	2.50	08/07/97
Site Investigation	**12/10/96**	**18.50**	**18/02/97**
Site investigation	12/10/96	18.50	18/02/97
Construction	**09/07/97**	**60.00**	**01/09/98**
Construction (Design and Build)	09/07/97	60.00	01/09/98
Completion	01/09/98	0.00	01/09/98

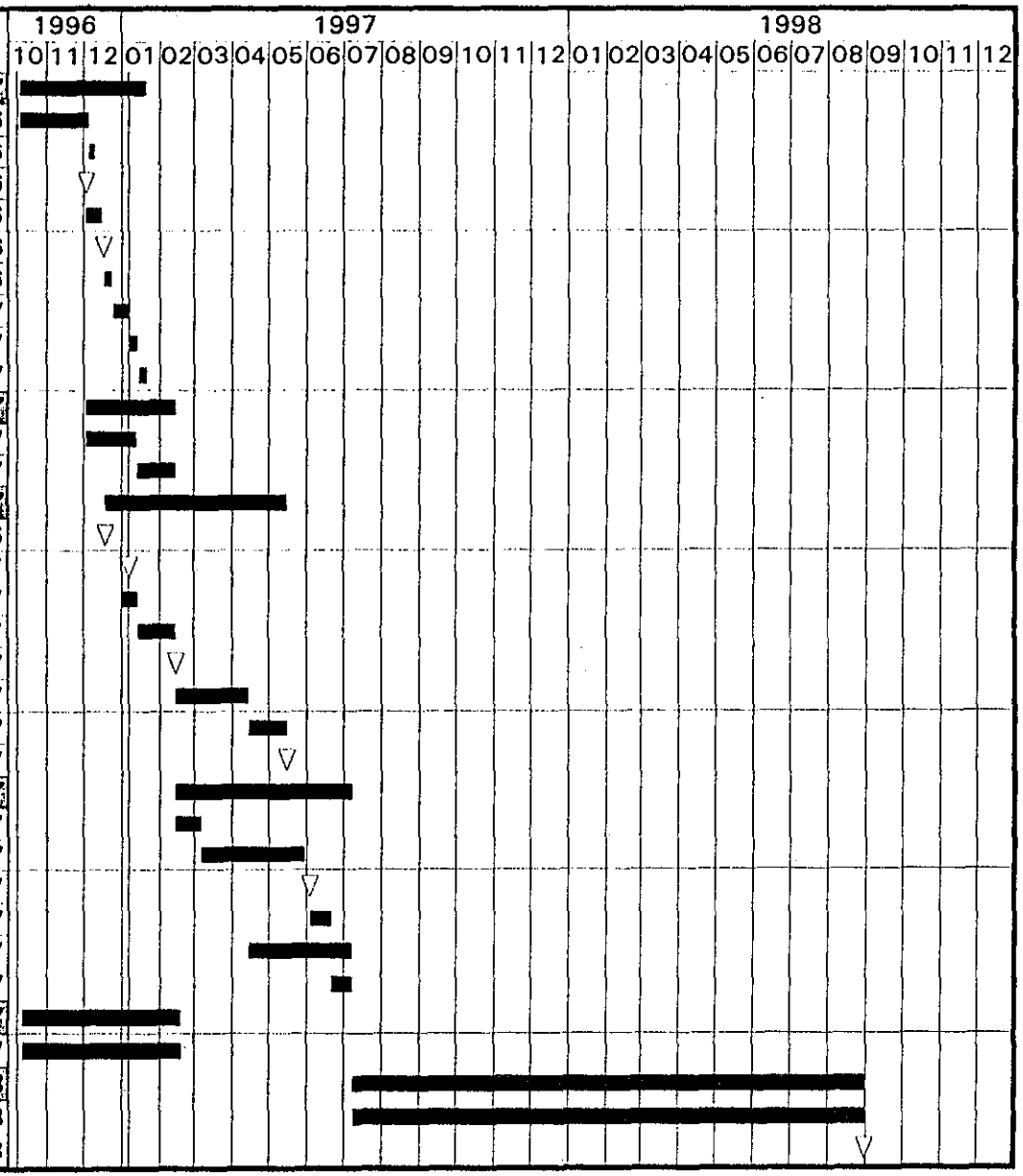

Figure 2.2

Highway Between Shap Pat Heung Interchange at Pok Oi Interchange - Remaining Works
Project Implementation Programme

Row #	Task Name	Start	End	Duration (Weeks)
1	PRELIMINARY PROJECT FEASIBILITY STUDY	02/12/96	03/10/97	43.80
2	Prepare draft PPFS report	02/12/96	19/02/97	11.60
3	Circulate PPFS report for comments	20/02/97	21/02/97	0.40
4	Finalise PPFS report	24/02/97	26/02/97	0.60
5	Consultant submit final PPFS report	26/02/97	26/02/97	0.00
6	sign-off by policy secretary anf others	26/02/97	26/02/97	0.00
7	Upgraded to Category B	03/10/97	03/10/97	0.00
8	CONSULTANT SELECTION	06/03/97	29/10/97	34.00
9	Approval of Block Vote	03/10/97	16/10/97	2.00
10	Approval use of consultant	06/03/97	26/03/97	3.00
11	Brief	27/03/97	28/05/97	9.00
12	Shortlisting of consultants	29/05/97	30/07/97	9.00
13	Appointment of consultant	31/07/97	29/10/97	13.00
14	REVIEW AND PRELIMINARY DESIGN	30/10/97	29/04/98	26.00
15	Preliminary design	30/10/97	15/04/98	24.00
16	EIA and DIA	30/10/97	18/02/98	16.00
17	Responses to comments	19/02/98	01/04/98	6.00
18	Finalise report	02/04/98	29/04/98	4.00
19	Submit final report	29/04/98	29/04/98	0.00
20	CONSULTATION	17/11/97	08/07/98	33.60
21	District Board	17/11/97	23/01/98	10.00
22	ACE	19/02/98	08/07/98	20.00
23	FMC on fill source	01/12/97	30/01/98	9.00
24	ROADS ORDINANCE	29/12/97	17/03/99	63.60
25	Roads Ordinance plan preparation	29/12/97	23/01/98	4.00
26	Circulate Ordinance plan	26/01/98	20/02/98	4.00
27	Scheme gazette	08/07/98	08/07/98	0.00
28	Objection period / resolution of objection	09/07/98	03/02/99	30.00
29	Exco authorisation	04/02/99	17/03/99	6.00
30	LAND CLEARANCE	30/10/97	07/04/99	75.00
31	Submit CAF	30/10/97	30/10/97	0.00
32	Land clearance (all government lands)	30/10/97	07/04/99	75.00
33	DETAILED DESIGN / CONTRACT	16/04/98	21/04/99	53.00
34	Finalise layout	16/04/98	20/05/98	5.00
35	Submit design memorandum	21/05/98	17/06/98	4.00
36	Design of civil / structural works	18/06/98	24/02/99	36.00
37	ACABAS submission	21/05/98	01/07/98	6.00
38	Approval from GEO	10/09/98	02/12/98	12.00
39	Finalise design	25/02/99	24/03/99	4.00
40	Draft tender documents	24/09/98	02/12/98	10.00
41	Submit draft tender documents for comments	02/12/98	02/12/98	0.00
42	Circulate draft tender documents	03/12/98	24/02/99	12.00
43	Finalise and production of tender documents	25/03/99	21/04/99	4.00
44	APPLY FUND FOR CONSTRUCTION	18/03/99	09/06/99	12.00
45	Prepare and submit PWSC paper	18/03/99	09/06/99	12.00
46	Upgraded to Category A	09/06/99	09/06/99	0.00
47	TENDER	09/06/99	23/09/99	15.20
48	Gazette tender	09/06/99	09/06/99	0.00
49	Tender period	11/06/99	22/07/99	6.00
50	Evaluate tender	23/07/99	02/09/99	6.00
51	Submit tender report	02/09/99	02/09/99	0.00
52	Award tender	23/09/99	23/09/99	0.00
53	CONSTRUCTION	24/09/99	14/02/02	125.00
54	Construction of vehicular bridges at roundabout	24/09/99	25/01/01	70.00
55	Construction of underpasses	24/09/99	23/08/01	100.00
56	Other civil works	24/09/99	14/02/02	125.00
57	Completion	14/02/02	14/02/02	0.00

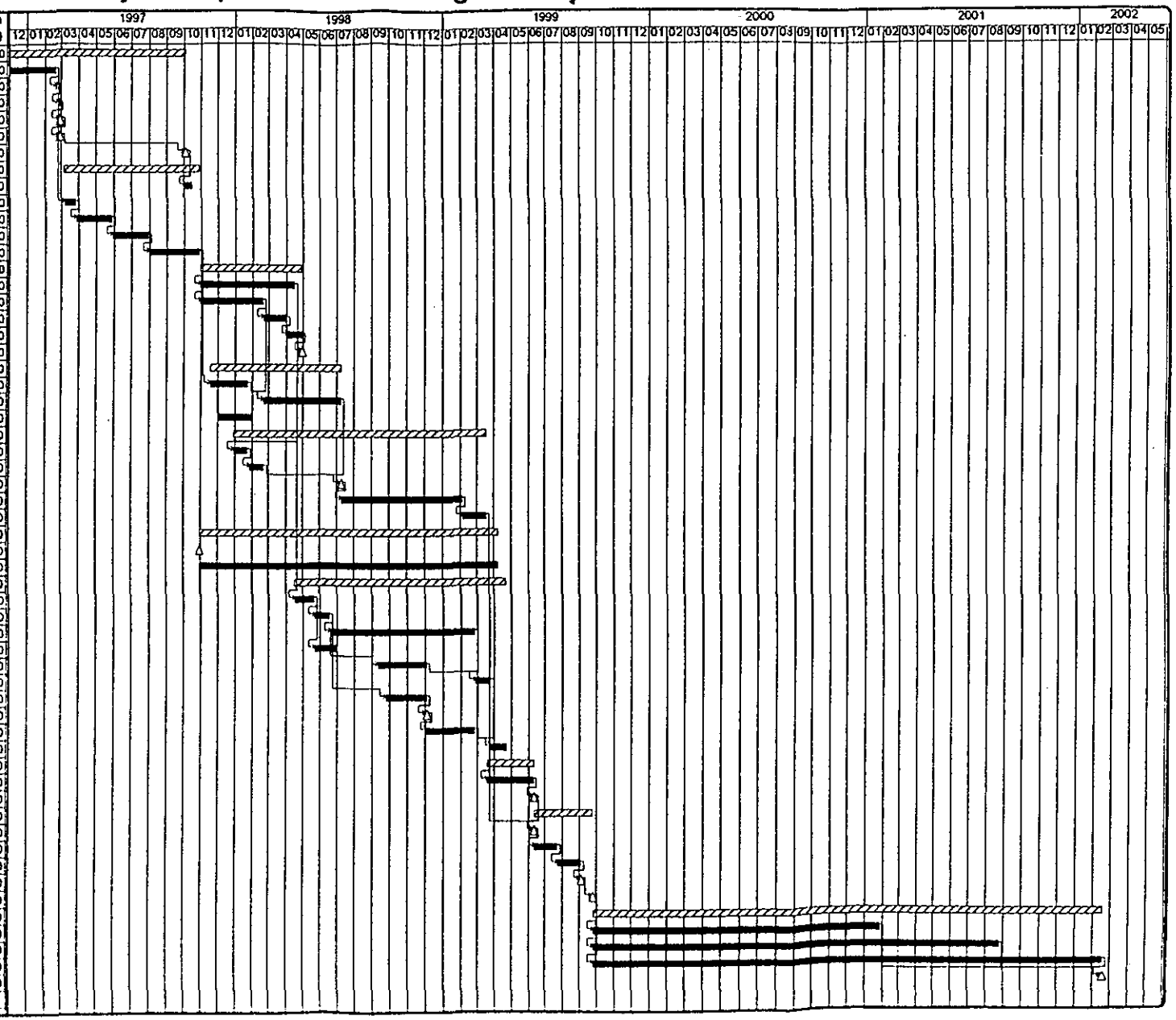

Figure 2.3

3 ENVIRONMENTAL LEGISLATION AND PLANNING GUIDELINES

Introduction

3.1 One of the Hong Kong Government's overall policy objectives on environmental planning, as outlined in the 1989 *White Paper on Pollution in Hong Kong*, is 'to avoid creating new environmental problems by ensuring the consequences for the environment are properly taken into account in site selection, planning and design of all new developments'.

3.2 This section highlights the relevant environmental legislation and guidelines which are currently applicable to the proposed project.

Noise

3.3 The *Hong Kong Planning Standards and Guidelines (HKPSG) Chapter 9: Environment* provides guidance for including environmental considerations in the planning of both public and private developments.

3.4 *HKPSG* states that 'The basic role of planning against noise is to provide an environment whereby noise impacts on sensitive uses are maintained at acceptable levels.'

3.5 Noise control legislation in Hong Kong comes under the *Noise Control Ordinance [Cap 400]* of 1988 regulations and associated Technical Memoranda (TM). The following TM have been issued on:

(i) *The Assessment of Noise from Places other than Construction Sites, Domestic Premises or Public Places* (1988)

(ii) *Noise from Construction Works other than Percussive Piling* (1988)

(iii) *Noise from Percussive Piling* (1988)

(iv) *Noise from Construction Work in Designated Areas* (1996)

3.6 The most recent legislation, *Noise Control (Construction Work) Regulation* and the associated TM on *Noise from Construction Work in Designated Areas* is designed to control noise from the use of specified powered mechanical equipment and the carrying out of prescribed construction work on construction sites within a designated area during restricted hours. Yuen Long falls within a Noise Control Designated Zone.

3.7 Noise Sensitive Receivers (NSRs) are defined by the *HKPSG* and *Noise Control Ordinance* as follows:

(i) all domestic premises, including temporary housing accommodation;

(ii) hotels and hostels

(iii) offices

(iv) educational institutions, including kindergartens, nurseries and all others where unaided voice communication is required

(v) places of public worship and courts of law

(vi) hospitals, clinics, convalescences and homes for the aged, diagnostic rooms and wards

(vii) amphitheatres and auditoria, libraries, performing arts centres and Country Parks

3.8 The appropriate Acceptable Noise Level (ANL) for a particular NSR is dependent on the character of the area in which the NSR is located, and the time of day under consideration. The Area Sensitivity Rating (ASR) is a function of the type of area within which the NSR is located and the degree of the effect on the NSR of particular Influencing Factors (IFs). IFs include any industrial area, major roads (ie. those with a heavy and generally continuous flow of vehicular traffic) and the area within the boundary of Hong Kong International Airport. Table 3.1 shows the Area Sensitivity Ratings given by the *Noise Control Ordinance*.

Table 3.1
Area Sensitivity Ratings

Type of Area containing NSR	Degree to which NSR is affected by IF	Not Affected	Indirectly Affected	Directly Affected
(i)	Rural area, including Country Parks or village type developments	A	B	B
(ii)	Low density residential area consisting of low-rise or isolated high-rise developments	A	B	C
(iii)	Urban area	B	C	C
(iv)	Area other than above	B	B	C

Notes:

'Country Park' means an area that is designated as a country park pursuant to section 14 of the *Country Parks Ordinance*.

'Directly Affected' means that the NSR is at such a location that noise generated by the IF is readily noticeable by the NSR and is a dominant feature of the noise climate of the NSR.

'Indirectly Affected' means that the NSR is at such a location that noise generated by the IF, whilst noticeable at the NSR, is not a dominant feature of the noise climate of the NSR.

'Not Affected' means that the NSR is at such a location that noise generated by the IF is not noticeable at the NSR.

'Urban Area' means and area of high density, diverse development including a mixture of such elements as industrial activities, major trade or commercial activities and residential premises.

Construction Noise

3.9 There are no statutory criteria for noise from construction work other than percussive piling generated during the daytime hours of 07:00-19:00, Monday to Saturday, excluding public holidays. However, EPD normally recommends 75 dB(A) L_{eq}(30 min) as the acceptable noise level during daytime hours at the facade of residential sensitive receivers and 70 dB(A) at schools (65 dB(A) during examinations) as outlined in the ProPECC paper (PN 2/93) on *Noise from Construction Activities - Non-Statutory Controls.*

3.10 Noise restrictions are imposed during the evenings (19:00-23:00), night-time (23:00-07:00) and all day on Sunday and public holidays. For construction activities during these hours, a Construction Noise Permit (CNP) is required from the Environmental Protection Department (EPD). The CNP application will be assessed in accordance with the Basic Noise Levels (BNLs) given in the *TM on Noise from Construction Works other than Percussive Piling* and *Noise from Construction Works within a Designated Area*, as shown in Tables 3.2 and 3.3.

Table 3.2
Basic Noise Levels for General Construction Noise in dB(A)

ASR / Time Period	A	B	C
All days during the evening (19:00-23:00), and general holidays (including Sundays) during the daytime and evening (07:00-23:00)	60	65	70
All days during the night-time (23:00-07:00)	45	50	55

Table 3.3
Basic Noise Levels for Construction Noise due to Specified Equipment and Processes in dB(A)*

ASR / Time Period	A	B	C
All days during the evening (19:00-23:00), and general holidays (including Sundays) during the daytime and evening (07:00-23:00)	45	50	55
All days during the night-time (23:00-07:00)	30	35	40

* Specified equipment includes: hand held breakers, concrete lorry mixers, dump trucks, concrete vibrators, bulldozers. Specified processes include: erection or dismantling of formwork or scaffolding, loading or unloading of rubble, wooden blocks, steel bars, wood or scaffolding material and hammering.

3.11 Noise criteria applied to control the noise from percussive piling is detailed in the *TM on Noise from Percussive Piling*. Any percussive piling requires a CNP from EPD. When considering the issue of a CNP, EPD compares the corrected noise level (CNL) with the Acceptable Noise Level (ANL) for the area. Table 3.4 shows the ANLs for percussive piling.

Table 3.4
Acceptable Noise Level for Percussive Piling in dB(A)

NSR Window Type or Means of Ventilation		ANL
(i)	NSR (or part of NSR) with no windows or other openings	100
(ii)	NSR with central air conditioning system	90
(iii)	NSR with windows or other openings but without central air conditioning system	85

Note: 10 dB(A) is deducted from the ANLs shown above for NSRs such as hospitals, medical clinics, education and other NSRs considered to be particularly sensitive to noise

3.12 The CNL relates to the tonality, impulsiveness and intermittency of the noise. In the event that the CNL exceeds the ANL, EPD will impose restrictions on the permitted hours of piling operation in accordance with Table 3.5.

Table 3.5
Permitted Hours of Percussive Piling Operation

Amount by which CNL exceeds ANL	Permitted hours of operation on any day not being a general holiday
more than 10 dB(A)	08:00-09:00 and 12:00-13:00 and 17:00-18:00
between 1 dB(A) and 10 dB(A)	08:00-09:30 and 12:00-14:00 and 16:30-18:00
no exceedance	07:00-19:00

3.13 The information required in an application for a CNP include:

(i) a map (preferably 1:1000 scale) showing precise details of the site location, site limits and nearby noise sensitive receivers, eg. residential buildings, schools, hospitals;

(ii) location of any stationary powered mechanical equipment on site or, in the case of an application for a percussive piling permit, the piling zone or actual pile locations;

(iii) details of the time period (time of day, duration in days/weeks/months) for which the CNP is required;

(iv) a description, including two photographs and identification codes, and number of units of each item of powered mechanical equipment to be used or, in the case of piling, details of the piling method and pile type including the number of units;

(v) details of any particularly quiet items of equipment or piling methods, special noise control measures to be employed on site, or any other information thought to be relevant.

3.14 During daytime works, EPD recommends that the advice in EPD's *Practice Note ProPECC PN2/93* on construction noise abatement practice is followed.

Operational Noise

3.15 *HKPSG* states that noise levels from a new fixed source should be 5 dB(A) below the relevant ANL presented in the *TM on The Assessment of Noise from Places other than Construction Sites, Domestic Premises or Public Places* or the prevailing background noise level, whichever is lower. The ANL from the TM for a given NSR is presented in dB(A) in Table 3.6 below.

Table 3.6
Acceptable Noise Levels during Operations

ASR / Time Period	A	B	C
Day (07:00-19:00) and Evening (19:00-23:00)	60	65	70
Night (23:00-07:00)	50	55	60

Road Traffic Noise

3.16 As outlined in the *HKPSG*, the severity of road traffic noise impact on sensitive uses depends on many variables, some of which can be controlled or influenced by land use planning. These variables include:

(i) road alignment, ie. providing distance separation between the noise receiver and the vehicles;

(ii) traffic composition and volume, ie. using traffic planning and management to control vehicle movements and type of vehicles at different times of the day;

(iii) line-of-sight, ie. using noise-tolerant buildings to reduce the angle of view of receiver on road traffic;

(iv) shieldings, eg. using barriers, road enclosures or road decking.

3.17 For road traffic noise, the *HKPSG* specifies the acceptable noise limit at the external facade of all domestic premises which rely on open windows for ventilation, including temporary housing areas, as L_{10} (1 hour) of 70 dB(A). Please refer to Table 3.7.

Table 3.7
Traffic Noise Standards

Use / Noise Source	Road Traffic Noise L_{10}(1 hr) dB(A)
All domestic premises including temporary housing accommodation	70
Hotels and hostels	70
Offices	70
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	65
Places of public worship and courts of law	65
Hospitals, clinics, convalescences and homes for the aged: diagnostic rooms and wards	55
Amphitheatres and auditoria, libraries, performing arts centres and Country Parks	depends on locations and construction

Notes:

1 The above standards apply to uses which rely on open windows for ventilation
2 The above standards should be viewed as the maximum permissable noise levels at the external facade

Air Quality

3.18 The principal legislation regulating air emissions in Hong Kong is the *Air Pollution Control Ordinance (APCO) [Cap 311]* of 1983 and its subsidiary regulations. The whole of the Territory has been divided into Air Control Zones. Yuen Long falls within the topographically confined Deep Bay Airshed.

3.19 *HKPSG* states that 'Air quality is affected by such factors as the emission rate of air pollutants, the separation distance between emission sources and receptors, topography, height and width of buildings as well as meteorology.'

Construction Dust

3.20 Dust measurements are made in terms of Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP).

3.21 During the construction phase of the project, an hourly average TSP limit of 500 $\mu g/m^3$ is recommended by EPD for assessing construction dust impacts. This limit is not statutory, but nonetheless has been used in many construction works in Hong Kong as a contractual requirement.

Operational Emissions

3.22 The Hong Kong Air Quality Objectives (AQOs) state the maximum acceptable concentration of air pollutants. The AQOs for one and 24 hour concentrations of five major pollutants are shown in Table 3.8. The Government aims to achieve the AQOs throughout the Territory as soon as 'reasonably practicable'. Efforts are being made to control and reduce air pollution emitters in areas where the AQOs are already exceeded, eg. by controlling new developments. The AQOs will apply to the operational phases of the project.

Table 3.8
Air Quality Objectives

Pollutant	Concentration (μg)m^3					Health effects of pollutant at elevated ambient levels
	Average Time					
	1hr	8hrs	24hrs	3mths	1yr	
Sulphur Dioxide	800[2]		350[3]		80	Respiratory illness; reduced lung function; morbidity and mortality rates increase at higher levels.
Total Suspended Particulate			260[3]		80	Respirable fraction has effects on health.
Respirable Suspended Particulates			180[3]		55	Respiratory illness; reduced lung function; cancer risk for certain particles; morbidity and mortality rates increase at higher levels.
Nitrogen Dioxide	300[2]		150[3]		80	Respiratory irritation; increased susceptibility to respiratory infection; lung development impairment.
Carbon Monoxide	30000[2]	10000[3]				Impairment of co-ordination; deleterious to pregnant women and those with heart and circulatory conditions.
Photochemical Oxidants as ozone	240[2]					Eye irritation; cough; reduced athletic performance; possible chromosome damage.
Lead				1.5		Affects cell and body processes; likely neuro-psychological effects, particularly in children; likely effects on rates of incidence of heart attacks, strokes and hypertension.

Notes: Concentrations measured at 298°K (25°C) and 101.325 kPA

1 Suspended particles in air with a nominal aerodynamic diameter of 10 μm or smaller.
2 Criteria not to be exceeded more than 3 times per year.
3 Criteria not to be exceeded more than once per year.

3.23 In order to obtain a licence to conduct a Specified Process, EPD may require the applicant to submit an air pollution control plan for the process. This will include:

(i) a description and technical particulars of the plant or equipment that may evolve an air pollutant;

(ii) details of pollution control equipment or measures proposed to minimise emissions and comply with the requirement to use the best practicable means of controlling air pollution;

(iii) a description (with maps) to identify sensitive receivers, eg. residential buildings, schools, hospitals;

(iv) an assessment of the resulting air quality and risk to human health, including supporting calculations and information;

(v) a statement that the best practicable means of controlling air pollution has been adopted or is proposed, including supporting calculations and information;

(vi) a plan for, or scheme of, monitoring the emission at source or the ambient concentration of any air pollutant.

3.24 The *HKPSG* recommends that any concrete batching plants and open storage areas should be located at least 100 m from any air sensitive receiver.

Water Quality

3.25 The principal legislation for controlling water pollution in Hong Kong is the *Water Pollution Control Ordinance (WPCO) [Cap 358]* of 1981 which allows for gazettal of Water Control Zones (WCZ) within which the discharge of liquid effluents and the deposit of matter into any water bodies, public sewers and drains are controlled. The WPCO is applicable for construction site discharges as well as for discharges during the operational phase.

3.26 Yuen Long lies within the Deep Bay Water Control Zone, which was declared in December 1990. Deep Bay is polluted by organic and inorganic nutrients from various sources both within and outside Hong Kong. The water quality objectives for Deep Bay are presented in Table 3.9.

Table 3.9
Statement of Water Quality Objectives (Deep Bay Water Control Zone)

Water Quality Objective			Part or Parts of Zone
A.	AESTHETIC APPEARANCE		
	(a)	Waste discharges shall cause no objectionable odours or discolouration of the water.	Whole Zone
	(b)	Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole Zone
	(c)	Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole Zone
	(d)	There should be no recognisable sewage-derived debris.	Whole Zone
	(e)	Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole Zone
	(f)	Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole Zone
B.	BACTERIA		
	(a)	The level of *Escherichia coli* should not exceed 610 per 100 mL, calculated as the geometric mean of all samples collected in one calender year.	Secondary Contact Recreation Subzone and Mariculture Subzone *(L.N. 455 of 1991)*
	(b)	The level of *Escherichia coli* should be zero per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Sub-zones
	(c)	The level of *Escherichia coli* should not exceed 1000 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
	(d)	The level of *Escherichia coli* should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive in one calendar year. Samples should be taken at least 3 times in a calender month at intervals of between 3 and 14 days.	Yuen Long Bathing Beach Subzone *(L.N. 455 of 1991)*

Water Quality Objective			Part or Parts of Zone
C.	COLOUR		
	(a)	Waste discharges shall not cause the colour of water to exceed 30 Hazen units.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	(b)	Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
D.	DISSOLVED OXYGEN		
	(a)	Waste discharges shall not cause the level of dissolved oxygen to fall below 4 milligrams per litre for 90% of the sampling occasions during the year; values should be taken at 1 metre below surface.	Inner Marine Subzone excepting Mariculture Subzone
	(b)	Waste discharges shall not cause the level of dissolved oxygen to fall below 4 milligrams per litre for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 2 measurements at 1 metre below surface and 1 metre above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 milligrams per litre within 2 metres of the seabed for 90% of the sampling occasions during the year.	Outer Marine Subzone excepting Mariculture Subzone
	(c)	The dissolved oxygen level should not be less than 5 milligrams per litre for 90% of the sampling occasions during the year; values should be taken at 1 metre below surface.	Mariculture Subzone
	(d)	Waste discharges shall not cause the level of dissolved oxygen to be less than 4 milligrams per litre.	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone, Water Gathering Ground Subzones and other inland waters of the Zone
E.	pH		
	(a)	The pH of the water should be within the range of 6.5-8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 units.	Marine waters excepting Yuen Long Bathing Beach Subzone
	(b)	Waste discharges shall not cause the pH of the water to exceed the range of 6.5-8.5 units.	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	(c)	The pH of the water should be within the range of 6.0-9.0 units.	Other inland waters

Water Quality Objective	Part or Parts of Zone
(d) The pH of the water should be within the range of 6.0-9.0 units for 95% of samples. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 units.	Yuen Long Bathing Beach Subzone
F. TEMPERATURE	
Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C.	Whole Zone
G. SALINITY	
Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole Zone
H. SUSPENDED SOLIDS	
(a) Waste discharges shall neither cause the natural ambient level to be raised by 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine waters
(b) Waste discharges shall not cause the annual median of suspended solids to exceed 20 milligrams per litre.	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Ganges Subzone, Indus Subzone, Water Gathering Ground Subzones and other inland waters
I. AMMONIA	
The un-ionized ammonical nitrogen level should not be more than 0.021 milligram per litre, calculated as the annual average (arithmetic mean).	Whole Zone.
J. NUTRIENTS	
(a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Inner and Outer Marine Subzones
(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.7 milligram per litre, expressed as annual mean.	Inner Marine Subzone
(c) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 milligram per litre, expressed as annual water column average (arithmetic mean of at least 2 measurements at 1 metre below surface and 1 metre above seabed).	Outer Marine Subzone
K. 5-DAY BIOCHEMICAL OXYGEN DEMAND	
(a) Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 3 milligrams per litre.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones

Water Quality Objective			Part or Parts of Zone
	(b)	Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 5 milligrams per litre.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
L.	CHEMICAL OXYGEN DEMAND		
	(a)	Waste discharges shall not cause the chemical oxygen demand to exceed 15 milligrams per litre.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones.
	(b)	Waste discharges shall not cause the chemical oxygen demand to exceed 30 milligrams per litre.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
M.	TOXINS		
	(a)	Waste discharges shall not cause the toxins in water to attain such level as to produce significant toxic carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	Whole Zone
	(b)	Waste discharges shall not cause a risk to any beneficial uses of the aquatic environment.	Whole Zone
N.	PHENOL		
	Phenols shall not be present in such quantities as to produce a specific odour, or in concentration greater than 0.05 milligrams per litre as C_6H_5OH.		Yuen Long Bathing Beach Subzone
O.	TURBIDITY		
	Waste discharges shall not reduce light transmission substantially from the normal level.		Yuen Long Bathing Beach Subzone

3.27 The *TM on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* was issued in 1991. Under the provisions of this TM, all discharges must be licensed. Tables included within the document identify standards related to effluent flow rates ranging from <10 m^3/day to 6,000 m^3/day, providing guidance on a case-by-case basis.

3.28 Recommendations of EPD's *Deep Bay Guidelines for Dredging, Reclamation and Drainage Works* should also be taken into account.

Construction Site Discharges

3.29 Advice on the handling and disposal of construction site discharges, including site runoff and contaminated wastewaters, is provided in the ProPECC Paper (PN1/94) on *Construction Site Drainage*.

Solid Waste

3.30 Disposal of chemical, household, street, trade and livestock waste is controlled by the *Waste Disposal Ordinance [Cap 354]* of 1980. This legislation covers all aspects of the production, storage, collection and disposal, including the treatment, reprocessing and recycling of waste. In 1989, the formulation of a strategic Waste Disposal Plan for Hong Kong was founded on this legislation.

3.31 Construction waste generated during the construction phase should be sorted on site into inert and non-inert fractions for reuse and recycling as far as practical. The non-inert fraction containing no more than 20% by volume of inert content can be disposed of at landfills, whilst the non-inert fraction should be delivered to public dumps or other reclamation sites. Inert material means soil, rock, asphalt, concrete, brick, cement plaster/mortar, building debris, aggregates, etc.

Waste Oil and Chemicals

3.32 Handling and disposal of waste oil and other chemicals are covered by the *Waste Disposal (Chemical Waste) (General) Regulations*. Chemical waste must be disposed of at licensed chemical waste disposal facilities.

3.33 The design of oil/fuel storage facilities is covered by the *Code of Practice for Oil Storage Installations* issued by the Building Authority. The handling of chemical spillages on land is regulated by the Fire Services Department.

4 EXISTING ENVIRONMENT, SENSITIVE RECEIVERS AND ECOLOGY

Introduction

4.1 In order to determine the existing and proposed land use within the construction sites and neighbouring areas, and to identify the sensitive receivers, a series of desk studies and site visits were undertaken.

4.2 A literature review, including reference to the 1:5,000 map, Outline Zoning Plan S/YL/2 dated 3 November 1995, S/YL-NSW/1 dated 3 June 1994, S/YL-TT/1 dated 8 July 1994, the *Preliminary Design Stage 2 Environmental Assessment for Route 3 (Country Park Section)* (R3PDS2EA)[1] and the *Detailed Environmental Impact Assessment for Route 3: Tai Lam Tunnel & Yuen Long Approach* (R3DEIA)[2], has provided an overall appreciation of the existing conditions within the areas affected by the Project.

Sensitive Uses/Receivers

4.3 *Hong Kong Planning Standards and Guidelines (HKPSG)* identifies the land uses categorised in Table 4.1 as sensitive to noise, air and water pollution. Additional air sensitive uses have been identified in the *TM for Issuing Air Pollution Abatement Notices to Control Air Pollution from Stationary Polluting Sources.*

4.4 The Study Area for the noise and air quality assessments extends 300 m from the centreline of the proposed works. The location of existing and future sensitive receivers potentially affected by construction and/or post-commission impacts are indicated in Figure 4.1. It should be noted that all the proposed works lie within the existing Yuen Long Highway and Route 3 road reserves. Consequently the study area for the ecological assessment only covers the area between the existing carriageways of the Yuen Long Highway and the Route 3 works area immediately north of Pok Oi Interchange.

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1 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 Impact Assessment - Technical Report* (undated) Freeman Fox Maunsell for Highways Department.

2 *Route 3: Tai Lam Tunnel & Yuen Long Approach, Northern Section - Detailed Environmental Impact Assessment - Final Report - Volume 1* (October 1995) CES (Asia) Ltd/Route 3 Contractors Consortium for Highways Department.

Table 4.1
Noise, Air and Water Sensitive Uses[1]

Uses	Noise Sensitive	Air Sensitive	Water Sensitive
All domestic premises including temporary housing accommodation	✓	✓	
Hotels and hostels	✓	✓	
Offices	✓	✓	
Factory		✓	
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	✓	✓	
Places of public worship and courts of law	✓	✓	
Hospitals, clinics, convalescences and homes for the aged (diagnostic rooms and wards)	✓	✓	
Amphitheatres and auditoria, libraries, performing arts centres and Country Parks	✓	✓	
Active recreational areas		✓	
Bathing waters and other contact recreational facilities			✓
Aquaculture and fisheries			✓
Agriculture			✓
Typhoon shelters, marinas and boat parks			✓
Water gathering grounds			✓
Nature reserves and Sites of Special Scientific Interest			✓

Note:

1 Uses as defined in *HKPSG Chapter 9: Environment* and the *TM for Issuing Air Pollution Abatement Notices to Control Air Pollution from Stationary Polluting Sources.*

4.5 Current sensitive receivers include: the Pok Oi Hospital; the villages of Yeung Uk Tsuen, Chuk San Tsuen, Kong Tau San Tsuen and Tai Kei Leng east of Yuen Long Highway; a number of dwellings near Ha Yau Tin Tsuen, Sheung Yau Tin Tsuen and Tai Kei Leng west of Yuen Long Highway; the Small Traders New Village, Wong Uk Tsuen and Tai Wai to the north of Castle Peak Road.

4.6 Future sensitive receivers include: the residential areas, schools and other developments planned for Areas 12, 14 and 15, Yuen Long and also the residential development at Au Tau adjacent to Pok Oi Hospital.

4.7 Sensitive receivers within the Study Area are currently impacted by traffic noise and emissions from the Yuen Long Highway and Castle Peak Road.

Concurrent Projects

4.8 There is a considerable amount of construction activity near the Pok Oi Interchange associated with the Route 3 Tai Lam Tunnel and Yuen Long Approach, which is the northern part of Route 3 CPS. Construction of Route 3 has the potential to impact on noise levels, construction dust levels and water quality (particularly suspended solids levels) in the Study Area during implementation of the projects. Route 3 CPS is scheduled for completion in July 1998.

4.9 Yuen Long South Areas 12 and 14 are scheduled for substantial redevelopment. In addition to the developments described below, planned facilities include a Indoor Recreation Centre in Area 12[3] and a Combined Wholesale Market in the G/IC area adjacent to the Pok Oi Interchange. These site are shown on the draft Yuen Long East Extension Area Layout Plan No. L/YL-EA/H. Two schools may also be required in Area 12 but, at the time of writing, their location has not been confirmed.

4.10 Town Planning Board (TPB) has approved a planning application for the Comprehensive Development Area (CDA) in Area 12. This development comprises commercial elements on a podium and 12 residential towers ranging from 24 to 36 storeys above the podium. Car parking is provided at ground level and two basement floors. The domestic and non-domestic Gross Floor Areas (GFA) are 175,790 sq.m. and 40,000 sq.m. respectively. According to the Master Layout Plan (see Figure 4.2), 2,934 flats will be provided and 6,703 persons will

[3] Memo DRS to PM/NTN ref. (3) in RSD 9/HQ712/84(9) II dated 16 December 1996.

be accommodated. TPB has also approved a Section 16 application for height relaxation at the R(B)2 site in Area 12. The development involves 11 residential blocks with building heights ranging from 12-13 storeys above ground.

4.11 TPB has approved a Section 16 application for a proposed residential development at Yuen Long CDA 15. The proposed development consist of twelve 24-32 storey residential blocks to be constructed on a 15 m high podium above commercial facilities. The Master Layout Plan is shown in Figure 4.3.

4.12 TPB has also approved a Section 16 application for a comprehensive residential development adjacent to Pok Oi Hospital. The land use zoning for this site is currently 'U'. The development involves three 12-15 storey residential blocks containing a total of 95 flats, to be constructed on top of a 2 storey podium plus two levels of basement carpark (58.5 mPD). The design population is 238 persons. The Master Layout Plan for the development is shown in Figure 4.4.

4.13 Environmental and engineering studies are currently underway for PWP 27CG - Yuen Long South Eastern Extension - Site Formation, Roads and Drainage Works which covers works in Area 14. The site formation and infrastructure works are currently scheduled for construction between July 2000 and July 2004.

4.14 A number of properties south of the Yuen Long Highway will be resumed prior to the implementation of PWP Item No. 70 CD - Yuen Long Bypass Floodway, which is scheduled for construction between March 2001 and March 2004. The floodway will act as a buffer between development to the south of floodway and traffic on the Yuen Long Highway. The proposed layout of the floodway is shown in Figure 4.5.

4.15 In view of the above, the sensitive receivers for the operational phase of the projects are expected to be significantly different in terms of location and numbers from the sensitive receivers for the construction phase.

4.16 Representative noise and air quality sensitive receivers (NSRs and ASRs) selected for the noise and air quality impact assessments are detailed in Sections 5 and 6.

Ecology

4.17 All the proposed works lie within the existing Yuen Long Highway and Route 3 CPS road reserves. Consequently the study area for the ecological assessment (carried out in late April 1997) only covers the area between the existing carriageways of the Yuen Long Highway and the Route 3 CPS works area immediately north of Pok Oi Interchange (see Figure 4.6).

4.18 The northern approach to the Pok Oi Flyover will be constructed on the area immediately north of the Pok Oi Interchange, which is currently used as part of the Route 3 CPS works area. As indicated in Photo 1, the area is heavily disturbed and devoid of vegetation.

4.19 The embankments between the existing carriageways of the Highway between Pok Oi Interchange and SPH Interchange were hydroseeded under the Yuen Long Southern Bypass Project and are now covered by grasses. Some spots have been invaded by the fast growing tree species *Acacia confusa*, *Acacia mangium* and *Eucalyptus citriodora* as shown in Photos 2, 4-8. The embankments inside the Pok Oi Interchange have been planted with paper-bark saplings, *Melaleuca leucadendron* (see Photo 3).

4.20 All tree species present within the ecology study area are exotic species commonly found in Hong Kong. All specimens have been recently established and their Diameter at Breast Height (DBH) are of no more than 4 cm. The *Lands Administration Office Instruction, Section D-12, Tree Preservation* (and hence, *WBTC No. 24/94* and *General Regulation 740*) define a tree as being of girth greater than 9.5 cm DBH; consequently the specimens found are not considered as 'trees'.

4.21 Some segments of drainage channel within the ecology study area have been colonised by the freshwater snail, *Ampullaria* sp (Photo 9). This snail is commonly found in Hong Kong and is not listed in the *Animals and Plant (Protection of Endangered Species) Ordinance [Cap 187].*

4.22 Given the coverage of the projects, the heavily and recently modified nature of the environment, the lack of species diversity, immaturity and commonness of flora and species found in the area, it is concluded that the construction works associated with the Pok Oi Flyover and Remaining Works will have little ecological impact.

LEGEND

AGR	Agriculture
CDA	Comprehensive Development Area
G/IC	Government / Institution / Community
O	Open Space
R(B)	Residential (Group B)
R(D)	Residential (Group D)
V	Village
U	UNDETERMINED
OU	OTHER SPECIFIED USES
GB	GREEN BELT
----	300m from site boundary
- - - -	water bodies

821500 E
822000 E
820500 E
834000 N
833500 N
833000 N
832500 N

YUEN LONG

GB
U
V
G/IC
OU
O
CDA
Yeung Uk Tsuen
Ha Yan Tin Tsuen
Tai Kei Leng
Sheung Yan Tin Tsuen
R(B)
Chuk San Tsuen
AGR
SITE BOUNDARY
Kong Tau San Tsuen
R(D)
Shung Ching San Tsuen

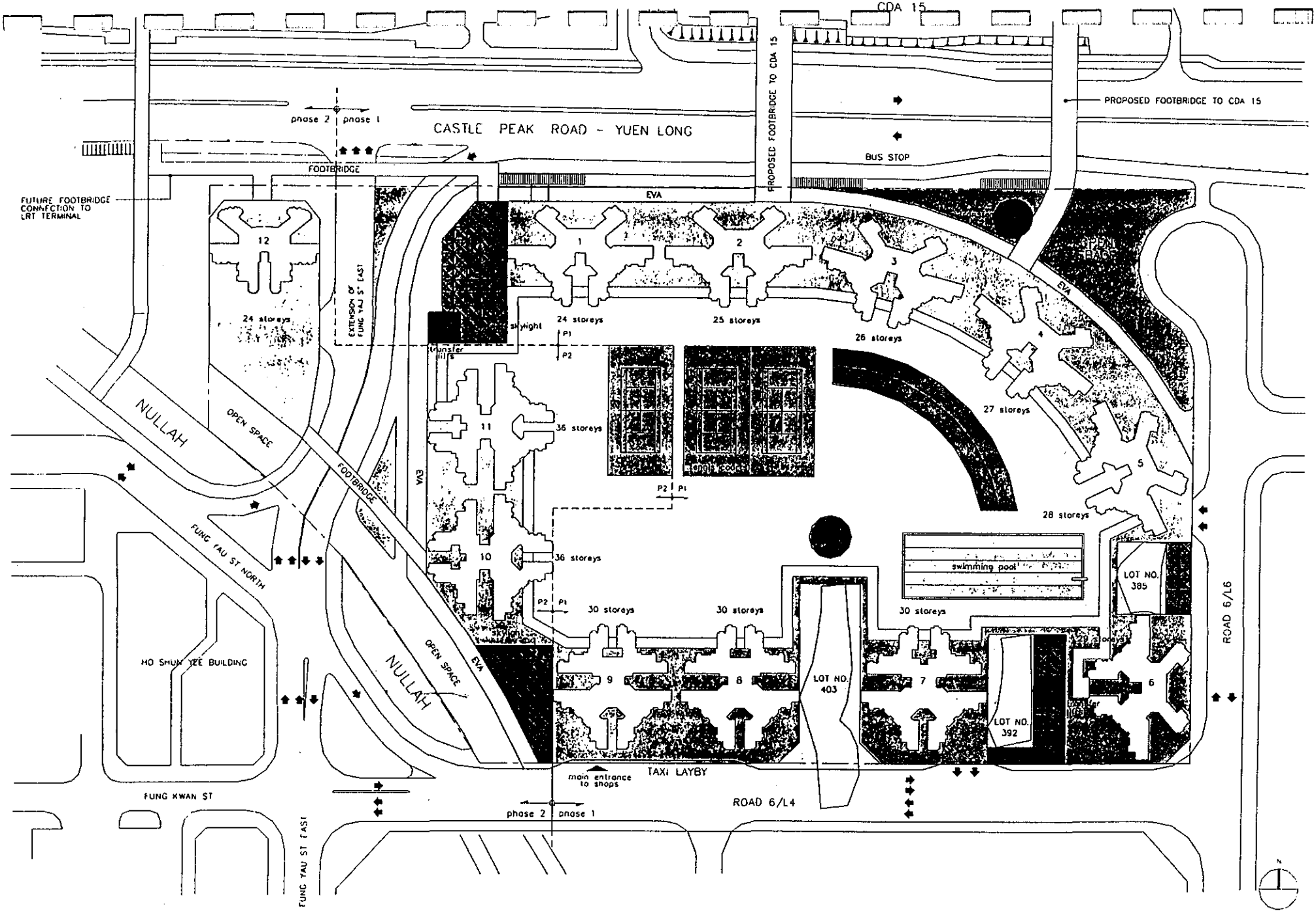
Contract Title :
HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER AND REMAINING WORKS

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

Title :

SENSITIVE RECEIVERS
(CURRENT & PLANNED)

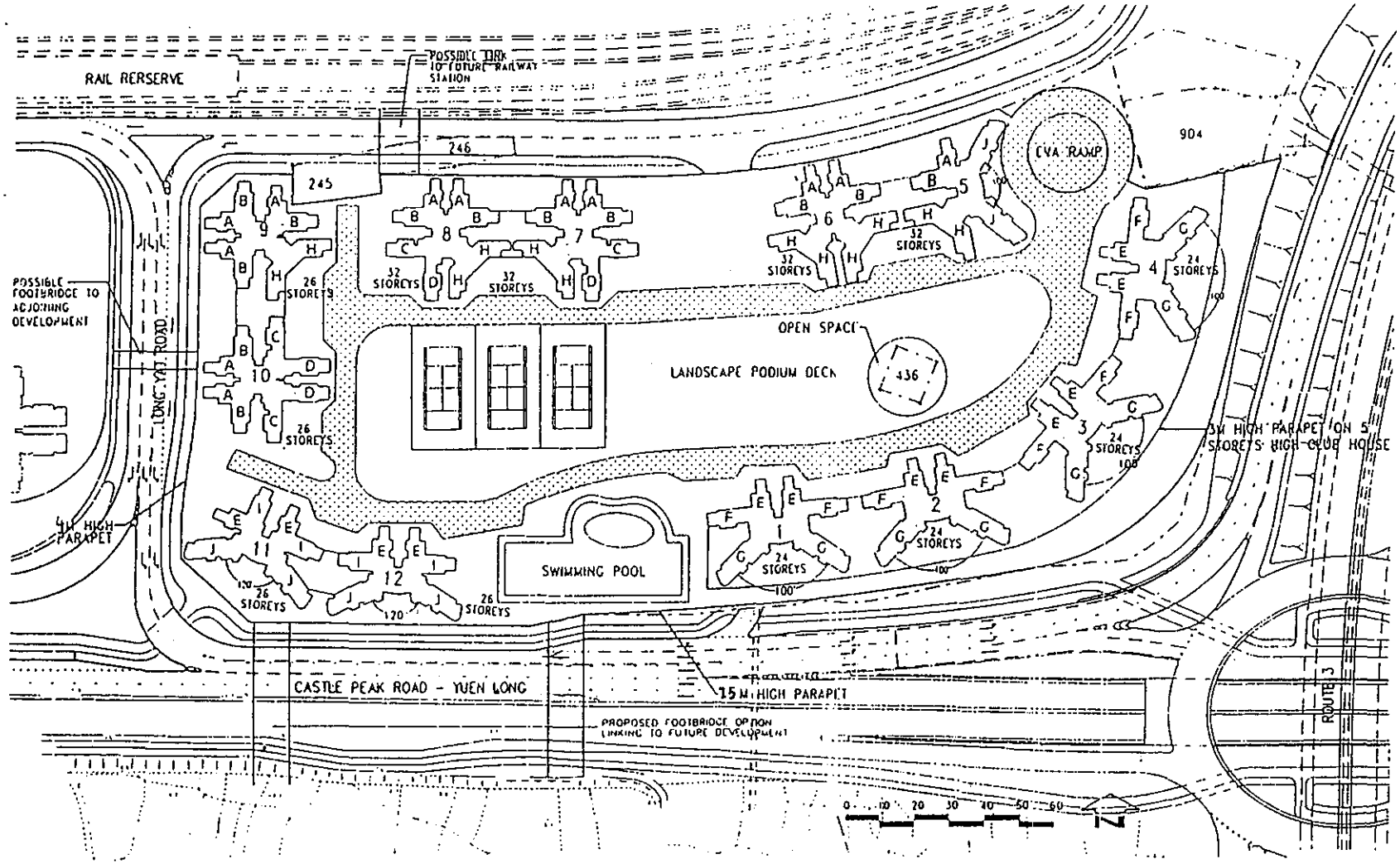
Figure No. 4.1	Revision 0
Reference	File Name 00230088.B04
Prepared MC	Checked JC
Date APR. 97	Scale N.T.S.



寶尼工程顧問有限公司 CONSULTING ENGINEERS 寶尼	Master Layout Plan - Proposed Residential Development at CDA12, Yuen Long	Not To Scale	Figure 4.2

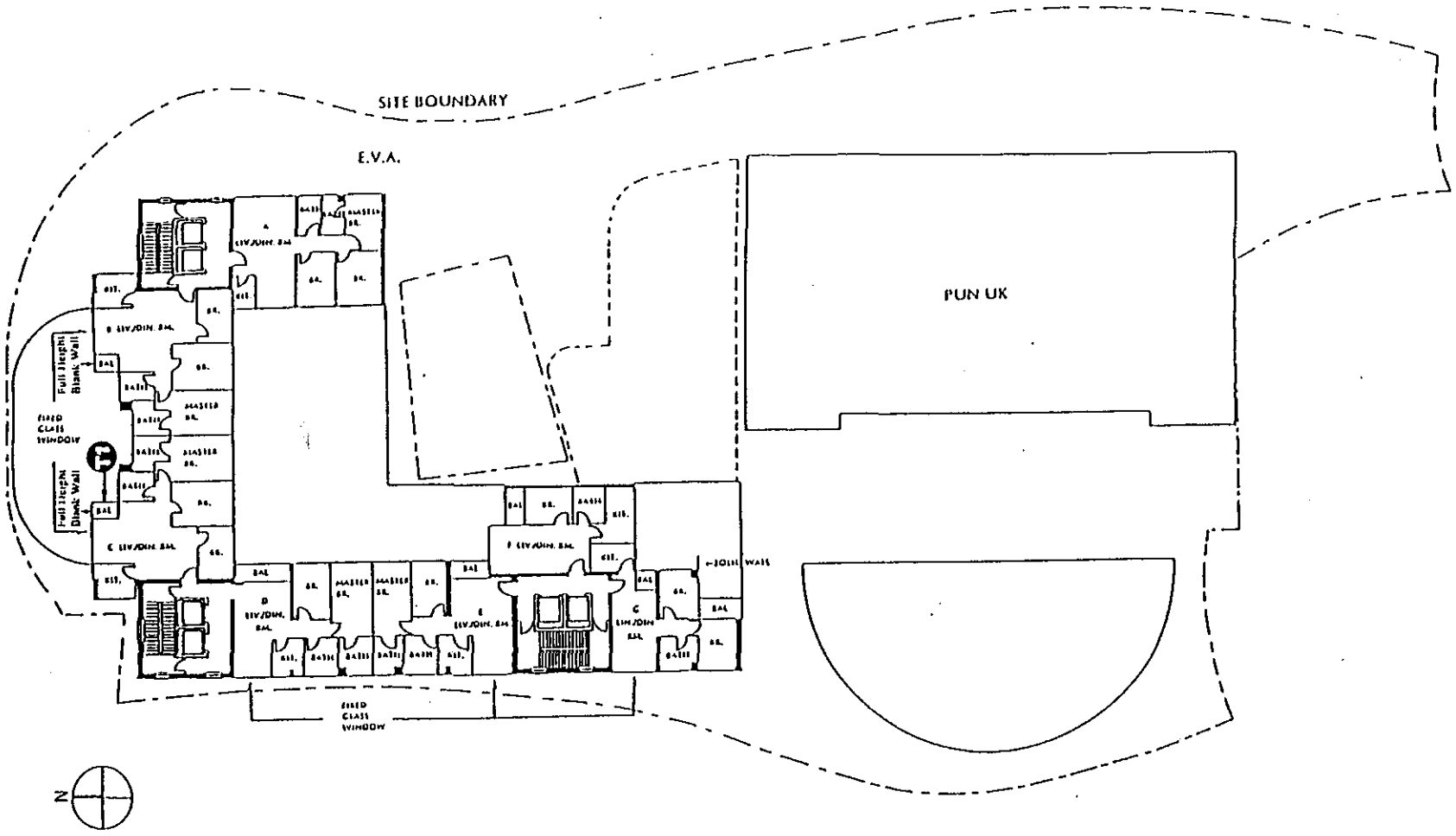
Figure 4.3

Not To Scale

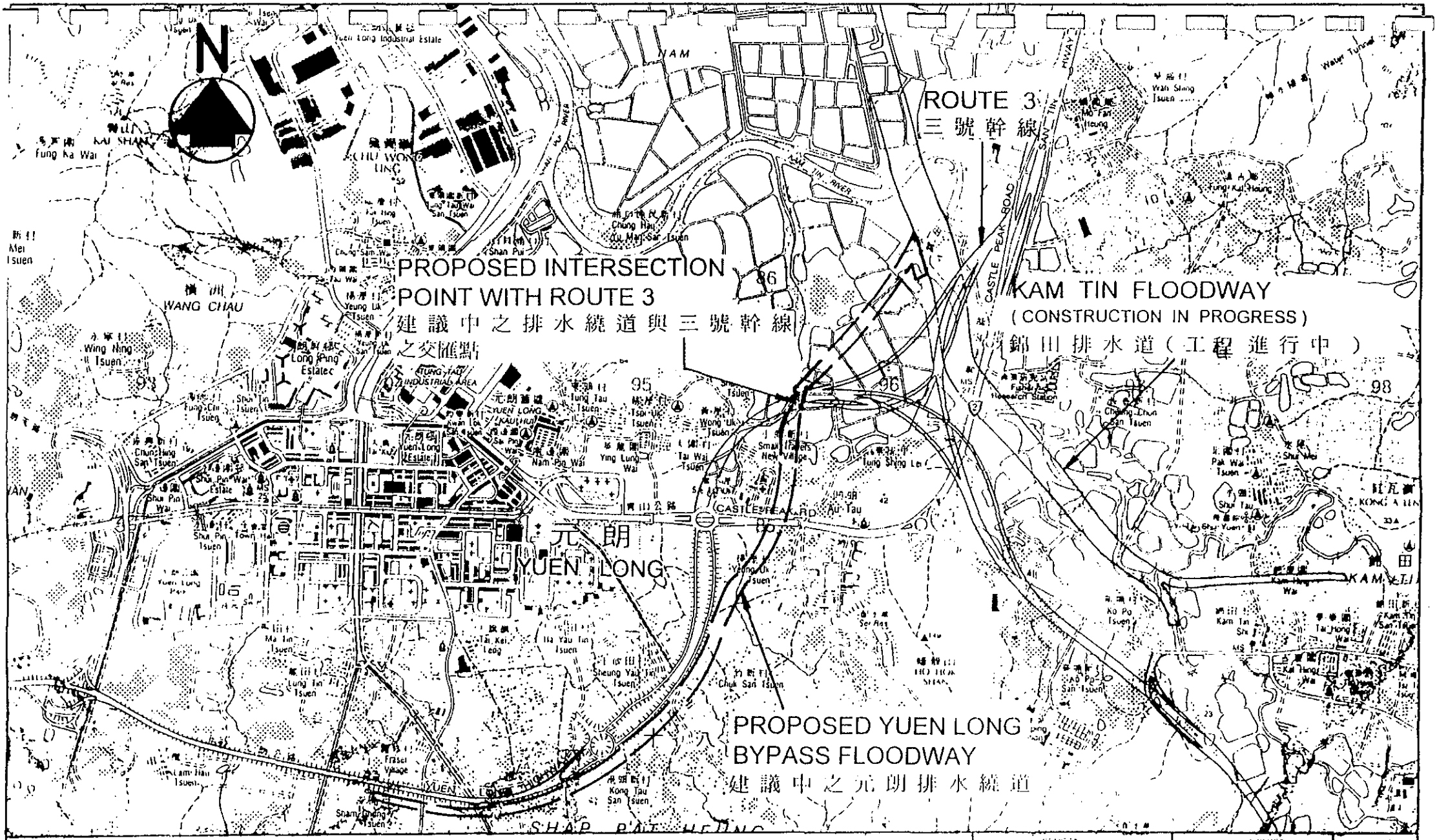


CONSULTING ENGINEERS 寶尼工程顧問有限公司 寶尼

Master Layout Plan - Proposed Residential Development at CDA15, Yuen Long



賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Master Layout Plan - Proposed Residential Development at "U" Zone, Au Tau, Yuen Long	Figure 4.4	
		Not To Scale	**March 1996**



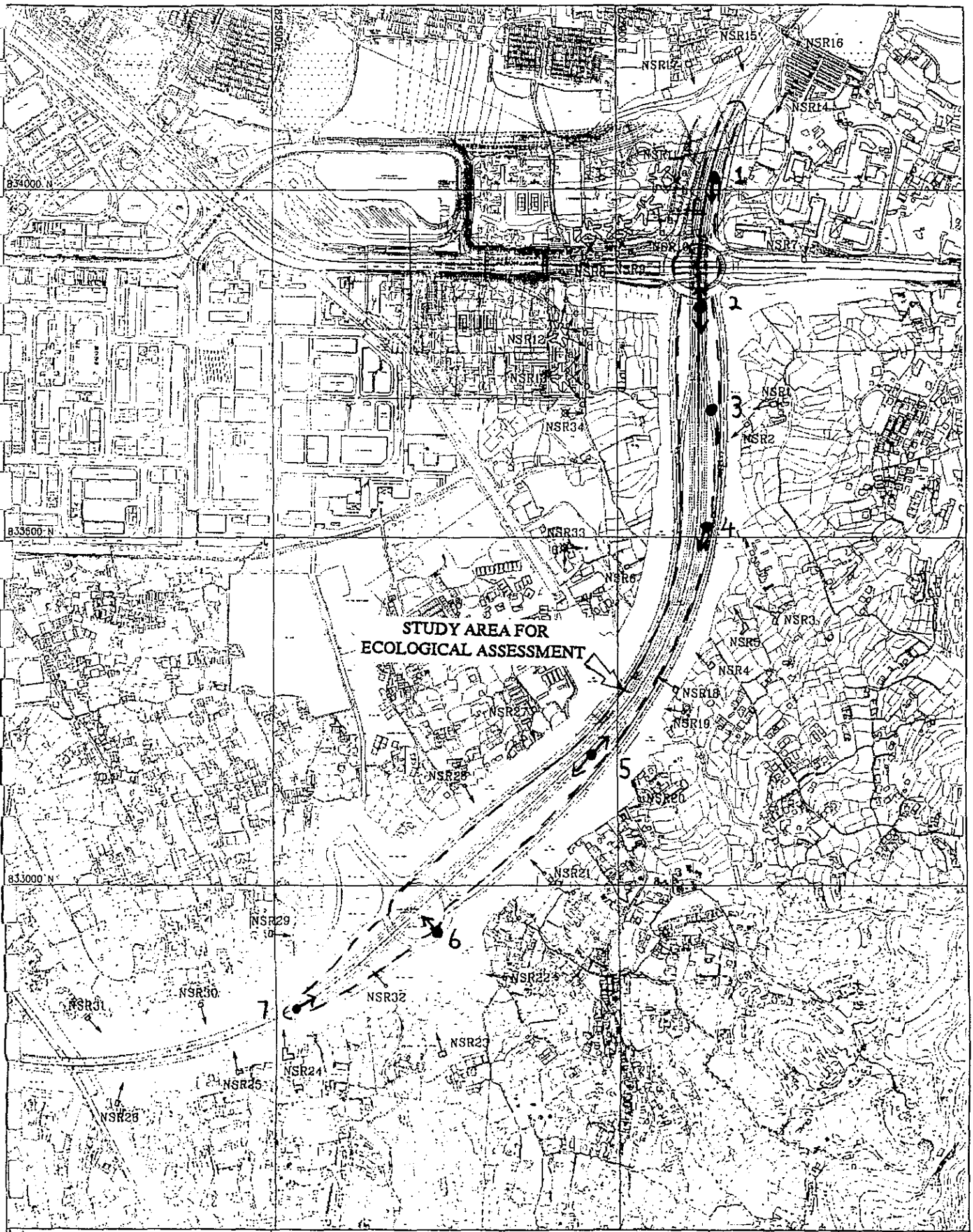
project title

YUEN LONG BYPASS FLOODWAY
元朗排水繞道

Figure 4.5

item no 項目編號	70CD/B	drawing no 圖則編號	NTN1220
scale 比例	1:20 000		
drawn 繪圖	Wanda Cheung	date 日期	30.8.96
checked 核對		date 日期	

NEW TERRITORIES NORTH DEVELOPMENT OFFICE
TERRITORY DEVELOPMENT DEPARTMENT
拓展署 新界北拓展處



Contract Title :
HIGHWAY BETWEEN SHAP PAT HEUNG INERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER AND REMAINING WORKS

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

Title :

ECOLOGICAL ASSESSMENT

(Photo Locations & Directions)

Figure No.	Revision
4.6	0
Reference	File Name
	00010088.B04
Prepared	Checked
HYH	RVC
Date	Scale
APR. 97	N.T.S.

Photo 1. Construction of Route 3 C P Section near the Pok Oi Interchange. (View: north to south, location 1)

Photo 2. Yuen Long highway, close to Pok Oi Interchange. The shrub at the left were young *Acacia confusa*. (View: north to south, location 2)

Photo 3. Pok On interchange. Some paper-bark tree, *Melaleuca leucadendron* were recently planted. (View: south to north, location 2)

Photo 4. Middle of Yuen Long highway. The shrub at the middle were *Acacia confusa*.(View: north to south, location 4)

Photo 5. Middle of the Yuen Long highway. The shrub at the bottom were young *Acacia confusa*. (View: north to south, location 5)

Photo 6. Middle of the Yuen Long highway. The plant at right was young *Eucalyptus citriodora*, height = 2.5m, DBH = 4 cm. (View: south to north, location 5)

Photo 7. Recent growth of young plant inside Shap Pat Heung Interchange. The height of *Eucalyptus citriodora (*E) was 4 metre with a DBH of 4cm. The rest were *Acacia mangium.* (View: location 6)

Photo 8. Southern side of Shak Pat Heung Interchange. The shrub on the lower right corner were young *Acacia confusa*. (View: south to north, location 7)

Photo 9. Common freshwater snail, *Ampullaria* sp. in the drainage channel. (View: location 3)

5 NOISE IMPACT ASSESSMENT

Introduction

5.1 In view of the proximity of existing and future sensitive receivers to Route 3 CPS, the Pok Oi Flyover and Yuen Long Highway, traffic noise will be the most significant impact.

5.2 This section details the findings of the traffic noise assessment undertaken in the R3DEIA and the results of the updated traffic noise assessment undertaken specifically for the projects.

Standards for Traffic Noise Assessment

5.3 As detailed in Section 3, road traffic noise is usually assessed as L_{10} (1 hour), that is the noise level exceeded for 10% of the one hour period during peak traffic flow.

5.4 The maximum permissible noise levels at the external facade of selected types of noise sensitive receivers (NSRs) such as those potentially affected by the projects are presented in Table 5.1.

Table 5.1
Traffic Noise Standards - Selected NSRs

Use / Noise Source	Road Traffic Noise L_{10}(1 hr) dB(A)
All domestic premises including temporary housing accommodation	70
Offices	70
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	65
Hospitals, clinics, convalescences and homes for the aged: diagnostic rooms and wards	55

Notes:

1 The above standards apply to uses which rely on open windows for ventilation
2 The above standards should be viewed as the maximum permissable noise levels at the external facade

5.5 In accordance with the ExCo directive *Equitable Redress for Persons Exposed to Increased Noise resulting from the Use of New Roads*[1], equitable redress in the form of direct technical remedies (eg. noise barriers) must be provided to satisfy the noise limits contained in HKPSG as far as practicable. Indirect technical remedies in the form of acoustic installation and the provision of air conditioning can only be provided to tackle the residual noise impact after all direct technical remedies are exhausted.

5.6 The following criteria are used to determine if any affected premises is eligible for consideration for indirect technical remedies:

(i) the predicted overall noise level from the new road together with other traffic noise in the vicinity must be above a specified noise level (e.g. 70 dB(A) for domestic premises in L_{10} (1 hour));

(ii) the predicted overall noise level is at least 1.0 dB(A) more than the prevailing traffic noise level, i.e. the total traffic noise level existing before the works to construct the road were commenced; and

(iii) the contribution to the increase in the predicted overall noise level from the new road must be at least 1.0 dB(A).

It should be noted that the provision of indirect technical remedies for non-institutional buildings must be approved by ExCo.

Noise Environment

Future Noise Environment - Recent studies

5.7 Traffic noise modelling studies were undertaken during the R3DEIA which took into account predicted noise levels from existing roads (ie. Castle Peak Road) and future roads (Route 3 CPS) on nearby sensitive receivers. The locations of these sensitive receivers are shown in Figure 5.1. The traffic flows used in the R3DEIA assessment for the sections around Pok Oi Interchange are presented in Table 5.2.

[1] *Equitable Redress for Persons Exposed to Increased Noise resulting from the Use of New Roads* (1986) Memorandum for Executive Council Ref: TBCR 6/3231/81-II.

Table 5.2
Predicted Traffic Flows near Pok Oi Interchange (2011)
(R3DEIA)

Road Segment	Total vehicles per hour	Percentage heavy vehicles
Castle Peak Road - Yuen Long to Pok Oi Interchange		
- east bound	2,140	62%
- west bound	1,990	67%
Castle Peak Road - Pok Oi Interchange to Au Tau Interchange		
- east bound	1,120	72%
- west bound	1,440	70%
Route 3		
- north bound	3,840	64%
- south bound	3,440	63%
Yuen Long Highway		
- north bound	2,610	60%
- south bound	2,610	63%

5.8 The noise studies indicate that without mitigation, noise levels experienced at nearby sensitive receivers in the design year (2011) would range between 69 and 84 L_{10}(1 hour) dB(A). Unmitigated noise levels are presented in Table 5.3.

5.9 The R3DEIA studies included the modelling of eight noise mitigation scenarios with barriers of differing heights and locations. Each scenario assumed the use of porous friction course surfacing on the whole of the Route 3 CPS mainline and all its link roads, and construction of a 3 m high barrier along both sides of the flyover linking Yuen Long Highway to Route 3 CPS.

5.10 The R3DEIA report states that:

> 'If noise barriers along the future flyover connecting Route 3 with the Yuen Long Southern Bypass (Yuen Long Highway) as assumed in the present study are not included or are altered, additional noise impacts would result at the southern facades of Pok Oi Hospital, and at residential facades near the hospital, in Wong Uk Tsuen and in Tai Wai Tsuen. With regard to the proposed flyover to be built by others, it is reasonable to expect that when the flyover is constructed, adequate mitigation measures will be adopted to ensure that unacceptable noise levels do not occur at nearby sensitive receivers as a result of noise emanating from the flyover. A 3 m barrier has been assessed as providing suitable mitigation (for flyover traffic noise).'

5.11 Scenario 6 or 'Mitigation Scheme 4' (developed under the R3DEIA) is the proposed traffic noise mitigation scheme for Route 3 CPS which takes into account engineering design constraints. The scheme includes roadside noise barriers with heights ranging from 0.8 m to 4 m along Route 3 CPS together with 3 m barriers on the flyover as shown in Figure 5.1. Highways Department has committed to providing at least these measures. The predicted noise levels under this scenario are presented in Table 5.3.

5.12 In view of the high noise levels likely to be experienced at Pok Oi Hospital as a result of traffic on Route 3, the flyover and other roads in the vicinity, the R3DEIA recommended that eligible noise sensitive rooms at Pok Oi Hospital be fitted with appropriate indirect technical remedies, ie. acoustic insulation and air conditioning.

5.13 The R3DEIA was endorsed by the Advisory Committee on the Environment (ACE) in 1996.

Table 5.3
Predicted Traffic Noise Impacts near Pok Oi Interchange (R3DEIA)

NSR	Storey	Facade Noise Level L_{10} dB(A)		
		Existing 1993	Basic Unmitigated	Mitigation Scheme 4
261 - Tung Shing Lei	1	61	69	65
281 - Tung Shing Lei	1	60	76	67
	2	61	77	68
299 - west of Tung Shing Lei	1	60	70	62
	2	60	71	63
338 - southwest of Tung Shing Lei	1	73	75	70
	2	75	77	74
	3	76	77	77
350 - Pok Oi Hospital	1	67	75	70
	4	69	76	72
	8	70	78	74
356 - east of Pok Oi Hospital	1	69	75	70
373 - Small Traders New Village	1	65	77	69
	2	66	77	70
382 - Small Traders New Village	1	61	76	68
	2	61	84	70
402 - Tai Wai Tsuen	1	64	72	67
	2	65	72	67
	3	65	73	68
568 - Wong Uk Tsuen	1	63	72	64
	2	64	73	64
	3	64	73	65
578 - Wong Uk Tsuen	1	65	74	65
	2	65	74	66
	3	66	75	66
585 - Wong Uk Tsuen	1	65	76	67
	2	65	77	68
	3	66	79	69
621 - east of Wong Uk Tsuen	1	64	79	69
	2	65	81	70
	3	65	82	72
630 - north of Small Traders New Village	1	63	77	68

Source: R3DEIA

Notes: 1 **Bold** represents noise level greater than *HKPSG*
2 For the 'Basic Unmitigated' Scenario which assumes no mitigation other than the use of friction course surfacing on the whole of the Route 3 mainline and its link roads, and 0.8 m parapet on bridges, underlined values represent the contribution of existing roads (ie. Castle Peak Road/Yuen Long Highway) greater than 70 dB(A)
3 NSR 350 is Pok Oi Hospital having *HKPSG* standard of 55 dB(A)

Baseline Traffic Flows - Current study

5.14 In October 1996, a morning peak hour traffic survey was undertaken on Castle Peak Road and Yuen Long Highway. The results of the survey are shown in Table 5.4.

5.15 The survey shows that the existing peak hour traffic flows along Castle Peak Road and Yuen Long Highway exceed 4,000 passenger car units (PCUs). The traffic flow volumes on Castle Peak Road higher than the traffic flow predictions for these roads in the year 2011 as used in the R3DEIA: the traffic volumes are compared in Table 5.4. The figures indicate that traffic flows in the year 2011 will have a different distribution than at present, and that flows on individual sections of roads may be lower than currently experienced.

Table 5.4
Traffic Flows near Pok Oi Interchange
2011 (Predicted) & 1996 (Observed)
(R3DEIA)

Road Segment	Total vehicles per hour (2011)	Total vehicles per hour (1996)
Castle Peak Road - Yuen Long to Pok Oi Interchange		
- east bound	2,140	2,235
- west bound	1,990	2,010
Castle Peak Road - Pok Oi Interchange to Au Tau Interchange		
- east bound	1,120	4,345
- west bound	1,440	3,620
Route 3		
- north bound	3,840	n/a
- south bound	3,440	n/a
Yuen Long Highway		
- north bound	2,610	2,565
- south bound	2,610	1,920

Noise - Operational Phase Assessment

Representative Noise Sensitive Receivers

5.16 Representative sensitive receivers selected for the operational phase noise and air assessments for the Pok Oi Flyover and Remaining Works projects are identical. They are listed in Table 5.5 and shown in Figure 5.2.

5.17 The Pok Oi Hospital has been excluded from this assessment. Further to the recommendations of the R3DEIA, it is understood that Pok Oi Hospital will be provided with indirect technical measures under the Route 3 Development Project. The installation programme is due to commence in May 1997 and to be completed by the end of the year. Pok Oi Hospital is also currently scheduled for redevelopment in the near future: it is understood that all existing and new buildings within the hospital complex will be centrally air conditioned and fitted with double glazed windows and would not depend on openable windows for ventilation.

Table 5.5
Representative Noise/Air Sensitive Receivers

NSRs	Description	mPD of G/F level	No. of Storeys
* NSR1	Village house at Yeung Uk Tsuen, Shap Pat Heung	4.6	1
* NSR2	Village house at Yeung Uk Tsuen, Shap Pat Heung	6.8	2
* NSR3	Village house between Yeung Uk Tsuen and Chuk San Tsuen, Shap Pat Heung	5.6	1
* NSR4	Village house between Yeung Uk Tsuen and Chuk San Tsuen, Shap Pat Heung	6.8	2
* NSR5	Village house between Yeung Uk Tsuen and Chuk San Tsuen, Shap Pat Heung, 2 storey building	6.8	1
* NSR6	Village house at Ha Yau Tin Tsuen	5.2	3
* NSR7	Home for the Aged at Pok Oi Hospital	5.5	6
NSR8	Proposed residential block 1 at CDA Area 15	5.5	24
NSR9	Proposed residential block 2 at CDA Area 15	5.5	24
NSR10	Proposed residential block 3 at CDA Area 15	5.5	24
NSR11	Proposed residential block 4 at CDA Area 15	5.5	24
NSR12	Proposed residential block 5 at CDA Area 12	5.0	23
NSR13	Proposed residential block 6 at CDA Area 12	5.0	23
* NSR14	Village house at Small Traders Village	4.1	2
* NSR15	Village house at Wong Uk Tsuen	4.1	3
* NSR16	Village house at Small Traders Village	4.1	2
* NSR17	Village house at Wong Uk Tsuen	4.1	3
* NSR18	Village house at Chuk San Tsuen	6.8	2
* NSR19	Village house at Chuk San Tsuen	6.8	2
* NSR20	Village house at Chuk San Tsuen	6.8	1
* NSR21	Village house at Chuk San Tsuen	7.9	1
* NSR22	Village house at Kong Tau San Tsuen	7.3	3
* NSR23	Village house at Kong Tau San Tsuen	8.0	3
* NSR24	Village house at Tai Kei Leng	7.0	1
* NSR25	Village house at Tai Kei Leng	7.0	1
* NSR26	Village house at Tai Kei Leng	8.0	2
* NSR27	Village house at Ha Yau Tin Tsuen	6.0	2
* NSR28	Village house at Ha Yau Tin Tsuen	6.0	1
* NSR29	Village house at Tai Kei Leng	6.8	3
* NSR30	Village house at Tai Kei Leng	5.0	3
* NSR31	Village house at Tai Kei Leng	7.0	2
* NSR32	Village house at Kong Tau San Tsuen	7.5	3
NSR33	Future residential blocks at R(B) zone in Area 12	5.0	12
NSR34	Future residential blocks at R(B) zone in Area 12	5.0	12

Note: * = existing sensitive receiver

5.18 All planned landuse zonings have been taken into account in the traffic noise assessment. These zonings include the CDA, R(B), R(D) and V areas shown in Figure 4.1. The maximum height of the residential buildings allowable within each zone has also been included in the calculations. Direct mitigation measures have been designed in this EIA Study to protect all future noise sensitive developments within these planning zones.

5.19 The potential traffic noise impacts on the most affected facades of the proposed residential developments at CDA12 and CDA15 referred to in Section 4 have been assessed.

5.20 It should be noted that there is another potential NSR, the proposed comprehensive residential development at Pun Uk, adjacent to Pok Oi Hospital. The landuse zoning in this area is 'U', which is not regarded as a noise sensitive land use. The Pun Uk development has been designed with a 'self protective' building design to minimise the potential traffic noise impact from Castle Peak Road, Route 3 CPS and the planned West Rail. As shown in Figure 4.5, all facades facing Route 3 CPS and Pok Oi Flyover are fitted with fixed windows. Consequently it has been excluded from this assessment.

5.21 NSR 32 has been selected to take into account the construction of any future 3-storey village house in the corner of the 'V' zone at Kong Tau San Tsuen. NSRs 33 and 34 have been selected to take into account future 12-storey residential developments in the R(B) zone west of the Highway.

Assessment Methodology

5.22 The road traffic noise calculation is based on the worst scenario traffic flows provided by the traffic consultants and follows the procedures stipulated in the *Calculation of Road Traffic Noise (CRTN)* which is published by Department of Transport, U.K.

5.23 For planning purposes, the morning peak traffic flow which has the highest traffic volume within 15 years after completion of a proposed highways project is adopted as the worst case scenario for traffic noise assessment. The percentage of heavy vehicles (ie. all vehicles with an unladen weight of 1,525 kg, which includes Light Goods Vehicles, Medium Goods Vehicles, Heavy Goods Vehicles, Container Vehicles and Buses/Coaches) during the peak traffic flow period is also significant and is taken into account when assessing traffic impact.

5.24 As the works will be completed in two phases, the Pok Oi Flyover (mid-1997 to mid-1998) and the Remaining Works (mid-1999 to early-2002), two separate traffic noise impact assessments have been undertaken.

5.25 The first assessment, for the Pok Oi Flyover works, is based on the 2001 morning peak hour traffic flow volume. The purpose of this assessment is to predict the traffic noise impact of the flyover and temporary distributor roads on NSRs 1-16, prior to completion of the Remaining Works. Details of the predicted peak morning traffic flows are shown in Figure 5.3 and summarised in Table 5.6.

5.26 For the second assessment, the highest morning peak hour traffic volume for the year 2011 has been adopted to predict the future traffic noise levels at all representative NSRs following completion of both the Pok Oi Flyover and the Remaining Works. Details of the predicted peak morning traffic flows are shown in Figure 5.4 and summarised in Table 5.7.

Table 5.6
Projected AM Peak Traffic Flow (2001)

Road	vehicles per hour	% of heavy vehicle	speed (kph)
Castle Peak Road - Yuen Long Section (YL-CPR)	7,668	17	70
Castle Peak Road - Au Tau Section (AU-CPR)	6,921	11	70
Castle Peak Road under Pok Oi Interchange (R-CPR)	5,048	21	70
Slip road from Castle Peak Road to Route 3 (YLNS & YLN)	2,071	10	50
Slip road from Pok Oi Interchange to Castle Peak Road - Yuen Long (YLS)	1,684	42	50
Slip road from Pok Oi Interchange to Castle Peak Road - Au Tau (AUN)	545	12	50
Slip road from Castle Peak Road - Au Tau to Pok Oi Interchange (AUS)	854	13	50
Slip road from Route 3 to Pok Oi Interchange (AUE)	1,645	37	50
Route 3 - Yuen Long Section (R3)	8,785	17	100
Yuen Long Southern Bypass (DR1&DR2)	6,254	16	70
Stage 1 Pok Oi Flyover (FDR)	5,053	15	100

Table 5.7
Projected AM Peak Traffic Flow (2011)

Road	vehicles per hour	% of heavy vehicle	speed (kph)
Castle Peak Road - Yuen Long Section (YL-CPR)	7,950	30	70
Castle Peak Road - Au Tau Section (AU-CPR)	8,848	25	70
Castle Peak Road under Pok Oi Interchange (R-CPR)	6,139	33	70
Slip road from Castle Peak Road to Route 3 (YLNS & YLN)	1,215	24	50
Slip road from Pok Oi Interchange to Castle Peak Road - Yuen Long (YLS)	1,014	38	50
Slip road from Pok Oi Interchange to Castle Peak Road - Au Tau (AUN)	1,379	22	50
Slip road from Castle Peak Road - Au Tau to Pok Oi Interchange (AUS)	688	32	50
Slip road from Route 3 to Pok Oi Interchange (AUE)	1,091	39	50
Route 3 - Yuen Long Section (R3)	6,334	36	100
Yuen Long Southern Bypass (DR1&DR2)	2,018	29	70
Stage 1 Pok Oi Flyover (FDR)	4,118	39	100
Yuen Long Southern Bypass (YLSB)	5,531	36	100
Slip road from Yuen Long Southern Bypass to Shap Pat Heung Interchange (WSPH)	429	17	50
Slip road from Yuen Long South to Shap Pat Heung Interchange (SWSPH)	393	25	50

5.27 For the purposes of the traffic noise impact assessment and for determining the eligibility of the installation of indirect technical remedies, roads within the Study Area have been divided into two groups: the new roads and existing roads. The new roads include Route 3 CPS and its slip road, the proposed Pok Oi Flyover and the Remaining Works. The existing roads include Castle Peak Road, Pok Oi Interchange and the existing slip road, Yuen Long Highway and the slip roads to Shap Pat Heung Interchange. Those NSRs already considered for indirect technical remedies under R3DEIA have not been reconsidered for eligibility under the Pok Oi Flyover and Remaining Works projects.

5.28 The calculation points for this assessment are taken as 1.2 m above the floor level of the NSRs and 1 m from the facade of openable windows.

5.29 The use of friction course surfacing on Route 3 CPS, Yuen Long Highway and the proposed flyover at Pok Oi Interchange has been taken into account in the noise calculations. In addition, the provision of a 0.8 m high solid concrete profile barrier has also been assumed in the noise calculations as a standard feature of the new trunk road.

Assessment Results

Pok Oi Flyover

5.30 The findings of the traffic noise assessment for the year 2001 are detailed in Tables 5.8 and 5.9. The assessment indicates that nearby NSRs will experience noise levels exceeding acceptable levels. The installation of the following noise barriers are considered the maximum practicable direct measures:

(i) a permanent 2.7 m high noise barrier, lined with appropriate sound absorptive material, to be constructed over the structural 0.8 m parapet either side of the Pok Oi Flyover (total height: 3.5 m);

(ii) a temporary noise barrier decreasing in height from 3.5 m to 2 m on the eastward side of the eastern temporary distributor road;

(iii) a temporary noise barrier increasing in height from 1.7 m to 3.5 m on the westward side of the western temporary distributor;

(iv) a temporary 0.8 m high noise barrier along the eastward side of the existing eastern distributor to protect NSR 1 and NSR 2.

5.31 At the time of writing, the timing of the development programme of the R(B) zone west of the Highway is unknown. If residential buildings in the R(B) zone (as represented by future NSRs 33 and 34) are built and occupied by the year 2002, two additional temporary noise barriers will be required:

(i) an 0.8 m high temporary noise barrier along the eastward side of the existing eastern distributor;

(ii) an 0.8 m high temporary noise barrier along the westward side of the existing western distributor.

5.32 The dimensions of the recommended noise barriers are shown in Figure 5.5. The barriers have been designed to protect existing and future NSRs from unacceptable traffic noise impacts as far as practicable. No existing NSRs will be eligible for the installation of indirect technical remedies under the Pok Oi Flyover project.

5.33 In addition, as mentioned in Section 4, the Yuen Long Bypass Floodway (currently in the preliminary design phase) is scheduled for construction between early 2001 and early 2004. The EIA for this project is currently being undertaken by Binnie Consultants Ltd. If the Yuen Long Bypass Floodway is endorsed, many of the existing NSRs adjacent to the Highway, on the eastern side, will be resumed prior to early 2001; Government may choose to implement an early resumption programme.

5.34 It is recommended that as an early task in the Detailed Design stage for the Pok Oi Flyover, the status of existing and proposed NSRs in the Study Area is reviewed: the design and installation of the temporary noise barriers can then, in consultation with EPD, be re-evaluated if necessary.

Table 5.8
Traffic Noise Levels in Year 2001 (without mitigation) - Pok Oi Flyover

NSR (* = existing NSR)	New Road Noise Level dB(A)	Existing Road Noise Level dB(A)	Total Noise Level (New Road + Existing Road) dB(A)	Noise Contribution from New Roads dB(A)
* NSR 1-G/F	70.7	69.5	73.2	3.7
* NSR 2-G/F	73.8	73.5	76.7	3.2
* NSR 2-1/F	73.9	73.5	76.7	3.2
* NSR 3-G/F	68.1	69.7	72.0	2.3
* NSR 4-G/F	65.8	76.2	76.6	0.4
* NSR 4-1/F	65.9	76.2	76.6	0.4
* NSR 5-G/F	69.4	72.7	74.4	1.7
* NSR 6-G/F	71.5	72.0	74.8	2.8
* NSR 6-1/F	71.5	72.0	74.8	2.8
* NSR 6-2/F	71.5	72.0	74.8	2.8
* NSR 7a-1/F	64.0	74.1	74.5	0.4
* NSR 7a-5/F	65.2	74.1	74.6	0.5
* NSR 7a-6/F	65.5	73.9	74.5	0.6
* NSR 7b-1/F	62.8	79.1	79.2	0.1
* NSR 7b-5/F	63.7	78.7	78.8	0.1
* NSR 7b-6/F	63.9	78.5	78.6	0.1
NSR 8a-10/F	69.5	78.1	78.7	0.6
NSR 8a-20/F	68.4	76.6	77.2	0.6
NSR 8a-24/F	68.2	76.1	76.8	0.7
NSR 8b-10/F	69.0	78.3	78.8	0.5
NSR 8b-20/F	67.8	76.7	77.2	0.5
NSR 8b-24/F	67.5	76.2	76.7	0.5
NSR 9a-10/F	70.7	76.3	77.4	0.9
NSR 9a-20/F	70.0	75.2	76.3	1.1
NSR 9a-24/F	69.7	74.8	76.0	1.2
NSR 9b-10/F	70.1	77.4	78.1	0.7
NSR 9b-20/F	69.3	76.2	77.0	0.8
NSR 9b-24/F	68.9	75.8	76.6	0.8
NSR 10a-10/F	72.7	72.0	75.4	3.4
NSR 10a-20/F	72.6	71.7	75.2	3.5
NSR 10a-24/F	72.3	71.6	75.0	3.6
NSR 10b-10/F	72.5	70.1	74.5	2.0

NSR (* = existing NSR)	New Road Noise Level dB(A)	Existing Road Noise Level dB(A)	Total Noise Level (New Road + Existing Road) dB(A)	Noise Contribution from New Roads dB(A)
NSR 10b-20/F	72.0	69.7	74.0	4.3
NSR 10b-24/F	71.5	69.7	73.7	4.0
NSR 11a-10/F	74.3	65.4	74.8	9.4
NSR 11a-20/F	73.6	64.8	74.1	9.3
NSR 11a-24/F	73.2	64.6	73.8	9.2
NSR 11b-10/F	74.6	66.7	75.3	8.6
NSR 11b-20/F	73.9	66.5	74.6	8.1
NSR 11b-24/F	73.6	66.5	74.4	7.9
NSR 12a-1/F	65.9	75.7	76.1	0.4
NSR 12a-10/F	65.5	75.7	76.1	0.4
NSR 12a-20/F	65.7	75.2	75.7	0.5
NSR 12a-23/F	65.6	75.1	75.6	0.5
NSR 12b-1/F	63.6	64.7	67.2	2.5
NSR 12b-10/F	64.0	64.7	67.4	2.7
NSR 12b-20/F	64.3	64.5	67.4	2.9
NSR 12b-23/F	64.3	64.8	67.6	2.8
NSR 12c-1/F	64.6	70.8	71.7	0.9
NSR 12c-10/F	64.0	70.8	71.6	0.8
NSR 12c-20/F	64.0	70.1	71.1	1.0
NSR 12c-23/F	64.0	70.0	71.0	1.0
NSR 12d-1/F	66.9	71.2	72.6	1.4
NSR 12d-10/F	67.2	70.8	72.3	1.5
NSR 12d-20/F	67.7	70.5	72.3	1.8
NSR 12d-23/F	67.8	70.3	72.2	1.9
NSR 13a-1/F	66.8	70.1	71.8	1.7
NSR 13a-10/F	67.5	70.7	72.4	1.7
NSR 13a-20/F	67.5	70.7	72.2	1.8
NSR 13a-23/F	67.6	70.3	72.2	1.9
NSR 13b-1/F	64.6	62.1	66.5	4.4
NSR 13b-10/F	64.5	62.1	66.5	4.4
NSR 13b-20/F	64.4	61.9	66.3	4.4
NSR 13b-23/F	64.3	62.3	66.4	4.1
NSR 13c-1/F	61.5	68.7	69.5	0.8
NSR 13c-10/F	62.9	68.8	69.6	1.1
NSR 13c-20/F	63.3	68.2	69.4	1.2
NSR 13c-23/F	63.5	68.1	69.4	1.3

NSR (* = existing NSR)	New Road Noise Level dB(A)	Existing Road Noise Level dB(A)	Total Noise Level (New Road + Existing Road) dB(A)	Noise Contribution from New Roads dB(A)
NSR 13d-1/F	66.7	68.0	70.4	2.4
NSR 13d-10/F	66.8	67.9	70.4	2.5
NSR 13d-20/F	66.9	67.7	70.3	2.6
NSR 13d-23/F	66.8	67.7	70.3	2.6
* NSR 14a-G/F	60.4	63.5	65.2	1.7
* NSR 14a-1/F	61.4	63.6	65.6	2.0
* NSR 15a-G/F	59.0	65.0	66.0	1.0
* NSR 15a-1/F	60.8	65.0	66.4	1.4
* NSR 15a-2/F	64.2	65.1	67.7	2.6
* NSR 16a-G/F	62.0	56.3	63.0	6.7
* NSR 16a-1/F	64.9	56.4	65.5	9.1
* NSR 17a-G/F	60.7	64.0	65.7	1.7
* NSR 17a-1/F	62.2	64.0	66.2	2.2
* NSR 17a-2/F	64.1	64.1	67.1	3.0
* NSR 18a-G/F	59.3	80.4	80.4	0.0
* NSR 18a-1/F	59.3	80.6	80.6	0.0
* NSR 19a-G/F	59.9	76.6	76.7	0.1
* NSR 19a-1/F	59.9	76.6	76.7	0.1
* NSR 20a-G/F	48.9	75.2	75.2	0.0
* NSR 27a-G/F	28.8	75.5	75.5	0.0
* NSR 27a-1/F	28.8	75.5	75.5	0.0
NSR 33a-1/F	67.2	70.3	72.0	1.7
NSR 33a-10/F	67.1	70.3	72.0	1.7
NSR 33a-12/F	67.1	70.3	72.0	1.7
NSR 33b-1/F	61.6	69.8	70.4	0.6
NSR 33b-10/F	61.5	69.7	70.3	0.6
NSR 33b-12/F	61.5	69.6	70.2	0.6
NSR 34a-1/F	67.4	69.3	71.5	2.2
NSR 34a-10/F	67.7	69.7	71.8	2.1
NSR 34a-12/F	67.7	69.6	71.8	2.2

Table 5.9
Traffic Noise Levels in Year 2001 (with mitigation) - Pok Oi Flyover

NSR (* = existing NSR)	Mitigated New Road Noise Level dB(A)	Existing Road Noise Level dB(A)	Total Noise Level (New Road + Existing Road) dB(A)	Noise Contribution from New Roads dB(A)
* NSR 1-G/F	60.0	67.1	67.9	0.8
* NSR 2-G/F	63.4	62.1	65.8	3.7
* NSR 2-1/F	66.2	65.1	68.7	3.6
* NSR 3-G/F	59.5	70.6	70.9	0.3
* NSR 4-G/F	58.6	76.2	76.3	0.1
* NSR 4-1/F	58.9	76.2	76.3	0.1
* NSR 5-G/F	60.4	72.3	72.6	0.3
* NSR 6-G/F	59.5	65.8	66.7	0.9
* NSR 6-1/F	60.7	66.3	67.4	1.1
* NSR 6-2/F	61.6	67.1	68.2	1.1
* NSR 7a-1/F	60.8	74.1	74.3	0.2
* NSR 7a-5/F	62.5	74.1	74.4	0.3
* NSR 7a-6/F	62.9	73.9	74.2	0.3
* NSR 7b-1/F	57.8	79.1	79.1	0.0
* NSR 7b-5/F	59.7	78.7	78.7	0.0
* NSR 7b-6/F	60.1	78.5	78.6	0.1
NSR 8a-10/F	68.5	78.1	78.6	0.5
NSR 8a-20/F	67.0	76.6	77.1	0.5
NSR 8a-24/F	66.7	76.1	76.6	0.5
NSR 8b-10/F	68.2	78.3	78.7	0.4
NSR 8b-20/F	66.8	76.7	77.3	0.6
NSR 8b-24/F	66.4	76.2	76.6	0.4
NSR 9a-10/F	69.4	76.3	77.1	0.8
NSR 9a-20/F	68.2	75.2	76.	0.8
NSR 9a-24/F	67.8	74.8	75.6	0.8
NSR 9b-10/F	69.0	77.4	78.0	0.6
NSR 9b-20/F	67.9	76.2	76.8	0.6
NSR 9b-24/F	67.6	75.8	76.4	0.6
NSR 10a-10/F	69.8	72.0	74.0	2.0
NSR 10a-20/F	70.8	71.7	74.3	2.6
NSR 10a-24/F	71.1	71.6	74.4	2.8
NSR 10b-10/F	69.5	70.1	72.8	2.7

NSR (* = existing NSR)	Mitigated New Road Noise Level dB(A)	Existing Road Noise Level dB(A)	Total Noise Level (New Road + Existing Road) dB(A)	Noise Contribution from New Roads dB(A)
NSR 10b-20/F	70.9	69.7	73.4	3.7
NSR 10b-24/F	70.9	69.7	73.4	3.7
NSR 11a-10/F	72.0	65.4	72.9	7.5
NSR 11a-20/F	72.7	64.8	73.4	8.6
NSR 11a-24/F	72.6	64.6	73.2	8.6
NSR 11b-10/F	72.1	66.7	73.2	6.5
NSR 11b-20/F	73.0	66.5	73.9	7.4
NSR 11b-24/F	72.9	66.5	73.8	7.3
NSR 12a-1/F	65.2	75.7	76.1	0.4
NSR 12a-10/F	64.1	75.7	76.0	0.3
NSR 12a-20/F	63.6	75.2	75.5	0.3
NSR 12a-23/F	63.3	75.1	75.4	0.3
NSR 12b-1/F	56.1	64.2	64.8	0.6
NSR 12b-10/F	58.4	64.5	65.5	1.0
NSR 12b-20/F	60.3	64.5	65.9	1.4
NSR 12b-23/F	60.7	64.7	66.2	1.5
NSR 12c-1/F	64.5	70.8	71.7	0.9
NSR 12c-10/F	63.7	70.8	71.6	0.8
NSR 12c-20/F	63.4	70.1	70.9	0.8
NSR 12c-23/F	63.3	70.0	70.8	0.8
NSR 12d-1/F	63.0	71.0	71.6	0.6
NSR 12d-10/F	63.8	70.8	71.6	0.8
NSR 12d-20/F	64.8	70.4	71.4	1.0
NSR 12d-23/F	65.0	70.3	71.4	1.1
NSR 13a-1/F	62.9	70.0	70.8	0.8
NSR 13a-10/F	64.5	70.7	71.6	0.9
NSR 13a-20/F	65.0	70.4	71.5	1.1
NSR 13a-23/F	65.2	70.3	71.5	1.2
NSR 13b-1/F	58.1	60.2	62.3	2.1
NSR 13b-10/F	60.5	61.4	64.0	2.6
NSR 13b-20/F	61.8	61.7	64.8	3.1
NSR 13b-23/F	62.0	62.1	65.1	3.0
NSR 13c-1/F	60.1	68.7	69.3	0.6
NSR 13c-10/F	60.8	68.5	69.2	0.7
NSR 13c-20/F	60.2	68.2	68.8	0.6

NSR (* = existing NSR)	Mitigated New Road Noise Level dB(A)	Existing Road Noise Level dB(A)	Total Noise Level (New Road + Existing Road) dB(A)	Noise Contribution from New Roads dB(A)
NSR 13c-23/F	60.4	68.1	68.8	0.7
NSR 13d-1/F	60.1	67.5	68.2	0.7
NSR 13d-10/F	62.4	67.7	68.8	1.1
NSR 13d-20/F	63.8	67.7	69.2	1.5
NSR 13d-23/F	64.1	67.6	69.2	1.6
* NSR 14a-G/F	57.3	63.5	64.4	0.9
* NSR 14a-1/F	58.3	63.6	64.7	1.1
* NSR 15a-G/F	58.7	65.0	65.9	0.9
* NSR 15a-1/F	60.5	65.0	66.3	1.3
* NSR 15a-2/F	63.8	65.1	67.5	2.4
* NSR 16a-G/F	61.6	56.3	62.7	6.4
* NSR 16a-1/F	64.6	56.4	65.2	8.8
* NSR 17a-G/F	57.5	64.0	64.9	0.9
* NSR 17a-1/F	58.5	64.0	65.1	1.1
* NSR 17a-2/F	60.2	64.1	65.6	1.5
* NSR 18a-G/F	50.9	80.4	80.4	0.0
* NSR 18a-1/F	51.1	80.6	80.6	0.0
* NSR 19a-G/F	49.9	76.6	76.6	0.0
* NSR 19a-1/F	50.0	76.6	76.6	0.0
* NSR 20a-G/F	48.8	75.2	75.2	0.0
* NSR 27a-G/F	28.6	75.5	75.5	0.0
* NSR 27a-1/F	28.6	75.5	75.5	0.0
NSR 33a-1/F	60.7	69.6	70.1	0.5
NSR 33a-10/F	63.1	70.0	70.8	0.8
NSR 33a-12/F	63.5	70.1	71.0	0.9
NSR 33b-1/F	46.6	69.2	69.2	0.0
NSR 33b-10/F	48.9	69.5	69.5	0.0
NSR 33b-12/F	49.5	69.5	69.5	0.0
NSR 34a-1/F	62.2	68.9	69.7	0.8
NSR 34a-10/F	64.3	69.5	70.6	1.1
NSR 34a-12/F	64.6	69.5	70.7	1.2

Pok Oi Flyover & Remaining Works

5.35 The findings of the traffic noise assessment for the year 2011 are detailed in Tables 5.10 and 5.11. The assessment indicates that nearby NSRs will experience noise levels exceeding acceptable levels. The installation of the following noise barriers are considered the maximum practicable direct measures:

(i) a 2.7 m high noise barrier, lined with appropriate sound absorptive material, to be constructed on the 0.8 m high parapet either side of the Pok Oi Flyover (total height: 3.5 m), as will already have been constructed under the earlier stage of the project;

(ii) a 0.3-2.2 m high noise barrier on 0.8 m high parapet on the eastern side of the Remaining Works to protect NSR1 and NSR2;

(iii) a short section of 0.2-0.4 m high noise barrier on the 0.8 m high parapet on the eastern side of the Remaining Works to protect NSR19;

(iv) a 1.2-2.7 m high noise barrier on the 0.8 m high parapet on the western side of the Remaining Works.

5.36 The dimensions of the recommended noise barriers are shown in Figure 5.6. The barriers have been designed to protect existing and future NSRs from unacceptable traffic noise impacts as far as practicable. No existing NSRs will be eligible for the installation of indirect technical remedies under the Remaining Works project.

5.37 As mentioned in Section 4, the Yuen Long Bypass Floodway (currently in the preliminary design phase) is scheduled for construction between early 2001 and early 2004. If the Yuen Long Bypass Floodway is endorsed, many of the existing NSRs adjacent to the Yuen Long Highway, on the southern side, will be resumed prior to early 2001. This would lead to the barrier design for the Remaining Works section, due to be constructed between mid-1999 to early 2002, being amended accordingly.

Table 5.10
Traffic Noise Levels in Year 2011 (without mitigation) - Pok Oi Flyover & Remaining Works

NSR (* = existing NSR)	New Road Noise Level dB(A)	Existing Road Noise Level dB(A)	Total Noise Level (New Road + Existing Road) dB(A)	Noise Contribution from New Roads dB(A)
* NSR 1-G/F	66.3	72.4	73.4	1.0
* NSR 2-G/F	67.8	74.6	75.4	0.8
* NSR 2-1/F	68.8	74.6	75.6	1.0
* NSR 3-G/F	64.7	71.0	71.9	0.9
* NSR 4-G/F	67.0	73.7	74.5	0.8
* NSR 4-1/F	67.8	73.7	74.7	1.0
* NSR 5-G/F	65.8	72.2	73.1	0.9
* NSR 6-G/F	66.6	73.1	74.0	0.9
* NSR 6-1/F	67.2	73.1	74.1	1.0
* NSR 6-2/F	67.8	73.1	74.2	1.1
* NSR 7a-1/F	64.4	76.3	76.6	0.3
* NSR 7a-5/F	66.2	76.2	76.6	0.4
* NSR 7a-6/F	66.5	76.0	76.5	0.5
* NSR 7b-1/F	62.7	81.7	81.8	0.1
* NSR 7b-5/F	64.5	81.3	81.4	0.1
* NSR 7b-6/F	64.9	81.1	81.2	0.1
NSR 8a-10/F	69.8	79.5	79.9	0.4
NSR 8a-20/F	69.9	78.0	78.6	0.6
NSR 8a-24/F	69.9	77.5	78.2	0.7
NSR 8b-10/F	69.5	79.7	80.1	0.4
NSR 8b-20/F	69.4	78.1	78.6	0.5
NSR 8b-24/F	69.3	77.6	78.2	0.6
NSR 9a-10/F	71.8	77.8	78.8	1.0
NSR 9a-20/F	72.0	76.7	78.0	1.3
NSR 9a-24/F	71.9	76.2	77.7	1.5
NSR 9b-10/F	71.1	78.8	79.5	0.7
NSR 9b-20/F	70.9	77.6	78.4	0.8
NSR 9b-24/F	70.9	77.1	78.0	0.9
NSR 10a-10/F	75.0	71.3	76.5	5.2
NSR 10a-20/F	74.3	70.8	75.9	5.1
NSR 10a-24/F	73.8	70.8	75.6	4.8
NSR 10b-10/F	75.1	73.4	77.3	4.1

NSR (* = existing NSR)	New Road Noise Level dB(A)	Existing Road Noise Level dB(A)	Total Noise Level (New Road + Existing Road) dB(A)	Noise Contribution from New Roads dB(A)
NSR 10b-20/F	74.9	73.2	77.1	4.1
NSR 10b-24/F	74.6	73.1	76.9	3.8
NSR 11a-10/F	76.6	69.0	77.3	8.3
NSR 11a-20/F	75.7	68.7	76.5	7.8
NSR 11a-24/F	75.4	68.6	76.2	7.6
NSR 11b-10/F	76.3	68.0	76.9	8.9
NSR 11b-20/F	75.5	67.5	76.1	8.6
NSR 11b-24/F	75.0	67.2	75.7	8.5
NSR 12a-1/F	66.6	77.0	77.4	0.4
NSR 12a-10/F	66.9	77.1	77.5	0.4
NSR 12a-20/F	67.8	76.7	77.2	0.5
NSR 12a-23/F	68.0	76.5	77.1	0.6
NSR 12b-1/F	63.3	66.3	68.1	1.8
NSR 12b-10/F	65.6	66.2	68.9	3.7
NSR 12b-20/F	67.3	66.1	69.8	3.7
NSR 12b-23/F	67.7	66.3	70.1	3.8
NSR 12c-1/F	64.5	71.6	72.4	0.8
NSR 12c-10/F	64.0	71.6	72.3	0.7
NSR 12c-20/F	64.5	71.0	71.9	0.9
NSR 12c-23/F	64.7	70.9	71.8	0.9
NSR 12d-1/F	67.0	72.4	73.5	1.1
NSR 12d-10/F	68.9	72.1	73.8	1.7
NSR 12d-20/F	70.3	71.8	74.1	2.3
NSR 12d-23/F	70.6	71.6	74.2	2.6
NSR 13a-1/F	66.4	71.9	73.0	1.1
NSR 13a-10/F	68.8	72.4	74.0	1.6
NSR 13a-20/F	69.9	72.1	74.1	2.0
NSR 13a-23/F	70.0	72.0	74.1	2.1
NSR 13b-1/F	62.7	63.9	66.4	2.5
NSR 13b-10/F	65.2	63.8	67.6	3.8
NSR 13b-20/F	66.6	63.6	68.4	4.8
NSR 13b-23/F	66.9	63.8	68.6	4.8
NSR 13c-1/F	63.7	70.0	70.9	0.9
NSR 13c-10/F	65.5	69.9	71.2	1.3
NSR 13c-20/F	66.6	69.6	71.4	1.8
NSR 13c-23/F	67.0	69.5	71.4	1.9

NSR (* = existing NSR)	New Road Noise Level dB(A)	Existing Road Noise Level dB(A)	Total Noise Level (New Road + Existing Road) dB(A)	Noise Contribution from New Roads dB(A)
NSR 13d-1/F	66.1	69.4	71.1	1.7
NSR 13d-10/F	68.6	69.3	72.0	2.7
NSR 13d-20/F	70.0	69.1	72.6	3.5
NSR 13d-23/F	70.1	69.0	72.6	3.6
* NSR 14a-G/F	62.1	66.1	67.6	1.5
* NSR 14a-1/F	63.1	66.3	68.0	1.7
* NSR 15a-G/F	61.2	67.1	68.1	1.0
* NSR 15a-1/F	62.9	67.1	68.5	1.4
* NSR 15a-2/F	66.1	67.2	69.7	2.5
* NSR 16a-G/F	64.5	58.1	65.4	7.3
* NSR 16a-1/F	67.4	58.1	67.9	9.8
* NSR 17a-G/F	62.5	66.9	68.2	1.3
* NSR 17a-1/F	64.3	66.9	68.8	1.9
* NSR 17a-2/F	66.9	66.9	69.5	2.6
* NSR 18a-G/F	69.1	77.2	77.8	0.6
* NSR 18a-1/F	70.6	77.3	78.1	0.8
* NSR 19a-G/F	67.2	73.4	74.3	0.9
* NSR 19a-1/F	68.1	73.4	74.5	1.1
* NSR 20a-G/F	65.2	72.1	72.9	0.8
* NSR 21a-G/F	62.8	74.0	74.3	0.3
* NSR 22a-G/F	57.6	69.5	69.8	0.3
* NSR 22a-1/F	58.6	69.6	69.9	0.3
* NSR 22a-2/F	59.5	69.6	70.0	0.4
* NSR 23a-G/F	57.8	68.6	68.9	0.3
* NSR 23a-1/F	58.8	68.7	69.1	0.4
* NSR 23a-2/F	59.4	68.8	69.3	0.5
* NSR 24a-G/F	58.9	70.7	71.0	0.3
* NSR 25a-G/F	51.5	70.1	70.2	0.1
* NSR 26a-G/F	30.2	67.5	67.5	0.0
* NSR 26a-1/F	30.2	67.5	67.5	0.0
* NSR 27a-G/F	65.0	72.3	73.0	0.7
* NSR 27a-1/F	65.0	72.3	73.0	0.7
* NSR 28a-G/F	62.6	73.7	74.0	0.3
* NSR 29a-G/F	58.9	70.3	70.6	0.3
* NSR 29a-1/F	59.7	70.7	71.0	0.3
* NSR 29a-2/F	60.3	71.1	71.4	0.3

NSR (* = existing NSR)	New Road Noise Level dB(A)	Existing Road Noise Level dB(A)	Total Noise Level (New Road + Existing Road) dB(A)	Noise Contribution from New Roads dB(A)
* NSR 30a-G/F	52.8	68.5	68.6	0.1
* NSR 30a-1/F	53.4	69.5	69.6	0.1
* NSR 30a-2/F	54.7	70.7	70.8	0.1
* NSR 31a-G/F	50.0	66.2	66.3	0.1
* NSR 31a-1/F	51.1	66.8	66.9	0.1
* NSR 32a-G/F	62.5	78.1	78.2	0.1
* NSR 32a-1/F	65.3	78.4	78.6	0.2
* NSR 32a-2/F	67.8	78.5	78.9	0.4
NSR 33a-1/F	66.6	70.3	71.8	1.5
NSR 33a-10/F	69.1	70.3	72.8	2.5
NSR 33a-20/F	69.7	70.3	73.0	2.7
NSR 33b-1/F	64.1	67.4	69.1	1.7
NSR 33b-10/F	66.8	67.3	70.1	2.8
NSR 33b-12/F	67.3	67.3	70.3	3.0
NSR 34a-1/F	66.4	70.7	72.1	1.4
NSR 34a-10/F	68.8	71.1	73.1	2.0
NSR 34a-12/F	69.2	71.0	73.2	2.2

Table 5.11
Traffic Noise Levels in Year 2011 (with mitigation) - Pok Oi Flyover & Remaining Works

NSR (* = existing NSR)	Mitigated New Road Noise Level dB(A)	Existing Road Noise Level dB(A)	Total Noise Level (New Road + Existing Road) dB(A)	Noise Contribution from New Roads dB(A)
* NSR 1-G/F	63.1	72.4	72.9	0.5
* NSR 2-G/F	66.1	74.6	75.2	0.6
* NSR 2-1/F	66.9	74.6	75.3	0.7
* NSR 3-G/F	64.4	71.0	71.9	0.9
* NSR 4-G/F	66.6	73.7	74.5	0.8
* NSR 4-1/F	67.4	73.7	74.6	0.9
* NSR 5-G/F	65.7	72.2	73.1	0.9
* NSR 6-G/F	62.5	73.1	73.5	0.4
* NSR 6-1/F	62.9	73.1	73.5	0.4
* NSR 6-2/F	63.3	73.1	73.5	0.4
* NSR 7a-1/F	60.8	76.3	76.4	0.1
* NSR 7a-5/F	62.8	76.2	76.4	0.2
* NSR 7a-6/F	63.2	76.0	76.2	0.2
* NSR 7b-1/F	58.4	81.7	81.7	0.0
* NSR 7b-5/F	60.5	81.3	81.3	0.0
* NSR 7b-6/F	61.0	81.1	81.1	0.0
NSR 8a-10/F	68.2	79.5	79.8	0.3
NSR 8a-20/F	67.1	78.0	78.3	0.3
NSR 8a-24/F	66.8	77.5	77.9	0.4
NSR 8b-10/F	68.1	79.7	80.0	0.3
NSR 8b-20/F	67.0	78.1	78.4	0.3
NSR 8b-24/F	66.9	77.6	78.0	0.4
NSR 9a-10/F	69.4	77.8	78.4	0.6
NSR 9a-20/F	68.6	76.7	77.3	0.6
NSR 9a-24/F	68.5	76.2	76.9	0.7
NSR 9b-10/F	68.9	78.8	79.2	0.4
NSR 9b-20/F	68.0	77.6	78.1	0.5
NSR 9b-24/F	68.0	77.1	77.6	0.5
NSR 10a-10/F	70.2	71.3	73.8	2.5
NSR 10a-20/F	72.7	70.8	74.9	4.1
NSR 10a-24/F	72.9	70.8	75.0	4.2
NSR 10b-10/F	70.1	73.4	75.1	1.7

NSR 10b-20/F	71.9	73.2	75.6	2.4
NSR 10b-24/F	72.6	73.0	75.8	2.8
NSR 11a-10/F	72.7	69.0	74.2	5.2
NSR 11a-20/F	74.6	68.7	75.6	6.9
NSR 11a-24/F	74.6	68.6	75.6	7.0
NSR 11b-10/F	72.8	68.0	74.0	6.0
NSR 11b-20/F	74.4	67.5	75.2	7.7
NSR 11b-24/F	74.3	67.2	75.1	7.9
NSR 12a-1/F	65.1	77.0	77.3	0.3
NSR 12a-10/F	64.1	77.1	77.3	0.2
NSR 12a-20/F	63.7	76.7	76.9	0.2
NSR 12a-23/F	63.4	76.5	76.7	0.2
NSR 12b-1/F	56.7	66.3	66.8	0.5
NSR 12b-10/F	58.0	66.2	66.8	0.6
NSR 12b-20/F	60.4	66.1	67.1	1.0
NSR 12b-23/F	61.3	66.3	67.5	1.2
NSR 12c-1/F	64.3	71.6	72.3	0.7
NSR 12c-10/F	63.5	71.6	72.2	0.6
NSR 12c-20/F	63.4	71.0	71.7	0.7
NSR 12c-23/F	63.5	70.9	71.6	0.7
NSR 12d-1/F	63.0	72.4	72.9	0.5
NSR 12d-10/F	63.5	72.1	72.7	0.6
NSR 12d-20/F	64.8	71.8	72.6	0.8
NSR 12d-23/F	65.2	71.6	72.5	0.9
NSR 13a-1/F	62.6	71.9	72.4	0.5
NSR 13a-10/F	64.1	72.4	73.0	0.6
NSR 13a-20/F	64.8	72.1	72.8	0.7
NSR 13a-23/F	65.0	72.0	72.8	0.8
NSR 13b-1/F	56.8	63.9	64.7	0.8
NSR 13b-10/F	58.7	63.8	65.0	1.2
NSR 13b-20/F	61.5	63.6	65.7	2.1
NSR 13b-23/F	62.4	63.8	66.2	2.4
NSR 13c-1/F	60.5	70.0	70.5	0.5
NSR 13c-10/F	61.1	69.9	70.4	0.5
NSR 13c-20/F	61.1	69.6	70.2	0.6
NSR 13c-23/F	61.6	69.5	70.2	0.7
NSR 13d-1/F	59.9	69.4	69.9	0.5
NSR 13d-10/F	61.4	69.3	70.0	0.7
NSR 13d-20/F	63.8	69.1	70.2	1.1

NSR 13d-23/F	64.3	69.0	70.3	1.3
* NSR 14a-G/F	58.7	66.1	66.8	0.7
* NSR 14a-1/F	59.6	66.3	67.1	0.8
* NSR 15a-G/F	61.2	67.1	68.1	1.0
* NSR 15a-1/F	62.9	67.1	68.5	1.4
* NSR 15a-2/F	66.1	67.2	69.7	2.5
* NSR 16a-G/F	64.1	58.1	65.1	7.0
* NSR 16a-1/F	67.1	58.1	67.6	9.5
* NSR 17a-G/F	59.2	66.9	67.6	0.7
* NSR 17a-1/F	60.0	66.9	67.7	0.8
* NSR 17a-2/F	61.6	66.9	68.0	1.1
* NSR 18a-G/F	67.5	77.2	77.6	0.4
* NSR 18a-1/F	68.9	77.3	77.9	0.6
* NSR 19a-G/F	65.8	73.4	74.1	0.7
* NSR 19a-1/F	66.7	73.4	74.2	0.8
* NSR 20a-G/F	64.4	72.1	72.8	0.7
* NSR 21a-G/F	62.8	74.0	74.3	0.3
* NSR 22a-G/F	57.6	69.5	69.8	0.3
* NSR 22a-1/F	58.6	69.6	69.9	0.3
* NSR 22a-2/F	59.5	69.6	70.0	0.4
* NSR 23a-G/F	57.8	68.6	68.9	0.3
* NSR 23a-1/F	58.8	68.7	69.1	0.4
* NSR 23a-2/F	59.4	68.8	69.3	0.5
* NSR 24a-G/F	58.9	70.7	71.0	0.3
* NSR 25a-G/F	51.5	70.1	70.2	0.1
* NSR 26a-G/F	30.1	67.5	67.5	0.0
* NSR 26a-1/F	30.1	67.5	67.5	0.0
* NSR 27a-G/F	64.3	72.3	72.9	0.6
* NSR 27a-1/F	64.3	72.3	72.9	0.6
* NSR 28a-G/F	62.6	73.7	74.0	0.3
* NSR 29a-G/F	58.9	70.3	70.6	0.3
* NSR 29a-1/F	59.7	70.7	71.0	0.3
* NSR 29a-2/F	60.3	71.1	71.4	0.3
* NSR 30a-G/F	52.8	68.5	68.6	0.1
* NSR 30a-1/F	53.4	69.5	69.6	0.1
* NSR 30a-2/F	54.7	70.7	70.8	0.1
* NSR 31a-G/F	50.0	66.2	66.3	0.1
* NSR 31a-1/F	51.1	66.8	66.9	0.1
* NSR 32a-G/F	62.5	78.1	78.2	0.1

* NSR 32a-1/F	65.3	78.4	78.6	0.2
* NSR 32a-2/F	67.8	78.5	78.9	0.4
NSR 33a-1/F	61.6	70.3	70.8	0.5
NSR 33a-10/F	63.5	70.3	71.1	0.8
NSR 33a-12/F	64.0	70.3	71.2	0.9
NSR 33b-1/F	59.9	67.4	68.1	0.7
NSR 33b-10/F	62.5	67.3	68.5	1.2
NSR 33b-12/F	63.0	67.3	68.7	1.4
NSR 34a-1/F	61.7	70.7	71.2	0.5
NSR 34a-10/F	63.2	71.1	71.7	0.6
NSR 34a-12/F	63.5	71.0	71.7	0.7

5.38 It should be noted that any gaps or openings in the noise barrier would greatly reduce the sound screening effect. Thus, in the detailed design of noise barriers, the barriers should be a continuous structure with no gaps or openings. In particular, there should be no gap between the noise barrier panels and the concrete plinth, and any street lamp, sign post, etc. would need to be integrated with the noise barriers.

Noise Barrier Selection - Discussion

5.39 Every engineering project undertaken in Hong Kong is subject to a wide variety of inter-related environmental, technical, cost and time constraints which can each contribute to the selection of the best practicable environmental option. This is similarly applicable in the case of the Pok Oi Flyover project.

5.40 In view of the urgency of the Pok Oi Flyover project and the fact that the site to the north of Pok Oi Interchange is occupied by Route 3 CPS until at least August 1998, there is no viable option other than for Government to entrust construction of the Pok Oi Flyover project to the Route 3 CPS consortium under a Design and Build contract. This course of action offers many advantages in terms of achieving the required tight construction deadline but also, on the other hand, imposes constraints on the type of noise barrier that can be built on the flyover.

5.41 A variety of flyover designs and construction methods have been considered in the Preliminary Project Feasibility Study report for the Pok Oi Flyover project. It has been concluded that, mainly as a result of time constraint, the design should be similar to those constructed elsewhere along the Route 3 CPS route. This would enable the flyover bridge to be constructed using the segmental launching system and equipment already in use by the Route 3 CPS contractors.

5.42 One of the advantages of the segmental launching system is that unlike construction using conventional methods, there is little interference with existing traffic flows under and around the works area: this is an important consideration in view of the existing traffic problems in the area. This technique is also relatively fast as the foundations and piers are to be constructed in parallel with the casting of the bridge segments.

5.43 There are a number of engineering constraints which have already been taken into account in the design of the flyover bridge, one of these being that the maximum height of any barrier would be no greater than 3.5 m in total from deck level. A higher noise barrier would result in the segmental deck jointing arrangement being insufficient. To accommodate additional stresses and related structural factors would require a re-design of the steel mould and launching girder used in the segmental launching and this would inevitably result in a substantial delay (estimated at around 6-9 months) to the project.

5.44 A 6-9 month delay would mean that the Pok Oi Flyover works could not be entrusted to the Route 3 CPS consortium, which would in turn add 1-2 years to the overall programme as a result of the requirement to comply with Government procedures for engaging contractors. This delay would not only lead to additional costs but also, as discussed in Section 1, compound the traffic congestion problems associated with vehicles travelling between the newly commissioned Route 3 CPS and the Yuen Long Highway via the existing roundabout at Pok Oi Interchange and lengthen the delay to the housing production programme in Yuen Long.

5.45 For the purposes of discussion, bearing in mind the above constraints, the effectiveness of a variety of barrier heights and configurations on the Pok Oi Flyover in mitigating noise at the most affected sensitive receivers (NSRs 10 and 11) has been evaluated. The results of the comparison are shown in Table 5.12.

Table 5.12
Comparison of Effectiveness of Varying Barrier Heights/Configurations at Pok Oi Flyover

NSR	No Mitigation Measures		Full Enclosure		3.5 m Barrier (1.7m barrier + 0.8m parapet)		5.5 m Barrier (4.7m barrier + 0.8m parapet)		5.5 m Barrier with 1 m Cantilever (4.7m + 0.8m)	
	TNL	NR	TNL	NR	TNL	NR	TNL	NR	TNL	NR
NSR 10a-5/F	76.3	n/a	73.4	-2.9	73.7	-2.6	73.5	-2.8	73.5	-2.8
NSR 10a-6/F	76.5	n/a	73.3	-3.2	73.7	-2.8	73.5	-3.0	73.4	-3.1
NSR 10a-7/F	76.5	n/a	73.2	-3.3	73.7	-2.8	73.4	-3.1	73.3	-3.2
NSR 10a-8/F	76.5	n/a	73.1	-3.4	73.7	-2.8	73.3	-3.2	73.3	-3.2
NSR 10a-9/F	76.6	n/a	73.1	-3.5	73.7	-2.9	73.3	-3.3	73.2	-3.4
NSR 10a-10/F	76.5	n/a	73.0	-3.5	73.8	-2.7	73.3	-3.2	73.2	-3.3
NSR 10a-20/F	75.9	n/a	72.5	-3.4	74.9	-1.0	73.3	-2.6	72.9	-3.0
NSR 10a-24/F	75.6	n/a	72.3	-3.3	75.0	-0.6	73.6	-2.0	72.9	-2.7
NSR 10b-5/F	77.0	n/a	74.9	-2.1	75.2	-1.8	75.0	-2.0	75.0	-2.0
NSR 10b-6/F	77.1	n/a	74.9	-2.2	75.2	-1.9	75.0	-2.1	75.0	-2.1
NSR 10b-7/F	77.2	n/a	74.8	-2.4	75.1	-2.1	75.0	-2.2	74.9	-2.3
NSR 10b-8/F	77.2	n/a	74.8	-2.4	75.1	-2.1	74.9	-2.3	74.9	-2.3
NSR 10b-9/F	77.3	n/a	74.7	-2.6	75.1	-2.2	74.9	-2.4	74.8	-2.5
NSR 10b-10/F	77.4	n/a	74.7	-2.7	75.1	-2.3	74.8	-2.6	74.8	-2.6
NSR 10b-20/F	77.2	n/a	74.5	-2.7	75.6	-1.6	74.8	-2.4	74.7	-2.5
NSR 10b-24/F	76.9	n/a	74.3	-2.6	75.9	-1.0	74.8	-2.1	74.6	-2.3
NSR 11a-5/F	76.9	n/a	72.3	-4.6	73.0	-3.9	72.6	-4.3	72.5	-4.4
NSR 11a-6/F	77.1	n/a	72.5	-4.6	73.3	-3.8	72.8	-4.3	72.7	-4.4
NSR 11a-7/F	77.2	n/a	72.6	-4.6	73.6	-3.6	73.0	-4.2	72.9	-4.3
NSR 11a-8/F	77.3	n/a	72.7	-4.6	73.8	-3.5	73.1	-4.2	73.0	-4.3
NSR 11a-9/F	77.3	n/a	72.8	-4.5	74.0	-3.3	73.2	-4.1	73.1	-4.2
NSR 11a-10/F	77.3	n/a	72.8	-4.5	74.2	-3.1	73.3	-4.0	73.1	-4.2
NSR 11a-20/F	76.5	n/a	72.4	-4.1	75.6	-0.9	73.8	-2.7	73.1	-3.4
NSR 11a-24/F	76.2	n/a	72.2	-4.0	75.6	-0.6	74.0	-2.2	73.1	-3.1
NSR 11b-5/F	76.6	n/a	72.6	-4.0	73.2	-3.4	72.9	-3.7	72.8	-3.8
NSR 11b-6/F	76.8	n/a	72.7	-4.1	73.4	-3.4	73.0	-3.8	72.9	-3.9
NSR 11b-7/F	76.9	n/a	72.7	-4.2	73.5	-3.4	73.0	-3.9	72.9	-4.0
NSR 11b-8/F	76.9	n/a	72.7	-4.2	73.7	-3.2	73.0	-3.9	72.9	-4.0
NSR 11b-9/F	77.0	n/a	72.7	-4.3	73.8	-3.2	73.1	-3.9	73.0	-4.0
NSR 11b-10/F	76.9	n/a	72.7	-4.2	74.0	-2.9	73.1	-3.8	73.0	-3.9
NSR 11b-20/F	76.1	n/a	72.1	-4.0	75.2	-0.9	73.5	-2.6	72.8	-3.3
NSR 11b-24/F	75.7	n/a	71.8	-3.9	75.1	-0.6	73.6	-2.1	72.7	-3.0

Notes: TNL = Total noise level in dB(A) from Pok Oi Flyover, Route 3 CPS and the unaltered (existing) roads; NR = Noise reduction achieved by mitigation measure

5.46 The results in Table 5.12 show that when compared with a 3.5 m noise barrier, a full noise enclosure over the Pok Oi Flyover only offers an additional reduction of 0.3-3.3 dB(A) at the worst affected NSRs (the two proposed residential blocks facing Route 3 CPS at CDA 15).

5.47 Construction of a full enclosure over the flyover offers a number of disadvantages over construction of noise barriers. The length of the enclosed sections, around 150 m on the flyover itself and another 150 m on the approach embankments, means that there will be additional requirements in terms of ventilation, fire access, safety and maintenance costs. There are additional related problems of air quality issues and noise breakout at the enclosure portals, which would lead to a localised elevation of traffic noise levels. The minimum height of any noise enclosure would be in excess of 5.5 m above the bridge deck to accommodate high sided vehicles: the visual impact of such a structure would be considerable. All these factors could be overcome but at the cost of a considerable delay to implementation of the Pok Oi Flyover project.

5.48 It is also important to note that because of the way that the flyover is constructed on two separate structures over the Pok Oi Interchange (one for south bound traffic and the other for north bound traffic), two parallel noise enclosures would have to be constructed, one over each carriageway. This would raise the construction costs from around $3.6 million for the 2.7 m noise barrier over the structural 0.8 m parapet either side of the flyover to in excess of $70 million for the twin enclosures.

5.49 Based on the current layout of the residential developments at CDA 15, the fifth to 24th floors of NSRs 10a, 10b, 11a and 11b (ie. 76 dwellings) could still experience unacceptable noise levels of up to 74.9 dB(A) in the worst case scenario even if the entire flyover is enclosed; this is because most of the traffic noise impact at these NSRs is contributed from the Pok Oi roundabout and the through-traffic on Castle Peak Road and Route 3 CPS.

5.50 Based on the above evaluation, the 3.5 m noise barrier (2.7 m barrier on a 0.8 m parapet) on the flyover section is recommended as the most practicable solution to the traffic noise issue.

Summary

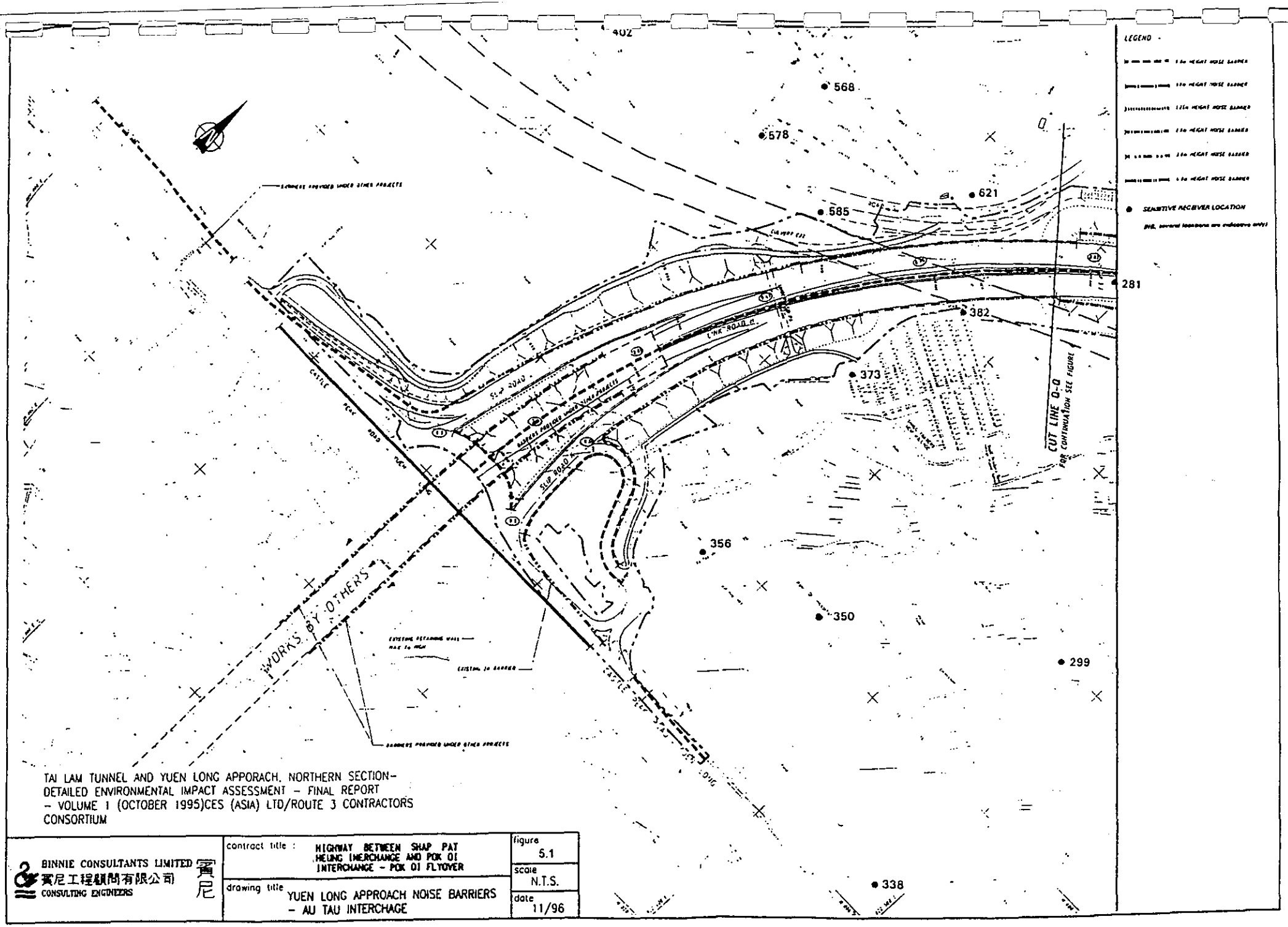
5.51 Sensitive receivers within the Study Area are already impacted by high levels of traffic noise from the existing Castle Peak Road and Yuen Long Highway. The traffic noise impact assessments have identified a number of locations where potential traffic noise impact from the new roads (Route 3 CPS, Pok Oi Flyover and the Remaining Works) exceeding the HKPSG requirement of 70 dB(A) will be experienced by existing or planned NSRs.

5.52 The assessment of the Pok Oi Flyover project, based on the 2001 traffic figures, has confirmed that the use of friction course and the installation of a 2.7 m noise barrier lined with sound absorptive material on the 0.8 m parapet either side of the flyover linking Route 3 CPS and Yuen Long Highway at Pok Oi Interchange will provide adequate traffic noise mitigation for most of the existing and proposed noise sensitive receivers.

5.53 For protection of the remaining affected NSRs, which are mainly low rise properties lying to the east and west of the temporary link roads, it is recommended that temporary noise barriers of between 0.8-3.5 m high are constructed along the temporary distributors. There are some cases where NSRs will still experience noise levels exceeding 70 dB(A); in all cases this problem is due to the traffic on existing roads.

5.54 The assessment of the completed Pok Oi Flyover and Remaining Works, based on the 2011 traffic figures, has established that the 2.7 m high noise barrier constructed on the 0.8 m high flyover parapet, together with sections of noise barrier ranging from between 1.4-3.5 m in total height along part of the trunk road constructed under the Remaining Works project, will be required to protect existing and future noise sensitive receivers.

5.55 Installation of the noise barriers will minimise the constraint on nearby residential developments, allowing developers maximum flexibility to develop adjacent or nearby sites to their full potential.



TAI LAM TUNNEL AND YUEN LONG APPORACH, NORTHERN SECTION-
DETAILED ENVIRONMENTAL IMPACT ASSESSMENT - FINAL REPORT
- VOLUME 1 (OCTOBER 1995)CES (ASIA) LTD/ROUTE 3 CONTRACTORS
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BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	contract title : HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER	figure 5.1
	drawing title YUEN LONG APPROACH NOISE BARRIERS - AU TAU INTERCHAGE	scale N.T.S.
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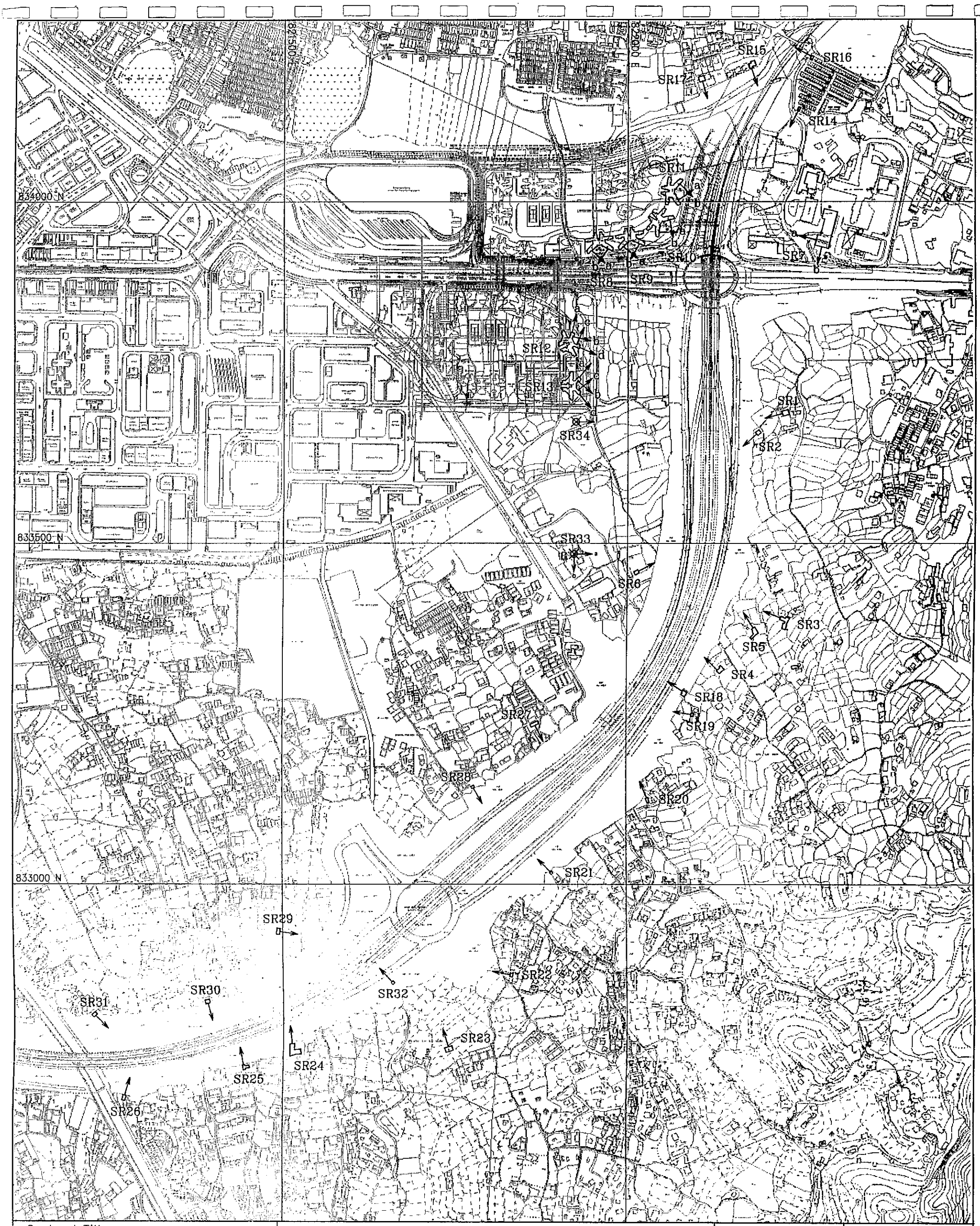

Contract Title :

HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER AND REMAINING WORKS

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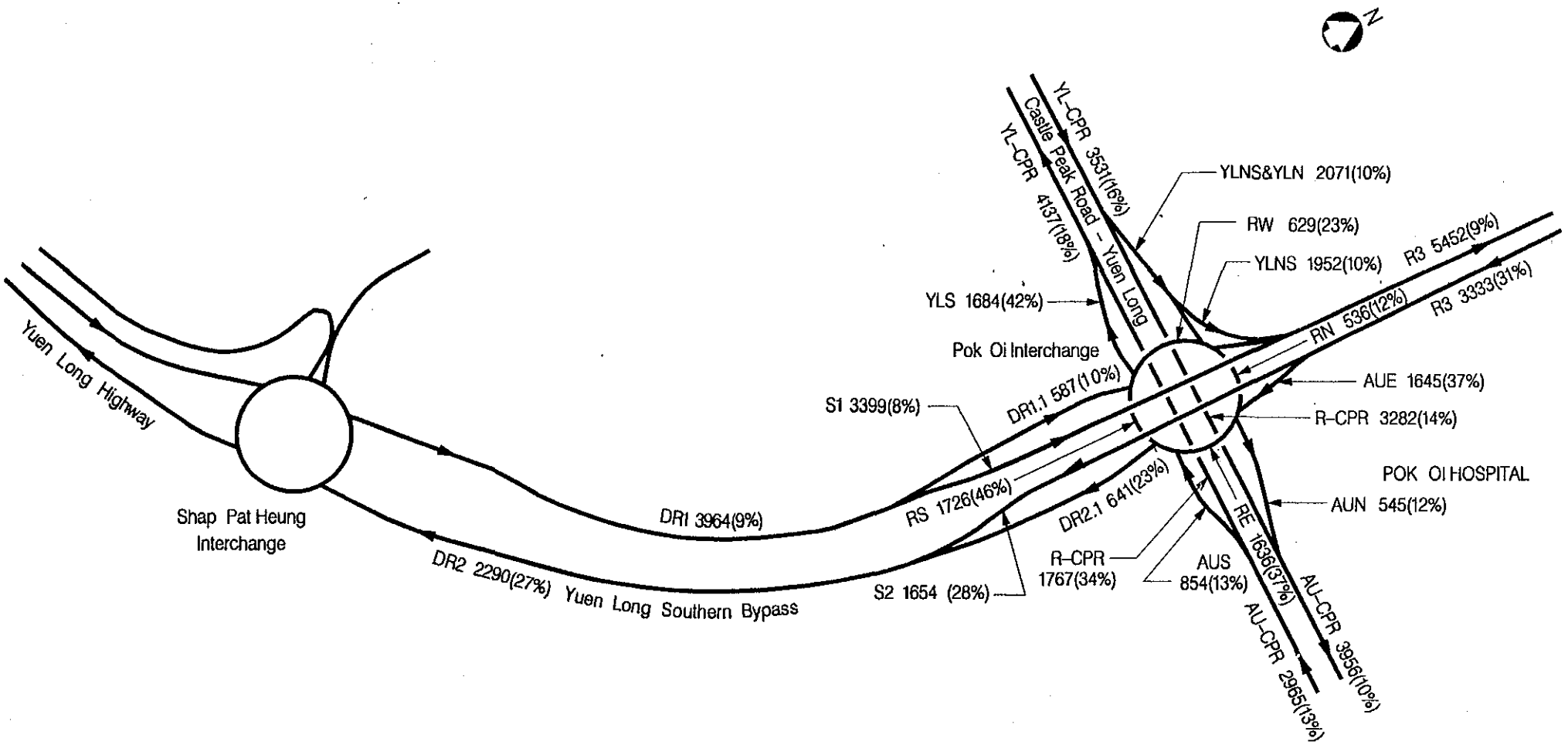
Title :

LOCATION OF NOISE / AIR SENSITIVE RECEIVERS

Figure No. 5.2	Revision 0
Reference	File Name 00010088.B04
Prepared	Checked
Date APR. 97	Scale N.T.S.



2965(13%) TRAFFIC FLOW IN VEHICLE/HR (% OF HEAVY VEHICLE)

Contract Title :
HIGHWAY BETWEEN SHAP PAT HEUNG INERCHANGE AND POK OI INTERCHANGE – POK OI FLYOVER

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

Title : YUEN LONG SOUTHERN BYPASS, STAGE II, PHASE 1 AND REMAINING WORKS

WSA 2001 A.M. PEAK HOUR FORECAST TRAFFIC FLOW

Figure No.	Revision
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Reference	File Name
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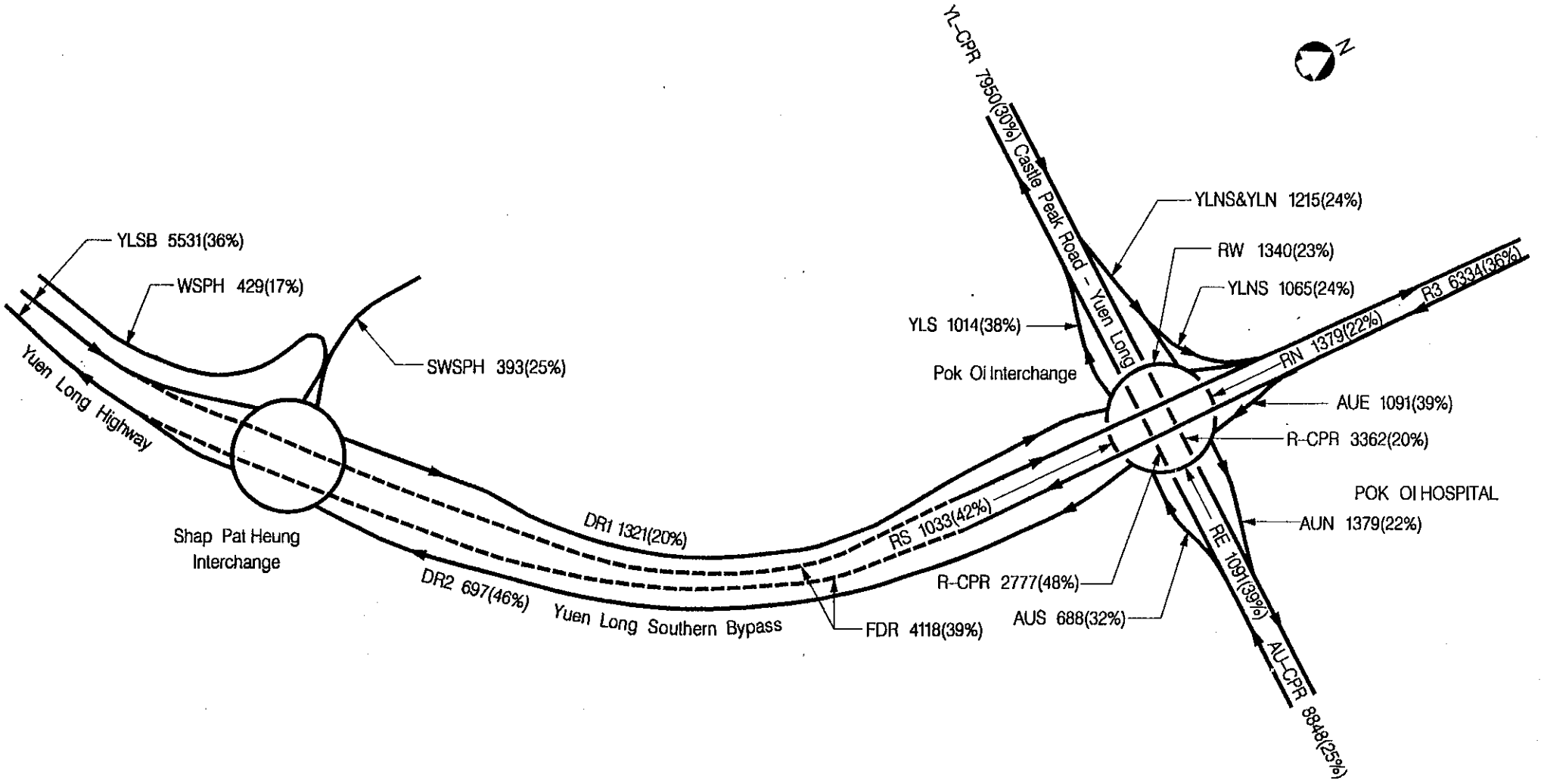

697(46%) TRAFFIC FLOW IN VEHICLE/HR (% OF HEAVY VEHICLE)

Contract Title : HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE – POK OI FLYOVER AND REMAINING WORKS	Title : YUEN LONG SOUTHERN BYPASS, STAGE II, PHASE 1 AND REMAINING WORKS	Figure No. 5.4	Revision 0
		Reference	File Name 00080088.B04
BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 ENGINEERS AND SCIENTISTS 賓尼	WSA 2011 A.M. PEAK HOUR FORECAST TRAFFIC FLOW	Prepared BH	Checked RVC
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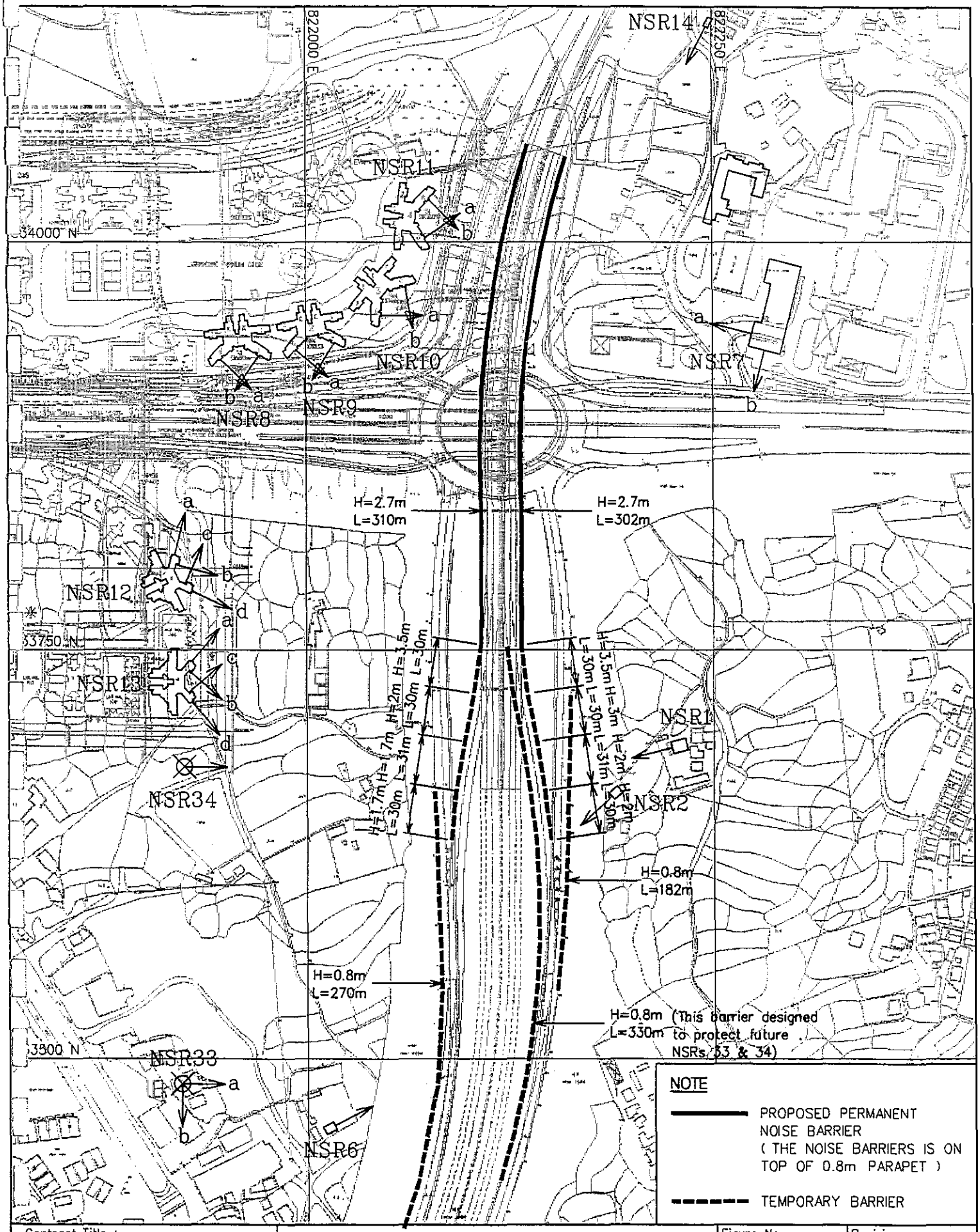

NOTE

PROPOSED PERMANENT NOISE BARRIER (THE NOISE BARRIERS IS ON TOP OF 0.8m PARAPET)

TEMPORARY BARRIER

Contract Title :
HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER AND REMAINING WORKS

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Title :

LOCATION AND HEIGHTS OF NOISE BARRIERS FOR POK OI FLYOVER PROJECT

Figure No.	Revision
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Reference	File Name
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Prepared	Checked
WKY	YWL
Date	Scale
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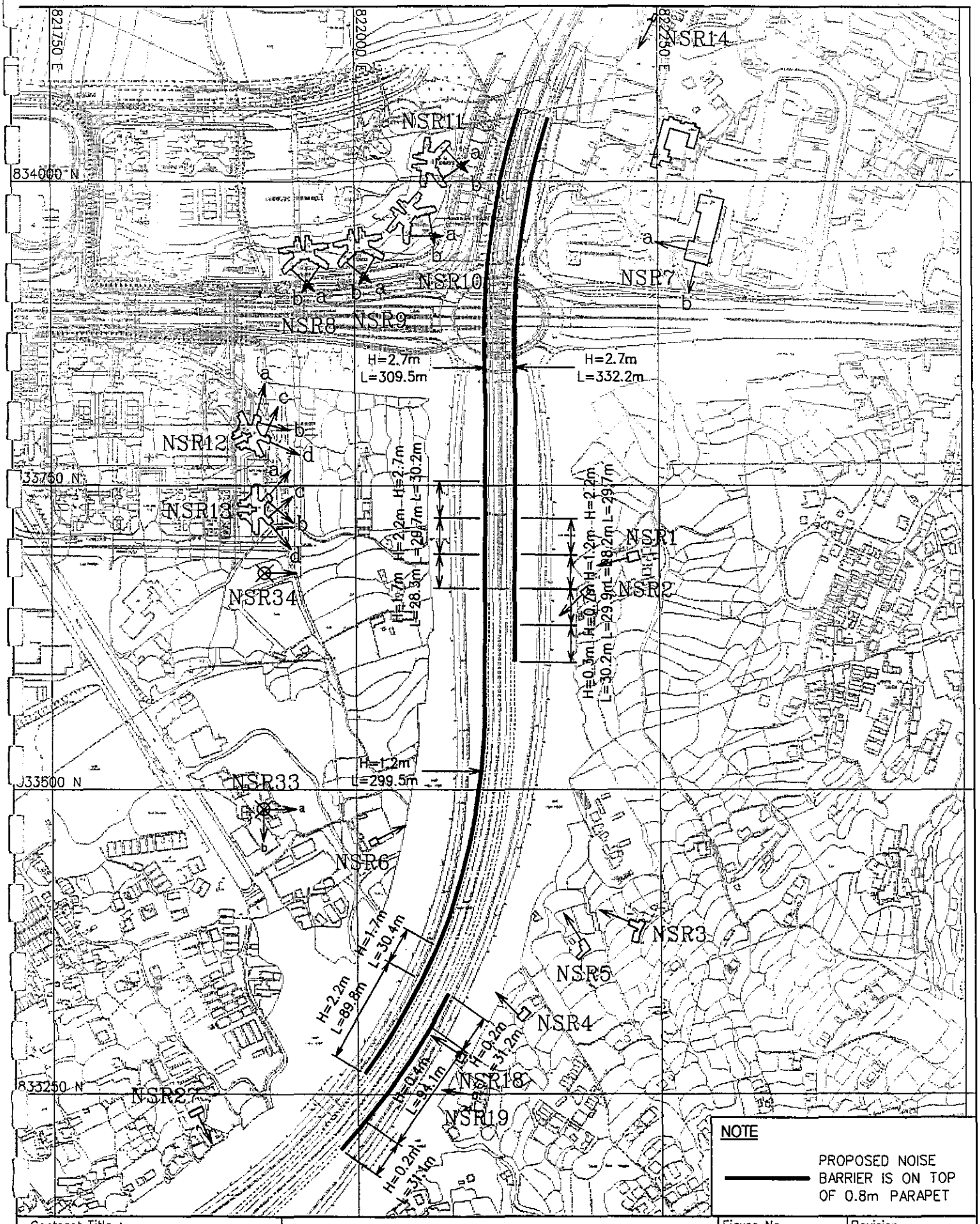

NOTE

PROPOSED NOISE BARRIER IS ON TOP OF 0.8m PARAPET

Contract Title :

HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER AND REMAINING WORKS

BINNIE CONSULTANTS LIMITED
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Title :

LOCATION AND HEIGHTS OF NOISE BARRIERS FOR POK OI FLYOVER & REMAINING WORKS PROJECT

Figure No.	Revision
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Reference	File Name
	00120088.B04
Prepared	Checked
WKY	YWL
Date	Scale
APR. 97	N.T.S.

6 AIR QUALITY IMPACT ASSESSMENT

Introduction

6.1 As stated in Section 3, Yuen Long is located in the Deep Bay Airshed, which is geographically confined and has a limited capacity to dust dispersion potential.

6.2 This section details the existing conditions in the area, the findings of the air quality impact assessment undertaken in the R3DEIA and the result of the air quality studies undertaken specifically for the Pok Oi Flyover and Remaining Works projects.

Air Quality Environment

Existing Air Quality - Recent studies

6.3 As Yuen Long is one of the rapidly developing urban areas of the New Territories, the general air quality in this area is becoming of concern. In late 1995, Yuen Long air quality monitoring station was commissioned by EPD and became the latest site to form part of the air monitoring network in Hong Kong. The station is located on the roof-top of the Yuen Long Police Station at Yuen Long Town Centre.

6.4 The maximum and average figures recorded for Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP) at the Yuen Long Station in the period between late 1995 and early 1996 are presented in Table 6.1[1].

Table 6.1
Maximum and Average Concentrations at Yuen Long EPD Station (1995 and 1996)

	1 hr		24 hr		Annual	
	Maximum	AQOs	Maximum	AQOs	Average	AQOs
TSP	N/A	500	150	260	109	80
RSP	N/A	N/A	90	180	62	55
NO_2	140	300	88	150	40	80
SO_2	120	800	40	350	16	80

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

[1] *Environment Hong Kong 1996*, (1996) Environmental Protection Department.

6.5 Table 6.1 indicates that the concentrations of NO_2 and SO_2 are fairly low and well below the AQOs. Recent studies such as Yuen Long South Development Engineering Works in Areas 13 and 14[2] as well as Engineering Investigations for the Development of Areas 3, 30, 31 in the Development Zone and the Reserve Zone[3] have included extensive modelling of the 159 industrial chimneys within the vicinity of the Study Area. These studies confirm that local concentrations of NO_2 and SO_2 are fairly low and well below the AQOs.

6.6 The short term maximum concentrations of TSP and RSP in the area are well below the AQOs, but the annual average of the particulates exceeds the AQOs. It should be noted that in 1996, six out of the nine monitoring stations in EPD's network had annual averages exceeding the annual AQOs of 80 $\mu g/m^3$. The other three non-exceeding stations also registered annual averages close to the AQO limits.

6.7 The high TSP and RSP levels measured at the Yuen Long station were probably due to the intensive construction activities in the vicinity such as the Route 3 (Country Park Section), Village Flood Protection for Yuen Long, Kam Tin & Ngau Tam Mei (30CD), Drainage Channels for Yuen Long & Kam Tin (43CD and 60CD) and the heavy industrial activities around Shenzhen. The long term trend of high TSP and RSP in Yuen Long area is likely to continue in the foreseeable future.

Future Air Quality - Recent studies

6.8 The R3DEIA assessed the potential air quality impact in 2011 based on traffic flows on both existing (ie. Castle Peak Road) and future roads (Route 3 CPS). The assessment considered the worst-case traffic-related air quality impacts at 1.5 m above local ground level (ie. the average height of the human breathing zone) as well as the impacts at 1.5 m, 3 m, 4 m and 5 m above ground level, to take into account the influence of the proposed noise barriers. In addition, the impact at the roof level of Pok Oi Hospital was modelled, as this is where fresh air intakes for the air conditioning system are likely to be located.

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2 *Yuen Long South Development Engineering Works in Areas 13 and 14: Draft Assessment Report* (in preparation), Binnie Consultants Ltd for Territory Development Department.

3 *Engineering Works for the Development of Areas 3, 30 & 31 in the Development Zone and Reserve Zone Final Assessment Report* (February 1997), Binnie Consultants Ltd for Territory Development Department.

6.9 Four of the sensitive receivers discussed above (ie. NSRs 382, 585, 621 and 630) were amongst the top ten highest maximum 1 hour average NO_2 concentrations modelled in the R3DEIA. A comparison between the predicted air pollutant levels with and without noise barriers is shown in Table 6.2.

6.10 The R3DEIA predicted that the maximum 1 hour, maximum 24 hour and annual average NO_2 concentrations experienced by air sensitive receivers (ASRs) including Pok Oi Hospital in the years 2002 and 2011, assuming that noise barriers proposed under Noise Mitigation 4 scenario were constructed, would comply with the relevant AQOs.

Table 6.2
Comparison of Predicted 1 Hour NO_2 Levels

Open road with ASRs at		Noise Mitigation 4 with SRs at Heights							
1.5 m above Ground		1 m		3 m		4 m		5 m	
ASR	1 hr conc	ASR	1 hr	ASR	1 hr	ASR	1 hr	ASR	1 hr
382	286	382	242	382	235	382	228	585	226
585	260	585	229	585	228	585	227	382	219
621	185	964	163	621	160	621	159	621	159
630	170	630	152	630	151	630	150	630	150

Source: R3DEIA

6.11 It is interesting to compare the NO_2 concentrations between the open road or no barrier design and the Noise Mitigation 4 scenario at the 1.5 m receptor height at the same sensitive receiver. NO_2 concentrations at this height are markedly higher under the no barrier scenario, indicating that the installation of noise barriers may result in the dual benefit of reduced air quality impacts as well as reduced traffic noise levels at the sensitive receivers.

Air Quality - Operational Phase Assessment

Representative Air Sensitive Receivers

6.12 As mentioned in Section 5, the representative sensitive receivers selected for the noise and air assessments for the Pok Oi Flyover and Remaining Works projects are identical. They are listed in Table 5.5 and shown in Figure 5.2.

Assessment Methodology

6.13 Vehicular emissions are the major source of NO_2 emissions in Hong Kong. Another major traffic-related air pollutant is RSP. In order to assess the potential air quality impacts resulting from the Project, the maximum hourly concentrations of NO_2 and RSP emissions from year 2011 traffic flows on Castle Peak Road, Yuen Long Highway, Route 3 CPS, Pok Oi Flyover and the associated slip roads were predicted using CALINE4. The results were compared with the relevant AQOs in order to assess whether compliance with these air quality standards is achieved.

6.14 The air quality assessment were based on the year 2011 traffic flow data. A breakdown of the types of vehicles in terms of the percentage of passenger cars (%P.Car) and heavy goods vehicles (%HGV) plus the emission rates of RSP and NO_2 is given in Table 6.3. The table should be read in conjunction with Figure 5.3 which identifies the various road segments.

Table 6.3
Calculation of Vehicular Emission Rates

Road Segment	Total Traffic Flow (veh/hr)	%PV	%HGV	RSP * gm/v-km	NO2 * gm/v-km
YLSB	5,531	63.7	36.3	0.231	3.402
WSPH	429	83.0	17.0	0.130	2.297
SWSPH	393	75.0	25.0	0.172	2.756
DR1	1,321	80.0	20.0	0.146	2.469
DR2	697	54.0	46.0	0.283	3.961
RE	1,091	61.0	39.0	0.246	3.560
RS	1,033	58.0	42.0	0.262	3.732
RW	1,340	77.0	23.0	0.162	2.641
RN	1,379	78.0	22.0	0.157	2.584
R-CPR	6,139	67.3	32.7	0.212	3.196
YLS	1,014	62.0	38.0	0.241	3.502
AUS	688	68.0	32.0	0.209	3.158
YLNS	1,065	76.0	24.0	0.167	2.699
YLNS&YLN	1,215	76.0	24.0	0.167	2.699
AUN	1,379	78.0	22.0	0.157	2.584
AUE	1,091	61.0	39.0	0.246	3.560

Road Segment	Total Traffic Flow (veh/hr)	%PV	%HGV	RSP * gm/v-km	NO2 * gm/v-km
YL-CPR	7,950	70.0	30.0	0.198	3.041
AU-CPR	8,848	75.4	24.6	0.170	2.731
FDR	4,118	61.5	38.5	0.243	3.530
R3	6,334	63.8	36.2	0.231	3.401

* RSP and NO_2 calculations have been based on EPD's traffic control MOBILE IV model's emission factor for the year 2011.

6.15 Gases were assumed to be inert and concentrations of NO_2 have been taken as 20 percent of the total NO_x concentration.

6.16 The assumed vehicular emissions factor for pollutants in the year 2011 were supplied by EPD's Vehicle Emission Control Section. These factors originated from the USEPA MOBILE IV program. In view of quasi-rural nature of the area, the annual background concentration of NO_2 of 25 $\mu g/m^3$ and RSP of 45 $\mu g/m^3$ at Junk Bay's station[4] were incorporated into the assessment to account for cumulative impacts. This station was selected for its remoteness and would indicate the background concentration level without the contributions from heavy traffic.

6.17 The following worst-case meteorological conditions were assumed:

Wind speed	1 m/s
Wind direction	(worst case for individual receiver)
Stability Class	D

6.18 The CALINE4 model domain of 12 x 15 grid covers the study area with grid spacing of 100 m.

Assessment Results

6.19 Peak-hour average pollution contours (including background NO_2 and RSP concentrations) at the pedestrian level are shown in Figures 6.1 and 6.2. The predicted maximum hourly NO_2 and RSP concentrations with background concentrations included at the representative ASRs are shown in Table 6.4.

[4] *Environment Hong Kong 1993* (1993), Environmental Protection Department.

Table 6.4
Predicted NO_2 and RSP Concentrations in Year 2011

ASR	Floor	Hourly NO_2 Concentration ($\mu g/m^3$)* (AQO: 300 g/m^3)	Hourly RSP Concentration ($\mu g/m^3$)* (No 1 hr AQO)
1	G/F	179	97
2	G/F	205	106
2	1/F	202	10
3	G/F	130	81
4	G/F	183	98
4	1/F	183	98
5	G/F	153	88
6	G/F	153	88
6	1/F	149	87
6	2/F	149	86
7	G/F	262	123
7	1/F	254	120
7	5/F	198	101
8	1/F	183	98
8	10/F	85	65
8	20/F	44	51
9	1/F	187	99
9	10/F	85	64
9	20/F	40	50
10	1/F	190	99
10	10/F	78	63
10	20/F	44	50
11	1/F	175	94
11	10/F	74	62
11	20/F	40	50
12	1/F	149	85
12	10/F	81	63
12	20/F	40	51
13	1/F	134	81
13	10/F	78	62
13	20/F	40	51
14	G/F	213	109
14	1/F	213	108

ASR	Floor	Hourly NO_2 Concentration ($\mu g/m^3$)* (AQO: 300 g/m^3)	Hourly RSP Concentration ($\mu g/m^3$)* (No 1 hr AQO)
15	G/F	281	131
15	1/F	281	131
15	2/F	277	129
16	G/F	258	124
16	1/F	266	126
17	G/F	190	100
17	1/F	187	99
17	2/F	187	98
18	G/F	239	117
18	1/F	235	116
19	G/F	194	102
19	1/F	187	101
20	G/F	175	96
21	G/F	115	75
22	G/F	81	64
22	1/F	77	63
22	2/F	77	63
23	G/F	77	62
23	1/F	74	62
23	2/F	74	61
24	G/F	175	96
25	G.F	149	87
26	G/F	81	64
26	1/F	81	64
27	G/F	111	74
27	1/F	111	74
28	G/F	115	75
29	G/F	100	70
29	1/F	100	69
29	2/F	96	68
30	G/F	111	74
30	1/F	111	74
30	2/F	107	73
31	G/F	74	62
31	1/F	74	62

ASR	Floor	Hourly NO_2 Concentration ($\mu g/m^3$)* (AQO: 300 g/m^3)	Hourly RSP Concentration ($\mu g/m^3$)* (No 1 hr AQO)
32	G/F	149	87
32	1/F	145	86
32	2/F	142	85
33	1/F	107	72
33	10/F	70	60
34	1/F	119	77
34	10/F	74	61

* background NO_2 concentration of 25 $\mu g/m^3$ is included.
** background RSP concentration of 45 $\mu g/m^3$ is included.

6.20 The modelling results show that the maximum hourly concentrations of NO_2 at all of the representative ASRs are within the 1-hour AQO. There is no 1-hour AQO for RSP concentration against which the modelling results shown in Table 6.4 can be compared. However, the modelling results show that the worst case situation under peak hour traffic conditions result in RSP concentrations which all comply with the 24-hour AQO. Thus it can be inferred that the 24-hour averaged RSP concentrations would also meet the 24-hour criteria as the peak hour results would be averaged with non-peak hour RSP concentrations.

6.21 As shown in Figures 6.1 and 6.2, the pollutant concentrations near Castle Peak Road and Route 3 CPS are the highest because of the high volume of traffic. It should be noted that for the sensitive receivers near Castle Peak Road, the pollutant concentration due to the Pok Oi Flyover is much lower than that due to Castle Peak Road.

6.22 The most sensitive ASR is the Home for the Aged at Pok Oi Hospital. The maximum hourly pollutant concentrations of NO_2 and RSP at G/F and 1/F are within the AQOs.

6.23 The proposed residential blocks in CDA 12 and CDA 15 (ASRs 8-13) are located close to Castle Peak Road, Yuen Long Highway and Route 3 CPS. Since the proposed residential blocks are built on a podium of about 15 metres high, the traffic emission impact has been reduced. The results in Table 6.4 show that the air quality is better on the upper floors as the traffic emission impact decreases when the vertical distance from the road increases.

6.24 The main source of vehicular emission impacts for ASRs south of Castle Peak Road is from Yuen Long Highway. The modelling results suggest that the traffic emission impact from Yuen Long Highway is within the acceptable level.

Barrier Effect

6.25 The configurations of the proposed noise barriers have been presented in Section 5. Noise barriers with heights varying from 0.8 m to 3.5 m are proposed for different sections of the Highway. The air quality associated with the 'barrier effect', ie. the presence of noise barriers, was assessed using the latest 2011 traffic flows and assuming that the road segments with the noise barrier are elevated roads which have the same level as the barriers.

6.26 The modelling results of the relevant ASRs including the effect from the proposed barriers are shown in Table 6.5.

Table 6.5
Comparison of Predicted NO_2 and RSP Concentrations in Year 2011 with and without Barrier Effect

ASR	Floor	NO_2 ($\mu g/m^3$)			RSP ($\mu g/m^3$)		
		without barrier effect	with barrier effect	% difference	without barrier effect	with barrier effect	% difference
1	G/F	179	179	0	97	96	-1
2	G/F	205	205	0	106	105	-1
2	1/F	202	198	-2	105	103	-1
3	G/F	130	130	0	81	80	0
4	G/F	183	183	0	98	97	-1
4	1/F	183	179	-2	98	97	-1
5	G/F	153	149	-2	88	87	0
6	G/F	153	152	0	88	87	0
6	1/F	153	153	0	87	87	0
6	2/F	149	149	0	86	86	0
7	G/F	262	262	0	123	123	0
7	1/F	254	254	0	120	120	0
7	5/F	198	198	0	101	101	0
8	1/F	183	186	2	98	99	1

ASR	Floor	NO_2 ($\mu g/m^3$)			RSP ($\mu g/m^3$)		
		without barrier effect	with barrier effect	% difference	without barrier effect	with barrier effect	% difference
8	10/F	85	89	5	65	66	2
8	20/F	44	44	0	51	51	0
9	1/F	187	190	2	99	100	1
9	10/F	85	85	0	64	65	1
9	20/F	40	44	10	50	50	0
10	1/F	190	198	4	99	101	2
10	10/F	78	81	4	63	64	2
10	20/F	44	44	0	50	50	0
11	1/F	175	187	7	94	98	4
11	10/F	74	78	5	62	63	2
11	20/F	40	40	0	50	50	0
12	1/F	149	153	3	85	86	1
12	10/F	81	85	5	63	64	2
12	20/F	40	40	0	51	51	0
13	1/F	134	138	3	81	81	0
13	10/F	78	81	4	62	62	0
13	20/F	40	44	10	51	51	0
14	G/F	213	213	0	109	109	0
14	1/F	213	213	0	108	108	0
15	G/F	281	276	-2	131	131	0
15	1/F	281	276	-2	131	130	0
15	2/F	277	273	-2	129	128	0
16	G/F	258	258	0	124	124	0
16	1/F	266	266	0	126	126	0
17	G/F	190	190	0	100	100	0
17	1/F	187	186	0	99	99	0
17	2/F	187	187	0	98	98	0
18	G/F	239	231	-3	117	115	-2
18	1/F	235	228	-4	116	114	-2
19	G/F	194	190	-2	102	100	-1
19	1/F	187	186	0	101	100	0
33	1/F	107	111	4	72	73	1
33	10/F	70	74	6	60	61	2
34	1/F	119	123	3	77	78	1
34	10/F	74	78	5	61	62	2

6.27 It is not expected that the barrier effect will be significant. The predicted NO_2 and RSP concentration levels associated with the noise barriers are well below the AQOs.

Pedestrian/Vehicle Underpasses

6.28 The users of the two pedestrian underpasses and one combined vehicular/pedestrian underpass are unlikely to be subjected to prolonged unacceptable air quality due to the traffic on the Highway. Under normal circumstances, users will not stay inside the underpasses for longer than five minutes.

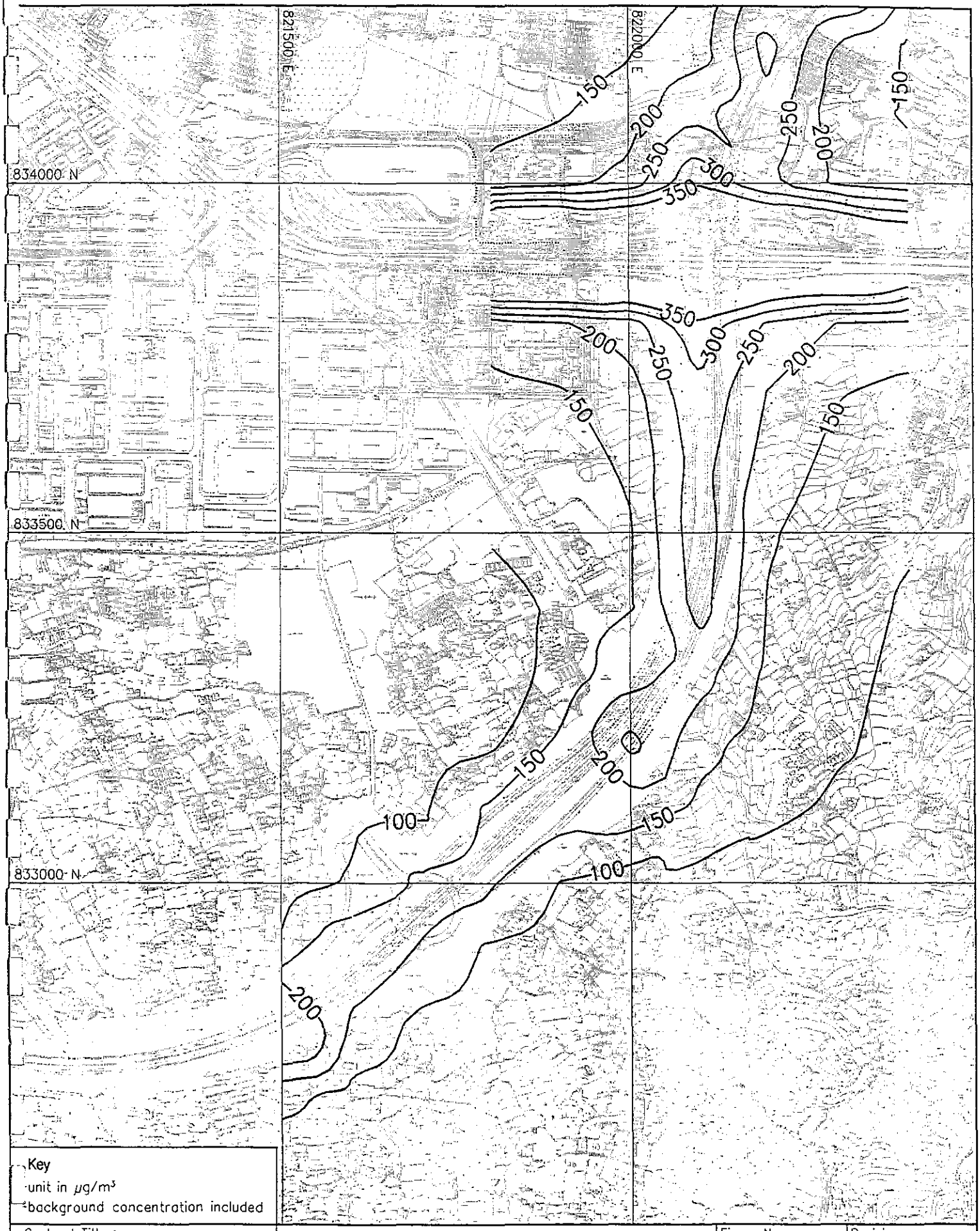
Cumulative Impact Assessment

6.29 The cumulative level of RSP in the Study Area is mainly generated from the traffic and has been assessed to be below the AQOs. The cumulative level of SO_2 is mainly generated from industrial chimneys and is below the AQOs. The major contribution to the cumulative NO_2 level is from traffic and it is expected that there will be no exceedance of the AQOs in the year 2011.

Summary

6.30 Air quality impacts of pollutant emissions from traffic on the flyover and Route 3 CPS were initially addressed in the R3DEIA. As discussed in earlier, the R3DEIA found that construction of the recommended noise barriers, including the proposed 3 m barriers on the flyover, appeared to have a beneficial impact in terms of the dispersal of vehicle emissions.

6.31 This assessment of the air quality impact for peak hour traffic levels in the year 2011 indicates the main source of air pollutants within the Study Area will be Castle Peak Road, which carries a particularly high volume of traffic. Traffic emissions from Pok Oi Flyover and the Highway itself will be within the AQOs and no mitigation measures are required.

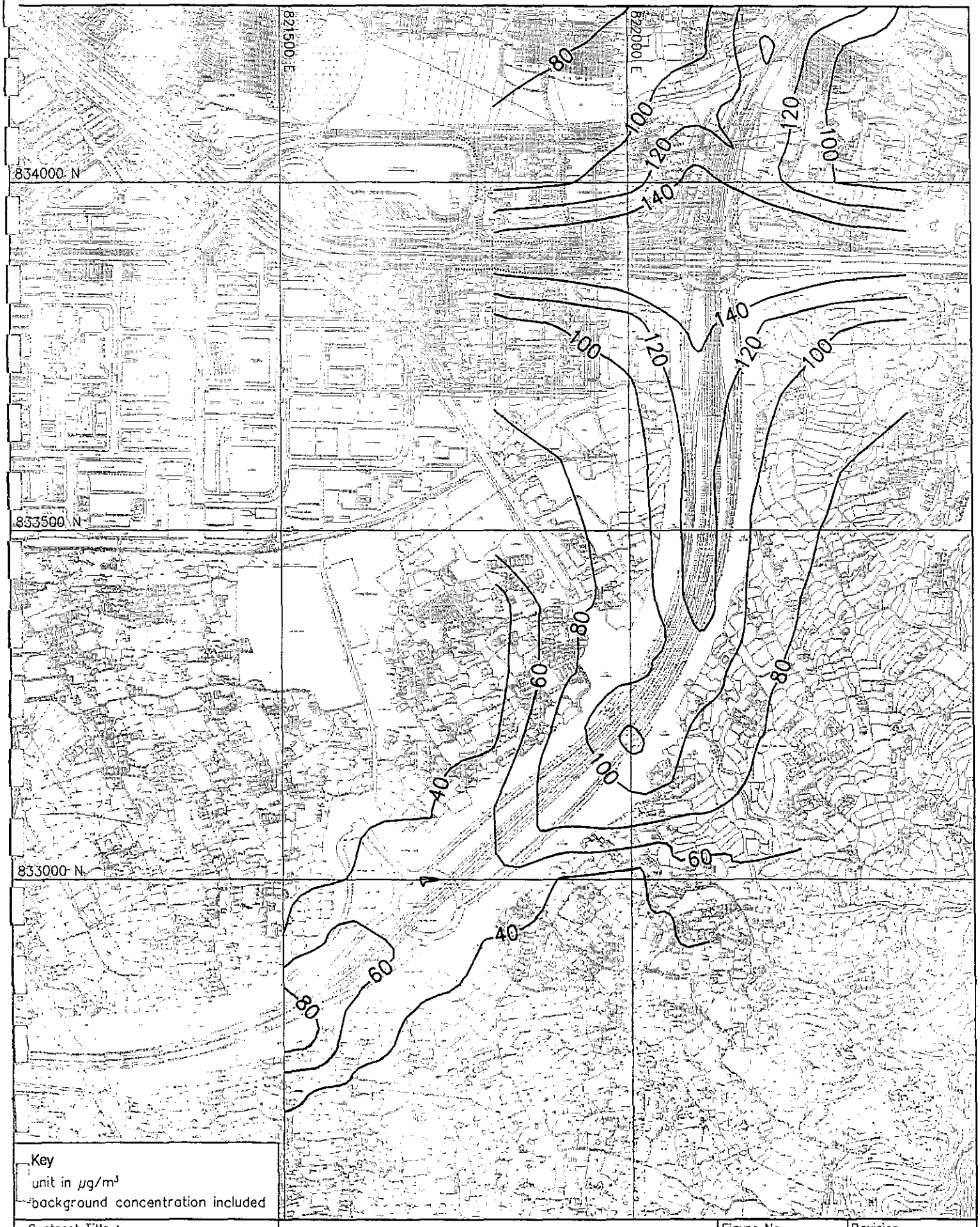


Contract Title :
HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER AND REMAINING WORKS

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

Title :
TRAFFIC EMISSION –
MAXIMUM NO_2 CONCENTRATIONS AT PEDESTRIAN LEVEL (1.5m above ground)
HOURLY AVERAGE
IN YEAR 2011

Figure No.	Revision
6.1	0
Reference	File Name
	00090088.B04
Prepared	Checked
WKY	YWL
Date	Scale
APR. 97	N.T.S.



Key
unit in $\mu g/m^3$
background concentration included

Contract Title :
HIGHWAY BETWEEN SHAP PAT HEUNG INTERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER AND REMAINING WORKS

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

Title :
TRAFFIC EMISSION –
MAXIMUM RSP CONCENTRATIONS AT
PEDESTRIAN LEVEL (1.5m above ground)
HOURLY AVERAGE
IN YEAR 2011

Figure No.	Revision
6.2	0
Reference	File Name
	00100088.B04
Prepared	Checked
WKY	YWL
Date	Scale
APR. 97	N.T.S.

7 CONSTRUCTION IMPACTS

Introduction

7.1 This section provides a general overview of potential construction impacts arising from the Project, together with various practical methods to mitigate the effects of those impacts.

7.2 The main construction activities will include: formation and capping of the road embankments using fill material; slope and drainage works; piling for the flyover piers and casting of the pilecaps, columns, column heads and concrete deck and/or installation of pre-cast deck segments; construction of the sub-base and road pavement; installation of noise barriers; landscaping works.

7.3 It should be noted that site preparation works, including construction of the peripheral channel, the removal and replacement of unsuitable materials, has already been undertaken under the Yuen Long Highway Stage 1 construction contract. Apart from stripping of vegetation and associated topsoil, no other earth removing works will be necessary prior to further filling for the formation of the trunk road embankments.

Construction Noise

Noise sources

7.4 Noise generation is likely to affect sensitive receivers both immediately adjacent to the construction site and along access roads to the site.

7.5 Temporary noise impacts during construction will be associated with piling, the use of powered mechanical equipment and the movement of construction vehicles.

7.6 Initial site investigations during the feasibility study report phase indicate that depth to rock in the vicinity of Pok Oi Interchange is over 80 m, consequently driven steel H piles may be used during construction of the flyover piers. Although the site is close to the Pok Oi Hospital, the existing bridges at the Pok Oi Interchange were constructed on driven steel H-piles which were driven to depths of 26-59 m below the base of the pile caps. Alternatively, friction piles may be used if the soil conditions are appropriate: this type of pile was used for other existing roundabout structures.

Representative Noise Sensitive Receivers

7.7 The representative NSRs for this assessment are those selected for the operational phase noise assessment in Section 5.

Standards for Construction Noise Assessment

7.8 As detailed in Section 3, there are no statutory criteria for noise from construction work other than percussive piling generated during the daytime hours of 07:00-19:00, Monday-Saturday, excluding public holidays. However, EPD normally recommends 75 dB(A) L_{eq}(30 min) as the acceptable noise level during daytime hours at the facade of residential sensitive receivers and 70 dB(A) at schools (65 dB(A) during examinations).

7.9 Noise restrictions are imposed during the evenings (19:00-23:00), night-time (23:00-07:00) and all day on Sunday and public holidays. For construction activities during these hours, a Construction Noise Permit is required.

7.10 According to the *TM on Construction Works other than Percussive Piling*, the Area Sensitivity Rating of the proposed development area is B. Yuen Long also falls into a Designated Area under the *TM on Construction Works within a Designated Area.* These factors correspond to acceptable noise levels as follows:

General Construction Noise

(i) 65 dB(A) for all days (19:00-23:00) and general holidays including Sundays (07:00-23:00)

(ii) 50 dB(A) for all days (23:00-07:00)

Construction due to Specified Equipment and Processes*

(i) 50 dB(A) for all days (19:00-23:00) and general holidays including Sundays (07:00-23:00)

(ii) 35 dB(A) for all days (23:00-07:00)

* Specified equipment includes: hand held breakers, concrete lorry mixers, dump trucks, concrete vibrators, bulldozers. Specified processes include: erection or dismantling of formwork or scaffolding, loading or unloading of rubble, wooden blocks, steel bars, wood or scaffolding material and hammering.

7.11 The *TM on Noise from Percussive Piling* specifies 85 dB(A) as the acceptable noise level for an NSR with windows or other openings but without a central air conditioning system.

Assessment Methodology

7.12 Construction noise has been calculated using the methodology specified in the *TM on Noise from Construction Work other than Percussive Piling* and the *TM on Noise from Percussive Piling.*

7.13 The construction equipment is assumed to be located at a notional source at the site boundary nearest to the NSR. For the worst case scenario, all the construction equipment is assumed to be operated simultaneously at this one point.

Distance Attenuation

7.14 For general construction noise, the correction for distance attenuation is calculated on the basis of the following formula:

$$SPL = SWL + 20LogD + 8$$

where SPL is the sound pressure level at the receiver
SWL is the total sound power level of the equipments
D is the distance between the noise source and the receiver

7.15 For noise generated from percussive piling, the correction for distance attenuation is based on *Table 4 - Correction Factors to Obtain the Predicted Noise Level from the Total Sound Power Level at Given Distance* found in the *TM on Noise from Percussive Piling.*

Facade Correction

7.16 A 3 dB(A) correction is added for the facade reflection effect of the NSR.

Construction Schedule and Equipment

7.17 The most significant noise impacts during the construction phase will be during the site formation, superstructure construction and pavement and utility installation works. Piling and the superstructure works will be carried out around the existing Pok Oi Roundabout (Pok Oi Flyover), around the vehicle/pedestrian underpass structure no. 9E (Remaining Works) and Shap Pat Heung Interchange (Remaining Works).

7.18 Tables 7.1-7.4 list the powered mechanical equipment likely to be used during the various construction periods and their associated Sound Power Levels (SWL).

Table 7.1
Construction Equipment Schedule: Piling Period

Equipment	No.	Sound Power Level (SWL) dB(A)	Total Sound Power Level (SWL) dB(A)
Percussive Piling Rig	2	116.0	119.0
The Total Sound Power Level (SWL)			**119.0 dB(A)**

Table 7.2
Construction Equipment Schedule: Site Formation Period

Equipment	No.	Sound Power Level (SWL) dB(A)	Total Sound Power Level (SWL) dB(A)
Air compressor (silenced type)	1	100.0	100.0
Excavator (tracked)	1	112.0	112.0
Bulldozer	1	115.0	115.0
Generator (silenced type)	1	100.0	100.0
Water Pump (electric)	1	88.0	88.0
Dumper	1	106.0	106.0
The Combined Total Sound Power Level (SWL)			**117.3 dB(A)**

Table 7.3
Construction Equipment Schedule: Superstructure Period

Equipment	No.	Sound Power Level (SWL) dB(A)	Total Sound Power Level (SWL) dB(A)
Air compressor (silenced type)	1	100.0	100.0
Generator (silenced type)	1	100.0	100.0
Crane Lorry	1	112.0	112.0
Water Pump (electric)	2	88.0	91.0
Concrete Lorry Mixer	1	109.0	109.0
Concrete Pump	1	109.0	109.0
Poker (hand-held)	2	113.0	116.0
Saw (circular, wood)	1	108.0	108.0
The Combined Total Sound Power Level (SWL)			**119.0 dB(A)**

Table 7.4
Construction Equipment Schedule: Pavement & Utility Installation Period

Equipment	No.	Sound Power Level (SWL) dB(A)	Total Sound Power Level (SWL) dB(A)
Air compressor (silenced type)	1	100.0	100.0
Bulldozer	1	115.0	115.0
Dump truck	1	117.0	117.0
Generator (silenced type)	1	100.0	100.0
Crane Lorry	1	112.0	112.0
Concrete Lorry Mixer	1	109.0	109.0
Asphalt Paver	1	109.0	109.0
Vibratory Roller	1	108.0	108.0
Power rammer (petrol)	1	108.0	108.0
The Combined Total Sound Power Level (SWL)			**121.1 dB(A)**

Predicted Noise Level (PNL)

7.19 The predicted noise levels at the identified nearby NSRs are summarised in Tables 7.5-7.8.

Table 7.5a
Predicted Noise Impact: Piling Period (Pok Oi Flyover)

NSR	Total SPL dB(A)	Distance metres	Distance Correction	Facade effect	Predicted noise Level dB(A)
NSR1	119.0 dB(A)	190 m	-58.0 dB(A)	+3 dB(A)	64.0 dB(A)
NSR7	119.0 dB(A)	150 m	-56.0 dB(A)	+3 dB(A)	66.0 dB(A)

Table 7.5b
Predicted Noise Impact: Piling Period (Remaining Works)

NSR	Total SPL dB(A)	Distance metres	Distance Correction	Facade effect	Predicted noise Level dB(A)
Vehicle/pedestrian underpass structure no. 9E					
NSR19	119.0 dB(A)	65 m	-47.5 dB(A)	+3 dB(A)	74.5 dB(A)
NSR20	119.0 dB(A)	90 m	-50.7 dB(A)	+3 dB(A)	71.3 dB(A)
NSR27	119.0 dB(A)	105 m	-52.3 dB(A)	+3 dB(A)	69.7 dB(A)
Structure no. 8A, 8B at Shap Pat Heung Interchange					
NSR21	119.0 dB(A)	135 m	-54.8 dB(A)	+3 dB(A)	67.2 dB(A)
NSR23	119.0 dB(A)	170 m	-57.2 dB(A)	+3 dB(A)	64.8 dB(A)
NSR28	119.0 dB(A)	135 m	-54.8 dB(A)	+3 dB(A)	67.2 dB(A)
NSR29	119.0 dB(A)	160 m	-56.6 dB(A)	+3 dB(A)	65.4 dB(A)

Table 7.6a
Predicted Noise Impact: Site Formation Period (Pok Oi Flyover)

NSR	Total SPL dB(A)	Distance metres	Distance Correction	Facade effect	Predicted noise Level dB(A)
NSR1	117.3 dB(A)	72 m	-45.1 dB(A)	+3 dB(A)	75.2 dB(A)
NSR2	117.3 dB(A)	34 m	-38.6 dB(A)	+3 dB(A)	81.7 dB(A)
NSR3	117.3 dB(A)	52 m	-42.3 dB(A)	+3 dB(A)	78.0 dB(A)
NSR4	117.3 dB(A)	72 m	-45.1 dB(A)	+3 dB(A)	75.2 dB(A)
NSR5	117.3 dB(A)	36 m	-39.1 dB(A)	+3 dB(A)	81.2 dB(A)
NSR6	117.30dB(A)	56 m	-43.0 dB(A)	+3 dB(A)	77.3 dB(A)
NSR7	117.3 dB(A)	140 m	-50.9 dB(A)	+3 dB(A)	69.4 dB(A)

Table 7.6b
Predicted Noise Impact: Site Formation Period (Remaining Works)

NSR	Total SPL dB(A)	Distance metres	Distance Correction	Facade effect	Predicted noise Level dB(A)
NSR18	117.3 B(A)	35 m	-38.9 dB(A)	+3 dB(A)	81.4 dB(A)
NSR19	117.3 dB(A)	58 m	-43.3 dB(A)	+3 dB(A)	77.0 dB(A)
NSR20	117.3 dB(A)	86 m	-46.7 dB(A)	+3 dB(A)	73.6 dB(A)
NSR21	117.3 dB(A)	72 m	-45.1 dB(A)	+3 dB(A)	75.2 dB(A)
NSR22	117.3 dB(A)	145 m	-51.2 dB(A)	+3 dB(A)	69.1 dB(A)
NSR23	117.3 dB(A)	160 m	-52.1 dB(A)	+3 dB(A)	68.2 dB(A)
NSR24	117.3 dB(A)	70 m	-44.9 dB(A)	+3 dB(A)	75.4 dB(A)
NSR25	117.3 dB(A)	140 m	-50.9 dB(A)	+3 dB(A)	69.4 dB(A)
NSR26	117.3 dB(A)	330 m	-58.4 dB(A)	+3 dB(A)	61.9 dB(A)
NSR27	117.3 dB(A)	76 m	-45.6 dB(A)	+3 dB(A)	74.7 dB(A)
NSR28	117.3 dB(A)	70 m	-44.9 dB(A)	+3 dB(A)	75.4 dB(A)
NSR29	117.3 dB(A)	94 m	-47.5 dB(A)	+3 dB(A)	72.8 dB(A)
NSR30	117.3 dB(A)	151 m	-51.6 dB(A)	+3 dB(A)	68.7 dB(A)
NSR31	117.3 dB(A)	325 m	-58.2 dB(A)	+3 dB(A)	62.1 dB(A)

Table 7.7a
Predicted Noise Impact: Superstructure Period (Pok Oi Flyover)

NSR	Total SPL dB(A)	Distance metres	Distance Correction	Facade effect	Predicted noise Level dB(A)
NSR1	119.0 dB(A)	180 m	-53.1 dB(A)	+3 dB(A)	68.9 dB(A)
NSR7	119.0 dB(A)	140 m	-50.9 dB(A)	+3 dB(A)	71.1 dB(A)

Table 7.7b
Predicted Noise Impact: Superstructure Period (Remaining Works)

NSR	Total SPL dB(A)	Distance metres	Distance Correction	Facade effect	Predicted noise Level dB(A)
Vehicle/pedestrian underpass structure no. 9E					
NSR19	119.0 dB(A)	65 m	-44.3 dB(A)	+3 dB(A)	77.7 dB(A)
NSR20	119.0 dB(A)	90 m	-47.1 dB(A)	+3 dB(A)	74.9 dB(A)
NSR27	119.0 dB(A)	105 m	-48.4 dB(A)	+3 dB(A)	73.6 dB(A)
Structure no. 8A, 8B at Shap Pat Heung Interchange					
NSR21	119.0 dB(A)	135 m	-50.6 dB(A)	+3 dB(A)	71.4 dB(A)
NSR23	119.0 dB(A)	170 m	-52.6 dB(A)	+3 dB(A)	69.4 dB(A)
NSR28	119.0 dB(A)	135 m	-50.6 dB(A)	+3 dB(A)	71.4 dB(A)
NSR29	119.0 dB(A)	160 m	-52.1 dB(A)	+3 dB(A)	69.9 dB(A)

Table 7.8a
Predicted Noise Impact: Pavement & Utility Installation Period (Pok Oi Flyover)

NSR	Total SPL dB(A)	Distance metres	Distance Correction	Facade effect	Predicted noise Level dB(A)
NSR1	121.1 dB(A)	72 m	-45.1 dB(A)	+3 dB(A)	79.0 dB(A)
NSR2	121.1 dB(A)	34 m	-38.6 dB(A)	+3 dB(A)	85.5 dB(A)
NSR3	121.1 dB(A)	52 m	-42.3 dB(A)	+3 dB(A)	81.8 dB(A)
NSR4	121.1 dB(A)	72 m	-45.1 dB(A)	+3 dB(A)	79.0 dB(A)
NSR5	121.1 dB(A)	36 m	-39.1 dB(A)	+3 dB(A)	85.0 dB(A)
NSR6	121.1 dB(A)	56 m	-43.0 dB(A)	+3 dB(A)	81.1 dB(A)
NSR7	121.1 dB(A)	140 m	-50.9 dB(A)	+3 dB(A)	73.2 dB(A)

Table 7.8b
Predicted Noise Impact: Pavement & Utility Installation Period (Remaining Works)

NSR	Total SPL dB(A)	Distance metres	Distance Correction	Facade effect	Predicted noise Level dB(A)
NSR18	121.1 dB(A)	35 m	-38.9 dB(A)	+3 dB(A)	85.2 dB(A)
NSR19	121.1 dB(A)	58 m	-43.3 dB(A)	+3 dB(A)	80.8 dB(A)
NSR20	121.1 dB(A)	86 m	-46.7 dB(A)	+3 dB(A)	77.4 dB(A)
NSR21	121.1 dB(A)	72 m	-45.1 dB(A)	+3 dB(A)	79.0 dB(A)
NSR22	121.1 dB(A)	145 m	-51.2 dB(A)	+3 dB(A)	72.9 dB(A)
NSR23	121.1 dB(A)	160 m	-52.1 dB(A)	+3 dB(A)	72.0 dB(A)
NSR24	121.1 dB(A)	70 m	-44.9 dB(A)	+3 dB(A)	79.2 dB(A)
NSR25	121.1 dB(A)	140 m	-50.9 dB(A)	+3 dB(A)	73.2 dB(A)
NSR26	121.1 dB(A)	330 m	-58.4 dB(A)	+3 dB(A)	65.7 dB(A)
NSR27	121.1 dB(A)	76 m	-45.6 dB(A)	+3 dB(A)	78.5 dB(A)
NSR28	121.1 dB(A)	70 m	-44.9 dB(A)	+3 dB(A)	79.2 dB(A)
NSR29	121.1 dB(A)	94 m	-47.5 dB(A)	+3 dB(A)	76.6 dB(A)
NSR30	121.1 dB(A)	151 m	-51.6 dB(A)	+3 dB(A)	72.5 dB(A)
NSR31	121.1 dB(A)	325 m	-58.2 dB(A)	+3 dB(A)	65.9 dB(A)

7.20 As can be seen from the above tables, the noise levels at some of the NSRs during the construction work are predicted to exceed 75 dB(A), depending on the distance from the NSRs to the proposed site boundary.

7.21 However, most of the NSRs exposed to the unacceptable noise levels are 2 storey buildings and are much lower than the proposed flyover and viaduct. Moreover, these NSRs are fully or partially screened by the existing Yuen Long Southern Bypass embankment. It is assumed the screening effect of the embankment will reduce the noise impacts at the NSRs by 5 dB(A).

7.22 In view of the proximity of many NSRs to the site boundary, it is recommended that the Contractor implements the noise mitigation measures listed below. It is assumed the use of these measures will reduce the noise impacts at the NSRs by a further 6 dB(A).

7.23 The construction noise impacts have been re-calculated in Tables 7.9 - 7.10 for the NSRs predicted to exceed the 75 dB(A) criterion. The calculation takes into account the shielding effect of the existing road embankment and the noise mitigation measures to be employed by the Contractor. The results show that implementation of the recommended measures will reduce construction noise impacts at nearby NSRs to within acceptable levels.

Table 7.9
Predicted Noise Impact with Mitigation Measures (Pok Oi Flyover)

NSR	Predicted Noise Level dB(A)	Mitigation Measures Correction dB(A)	Acceptable Noise Level (ANL) dB(A)	Mitigated Noise Levels dB(A)
Site Formation Period				
NSR1	75.2 dB(A)	11.0 dB(A)	75.0 dB(A)	64.2 dB(A)
NSR2	81.7 dB(A)	11.0 dB(A)	75.0 dB(A)	70.7 dB(A)
NSR3	78.0 dB(A)	11.0 dB(A)	75.0 dB(A)	67.0 dB(A)
NSR4	75.2 dB(A)	11.0 dB(A)	75.0 dB(A)	64.2 dB(A)
NSR5	81.2 dB(A)	11.0 dB(A)	75.0 dB(A)	70.2 dB(A)
NSR6	77.3 dB(A)	11.0 dB(A)	75.0 dB(A)	66.3 dB(A)
Pavement & Utility Installation Period				
NSR1	79.0 dB(A)	11.0 dB(A)	75.0 dB(A)	68.0 dB(A)
NSR2	85.5 dB(A)	11.0 dB(A)	75.0 dB(A)	74.5 dB(A)
NSR3	81.8 dB(A)	11.0 dB(A)	75.0 dB(A)	70.8 dB(A)
NSR4	79.0 dB(A)	11.0 dB(A)	75.0 dB(A)	68.0 dB(A)
NSR5	85.0 dB(A)	11.0 dB(A)	75.0 dB(A)	74.0 dB(A)
NSR6	81.1 dB(A)	11.0 dB(A)	75.0 dB(A)	70.1 dB(A)

Table 7.10
Predicted Noise Impact with Mitigation Measures (Remaining Works)

NSR	Predicted Noise Level dB(A)	Mitigation Measures Correction dB(A)	Acceptable Noise Level (ANL) dB(A)	Mitigated Noise Levels dB(A)
Site Formation Period				
NSR18	81.4 dB(A)	11.0 dB(A)	75.0 dB(A)	70.4 dB(A)
NSR19	77.0 dB(A)	11.0 dB(A)	75.0 dB(A)	66.0 dB(A)
NSR21	75.2 dB(A)	11.0 dB(A)	75.0 dB(A)	64.2 dB(A)
NSR24	75.4 dB(A)	11.0 dB(A)	75.0 dB(A)	64.4 dB(A)
NSR28	75.4 dB(A)	11.0 dB(A)	75.0 dB(A)	64.4 dB(A)
Superstructure Period (vehicle/pedestrian underpass structure no. 9E)				
NSR19	77.7 dB(A)	11.0 dB(A)	75.0 dB(A)	66.7 dB(A)
Pavement & Utility Installation Period				
NSR18	85.2 dB(A)	11.0 dB(A)	75.0 dB(A)	74.2 dB(A)
NSR19	80.8 dB(A)	11.0 dB(A)	75.0 dB(A)	69.8 dB(A)
NSR20	77.4 dB(A)	11.0 dB(A)	75.0 dB(A)	66.4 dB(A)
NSR21	79.0 dB(A)	11.0 dB(A)	75.0 dB(A)	68.0 dB(A)
NSR24	79.2 dB(A)	11.0 dB(A)	75.0 dB(A)	68.2 dB(A)
NSR27	78.5 dB(A)	11.0 dB(A)	75.0 dB(A)	67.5 dB(A)
NSR28	79.2 dB(A)	11.0 dB(A)	75.0 dB(A)	68.2 dB(A)
NSR29	76.6 dB(A)	11.0 dB(A)	75.0 dB(A)	65.6 dB(A)

Concurrent Project

7.24 The construction of the Pok Oi Flyover may be concurrent with construction of the remaining part of the Route 3 CPS, adjacent to Pok Oi Interchange. NSR 7 would be most affected by this concurrent project. Construction noise is, however, expected to be within acceptable levels if the recommended mitigation measures are implemented.

Recommended Mitigation Measures

7.25 The following construction noise mitigation measures should be implemented during the projects:

(i) selection of silenced equipment, such as compressors and generators;

(ii) ensuring that vehicles and plant are properly maintained, especially in relation to exhaust systems;

(iii) siting of noisy equipment, such as compressors and generators, as far away from sensitive receivers as possible and turning off noisy equipment when not currently in use;

(iv) careful supervision and non-concurrent scheduling of work;

(v) use of temporary acoustic barriers and acoustic machinery enclosures near particularly sensitive receivers.

7.26 Wherever possible, construction activities and vehicle movements to and from the site should be limited to normal working hours (07:00-19:00) during weekdays (excluding Sundays and Public Holidays).

Air Quality

7.27 As stated in Section 3, Yuen Long is located in the Deep Bay Airshed, which is geographically confined and has a limited capacity for dust dispersion potential.

7.28 Dust, measurable as TSP (Total Suspended Particulates) and RSP (Respirable Suspended Particulates), will be generated as the result of construction activities.

Dust Generation Scenarios

7.29 The worst case scenario for construction dust generation is likely to include the following activities happening concurrently: movement of vehicles on unpaved roads and haul routes; the transport, unloading and compaction of fill material; wind erosion of exposed areas. Movement of vehicles on haul roads is usually the greatest single source of construction dust.

7.30 Mud carried off site on construction plant and site vehicles and deposited on public roads can increase the area affected by dust generation by drying out and causing regular traffic to produce a dust nuisance to nearby sensitive receivers.

7.31 The project will be implemented in two phases. The most significant air quality impacts will occur during:

(i) Scenario I: site clearance, the importation and placement of fill for embankment formation for Pok Oi Flyover (July 1997-September 1998);

(ii) Scenario II: site clearance, the importation and placement of fill for embankment formation for the Remaining Works (May 1999-April 2001).

7.32 The two construction scenarios will take place consecutively. Other engineering infrastructure such as construction of the flyover spans, drainage works and installation of noise barriers, traffic aids and utilities will have relatively minor impacts compared with Scenario I and Scenario II.

7.33 The final levels for the proposed roads have been determined from the latest engineering study. Using this information, the quantity of fill materials required for the proposed roads has been calculated. Some 120,000 m^3 of fill material will need to be imported to the Site in order to form the embankments for the Pok Oi Flyover. An additional 180,000 m^3 of fill material will be required for the Remaining Works. The total surface area of the embankments is around 2 ha; the total length of the proposed road network is around 1.5 km.

Assessment Methodology

Fugitive Dust Model

7.34 The Fugitive Dust Model (FDM) which is approved by United States Environmental Protection Agency (USEPA) and Hong Kong's Environmental Protection Department (EPD) was used to assess the impact of the site formation dust emissions on the surrounding area. A detailed description of the model is given by the User's Guide[1]. Briefly, FDM (which is an atmospheric dispersion model) is specifically designed for the analysis of fugitive dust sources. The model is based on the widely used Gaussian Plume formulation for estimating pollutant concentrations, but has been adapted to incorporate a gradient-transfer deposition algorithm which accounts for the settling out of dust particles, and includes the wind dependence factor on the dust emission rates.

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

7.35 During the air quality assessment, the potential TSP and RSP impacts were evaluated. The assessment was based on the 1994 sequential meteorological data collected at the Lau Fau Shan Station containing the hourly wind direction, wind speed, stability and temperature. The surface roughness factor was 10.0 cm. The Study Area was treated as one domain which fully covered the impacts on the nearby sensitive receivers in relation to the two scenarios for dust assessment. The domain of 12 x 15 grid had a grid spacing of 100 m. The default particle distribution in FDM was used. The fraction in each of 0-2.5, 2.5-5, 5-10,10-15 and greater than 15 μm is 0.0262, 0.0678, 0.1704, 0.1536 and 0.5820 respectively. An average dust density of 2.5 g/cm^3 was assumed.

Dust Sources

7.36 Construction dust sources have been identified above as:

(i) loading and unloading of materials;
(ii) movement of vehicles on unpaved roads and haul routes;
(iii) wind erosion of exposed areas.

Pok Oi Flyover

7.37 Construction of the Pok Oi Flyover will involve foundation works, formation of the approach embankments, construction and surfacing of the flyover and access roads, installation of the noise barriers and drainage, streetlighting, traffic aids, utilities and landscaping.

7.38 The dust associated with construction activities is likely to include that generated from top soil removal, travel over unpaved roads, loading and unloading of materials and wind erosion of exposed areas. Percussive piling will be required to provide foundations for the flyover. No blasting or concrete batching plant will be needed.

7.39 Apart from stripped vegetation and associated topsoil, no other unsuitable material is expected to be excavated during the formation of the road embankments. Although the estimated volume of fill material to be imported is about 120,000 m^3, the area over which it will be unloaded and worked is relatively small. In addition, most of these materials will be special fill and capping layer materials used for approach ramps and backfilling of abutments rather than normal soft fill used in embankments.

7.40 Levelling, compacting and resurfacing of roads will not involve significant movement of materials; hence dust impacts will be insignificant. The impact of dust emission will be short term and relatively minor.

7.41 The narrow nature of the site makes gives rise to well defined movement corridors ideally suited to frequent watering. Provided that regular watering is carried out, it is anticipated that dust impacts to nearby sensitive receivers will not be significant and the AQOs can thus be maintained throughout the duration of the project.

Remaining Works

7.42 The '*worst case scenario*' for the Pok Oi Flyover and Remaining Works projects, which is the scenario modelled using FDM in this assessment, would be topsoil removal, loading and unloading of some 180,000 m^3 of fill material, movement of trucks on unpaved roads and wind erosion taking place concurrently along the entire length of the exposed area (some 1,100 m) for the Remaining Works, ie. Scenario II. Based on the proposed engineering practices, the stockpiling of materials will not be required as fill will be unloaded at the location at which it is required. The most likely haul routes for the movement of material were assumed to occur along the alignment of the proposed roads for the Remaining Works.

7.43 Vehicle roundtrip calculations were based on a 9 hour working day, 26 days per month. The capacity of the trucks was assumed to be 6 m^3. Particulate emission rates for the identified potential dust sources were determined according to the USEPA publication *Compilation of Air Pollution Emission Factors (AP42).* Dust emission factors were calculated using the latest equations in the draft 5th Edition of USEPA AP42 (1995).

7.44 The equations used for the calculation of emission rates for each dust source are shown in Appendix B. The parameters used for the calculation of emission rates and the emission rates for the worst-case scenarios are summarised in Appendix C.

Model Results

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

7.46 Table 7.11 shows the maximum 1 hour and 24 hour average TSP and RSP concentrations at the sensitive receivers with and without adoption of dust suppression measures. With no mitigation, all sensitive receivers are subject to excessive dust concentration levels.

Table 7.11
Predicted Maximum Hourly and Daily Particulate Concentrations ($\mu g/m^3$)
- Scenario II

ASR	Without Mitigation			With 95% Reduction of Dust Emission from Haul Roads		
	TSP		RSP	TSP		RSP
	Hourly	Daily	Daily	Hourly	Daily	Daily
1	3942	764	366	341	181	104
2	4944	995	470	391	193	109
5	4377	1058	499	363	196	111
6	2410	1106	520	267	198	112
7	1802	443	222	234	165	97
9	561	278	148	171	157	93
13	523	273	145	169	156	93
18	4380	1368	638	362	211	117
21	3564	1054	497	322	195	110
25	4324	1026	484	368	194	110
28	2424	1149	539	264	200	112
30	2612	953	451	274	191	108
34	523	266	142	169	156	93

Note: Background dust concentrations have been included.

7.47 Dust due to truck movements on unpaved roads on the site constitutes the greatest source of construction dust; emission rates associated with unpaved roads can account for 95% of the total dust emission rates. Other dust sources including loading and unloading, stockpiling, wind erosion and top soil removal are relatively minor. The unmitigated cumulative hourly impacts including all the dust sources plus the background dust level shows that the predicted concentration levels at all of the representative sensitive receivers will exceed the AQOs.

7.48 Figures 7.1, 7.2 and 7.3 illustrate the unmitigated dust isopleths on the Study Area at pedestrian level. ASRs 2, 5, 18 and 25 register the highest dust levels due to the dominant westerly wind direction in this area (see Table 7.11).

7.49 Haul road traffic generates the most dust. It has been shown that watering twice a day can reduce the haul road emission rate by half, thereby lowering the overall dust level concentration from a site by as much as 50%[2]. It is our experience from other similar sites on Hong Kong when undertaking the Environmental Monitoring and Auditing Phase[3] that higher mitigation levels can be achieved if watering is undertaken regularly and frequently.

7.50 To ensure full compliance with the AQOs and to make allowance for concurrent works, particularly during very dry days or worst dust situations, it is recommended that watering of the entire length of all haul roads should be conducted every one hour. Fiscal incentives will be used to ensure that working and backup bowsers will be maintained on site at all times throughout the working day. Reducing dust emissions from the haul roads by 95% by this means is achievable; the results in Table 7.11 and Figures 7.4, 7.5 and 7.6 demonstrate that the AQOs can be met at all sensitive receivers.

Other air pollutants

7.51 Pollutants such as sulphur dioxide, nitrogen oxides and fine particulates may arise from the exhaust emissions of diesel powered vehicles and mechanical plant within the works site. As the number of construction vehicles will be relatively small, the air pollutants associated with vehicle emissions will be insignificant.

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

3 *Environmental Project Office (ENPO), West Kowloon Project Office* (1995-1997), Binnie Consultants Limited for Environment Protection Department.

Recommended Mitigation Measures

7.52 If the following good construction practices are undertaken on site, the impact of dust and other air pollutants will be minimised:

(i) any unpaved areas including haul roads, construction areas and stockpiled spoil should be regularly and frequently watered by fixed and/or mobile spray systems. Watering of the haul road not less than once every hour during the working day may be required under dry or windy conditions: watering and cleaning of paved roads within and adjacent to the site needs to be carried out more frequently;

(ii) where possible, storage and handling areas should be located on hard standing to facilitate cleaning and minimise dust generation;

(iii) screens should be erected in tipping areas to minimise dust emissions;

(iv) stockpiles of sand, aggregate or other dusty materials greater than 20 m^3 should be enclosed on three sides with walls extending above and beyond the pile and, where possible, stockpiles should be stored in sheltered areas;

(v) the speed of vehicles running over any unpaved areas should be restricted to an appropriate level;

(vi) all vehicles entering and leaving the site should have their loads covered;

(vii) wheel washing facilities should be provided at site exits and all vehicles leaving the site should pass through the wheel wash. The wheel wash should be cleaned regularly to remove sediment. A hard surfaced road should be provided between the wheel wash and the public. Mud or similar material deposited on public roads near the site should be removed immediately;

(viii) all construction plant travelling to and from the site should be routed - as far as possible - to avoid sensitive receivers in the area;

(ix) plant and vehicles should be regularly inspected to ensure that they are operating efficiently and that exhaust emissions are not causing a nuisance. Exhaust systems on site dump trucks should be routed vertically behind the cab or away from the ground.

Water Quality

7.53 As mentioned in Section 3, the site is located in the Deep Bay Water Control Zone, which has considerable water quality problems. All unsuitable material has already been removed from the Site under an earlier contract. However, the remaining construction works could result in adverse impact on the local surface water system unless appropriate measures are taken.

7.54 Potential impacts on water quality from construction activities would result from uncontrolled construction site runoff and drainage, or direct discharge of sewage, oil or other contaminants, to the local drainage system.

Surface water runoff

7.55 Excavated spoil and general waste arisings may be temporarily stockpiled which, along with the storage of cement, fuels and other materials on site, could result in erosion during periods of rainfall and contaminated runoff from the site.

Construction work force

7.56 The construction work force will require some on-site provisions, including canteen and sanitary facilities. This will generate 'domestic' and sewage waste which should be taken away for treatment and/or disposal elsewhere.

Recommended Mitigation Measures

7.57 Good site management practice should ensure that construction impacts on water quality are kept to a minimum. Advice on the handling and disposal of construction site discharges is provided in the ProPECC Paper (PN 1/94) on *Construction Site Drainage*.

7.58 Prevention of surface water contamination during construction involves two basic elements:

(i) minimising the quantity of water which might become contaminated by high levels of suspended solids (silt) off exposed and disturbed ground surfaces;

(ii) collection and treatment of potentially contaminated water to appropriate standards.

7.59 The potential for erosion and sedimentation can be limited by the following means:

(i) where possible, surface excavation work should be scheduled for the dry season. Areas of excavation should be minimised and exposed surfaces stabilised appropriately by covering with aggregate, hydroseeding, etc;

(ii) boundaries of earthworks should be protected by temporary drainage;

(iii) local temporary grading of the ground surface during construction should direct site runoff towards regularly cleaned and maintained silt traps and oil/grease separators to minimise the risk of contamination of surface water courses. The silt and oil/grease traps should be appropriately designed for the local drainage and ground conditions.

7.60 To minimise the risk of contamination from oil, diesel and solvents:

(i) compounds in the works area should be designed to take account of contaminated surface water. Oil and fuel bunkers, which should be locked and sited on sealed areas, should be enclosed by bunds capable of holding 110% of the bunker capacity in order to prevent discharges due to accidental spillages or breaching of tanks;

(ii) layers of sawdust or equivalent material should be laid underneath or around any construction plant or equipment that leaks oil. The polluted clean up materials should be replaced with fresh material on a regular basis. Any polluted materials should be disposed of in an acceptable manner.

7.61 To eliminate the risk of pollution from sewage;

(i) all personnel on site should be required to use proper sanitary facilities, eg. temporary chemical toilets;

(ii) all polluted water should be treated to relevant standards. in compliance with the TM on *Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* prior to discharge to the public foul sewerage system.

Solid Waste

Sources

7.62 The main source of solid waste arisings during construction are likely to be damaged used and surplus construction materials and some 'municipal' type waste, eg. cardboard and plastic packaging.

Mitigation

7.63 Provided that there is strict control of wastes from construction works and that arisings are stored, transported and disposed of using approved methods, significant adverse environmental impacts can be avoided.

7.64 'Municipal' type waste should be collected in black refuse sacks and delivered to, and disposed of at, an approved landfill.

7.65 Used lubricants and waste oil should be collected and stored in suitable, fully labelled containers. These containers should be stored in a designated secure place. If the chemicals cannot be reused, they should be treated as chemical waste.

7.66 Dry concrete waste should be sorted out from other waste and recycled for reuse or sorted for disposal at the public dump.

7.67 Wood should be reused and recycled wherever possible. Burning of wood or any other construction waste on site is prohibited by law.

7.68 Sewage from the site toilets, washing facilities and any temporary canteen should be treated and disposed of appropriately to Government standards.

7.69 Mitigation measures associated with the importation and handling of fill material are outlined above under the air quality section.

Traffic

7.70 Some disruption of traffic movements on the existing road network will be inevitable during construction of the Project.

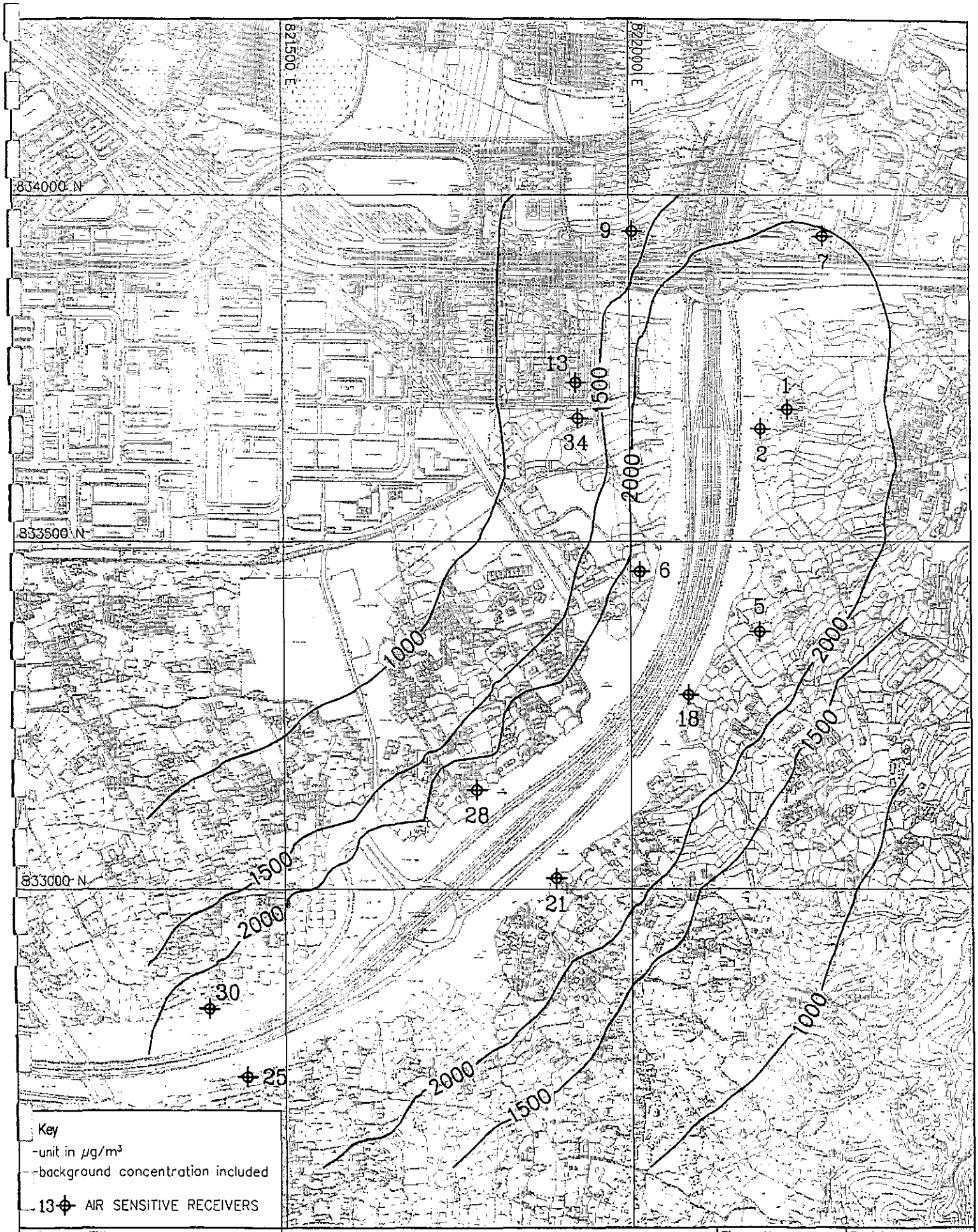
Mitigation

7.71 Traffic disruption can be minimised by the implementation of effective traffic management systems and, in particular, the use of pre-cast beams for deck construction.

Environmental Monitoring and Audit

7.72 It is inevitable that construction of the Pok Oi Flyover and Remaining Works will impact on the existing environment. Where potential adverse impacts from the construction and operation of the Project have been identified in the EIA, a series of mitigation measures have ben set out to prevent these impacts, or at least to reduce them to an acceptable level. Most of these mitigation measures are what may be termed 'good construction practice'.

7.73 An Environmental Monitoring & Audit Manual has been developed as part of the EIA Report to ensure that good construction practice and monitoring of construction noise, dust and runoff quality is carried out systematically.



Key
- unit in $\mu g/m^3$
- background concentration included

13 ⊕ AIR SENSITIVE RECEIVERS

Contract Title :
HIGHWAY BETWEEN SHAP PAT HEUNG INERCHANGE AND POK OI INTERCHANGE - POK OI FLYOVER AND REMAINING WORKS

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

Title :
SCENARIO 2 –
MAXIMUM TSP CONCENTRATIONS AT PEDESTRIAN LEVEL (1.5m above ground)
HOURLY AVERAGE
(COMPLETELY UNMITIGATED)

Figure No.	Revision
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Reference	File Name
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Prepared	Checked
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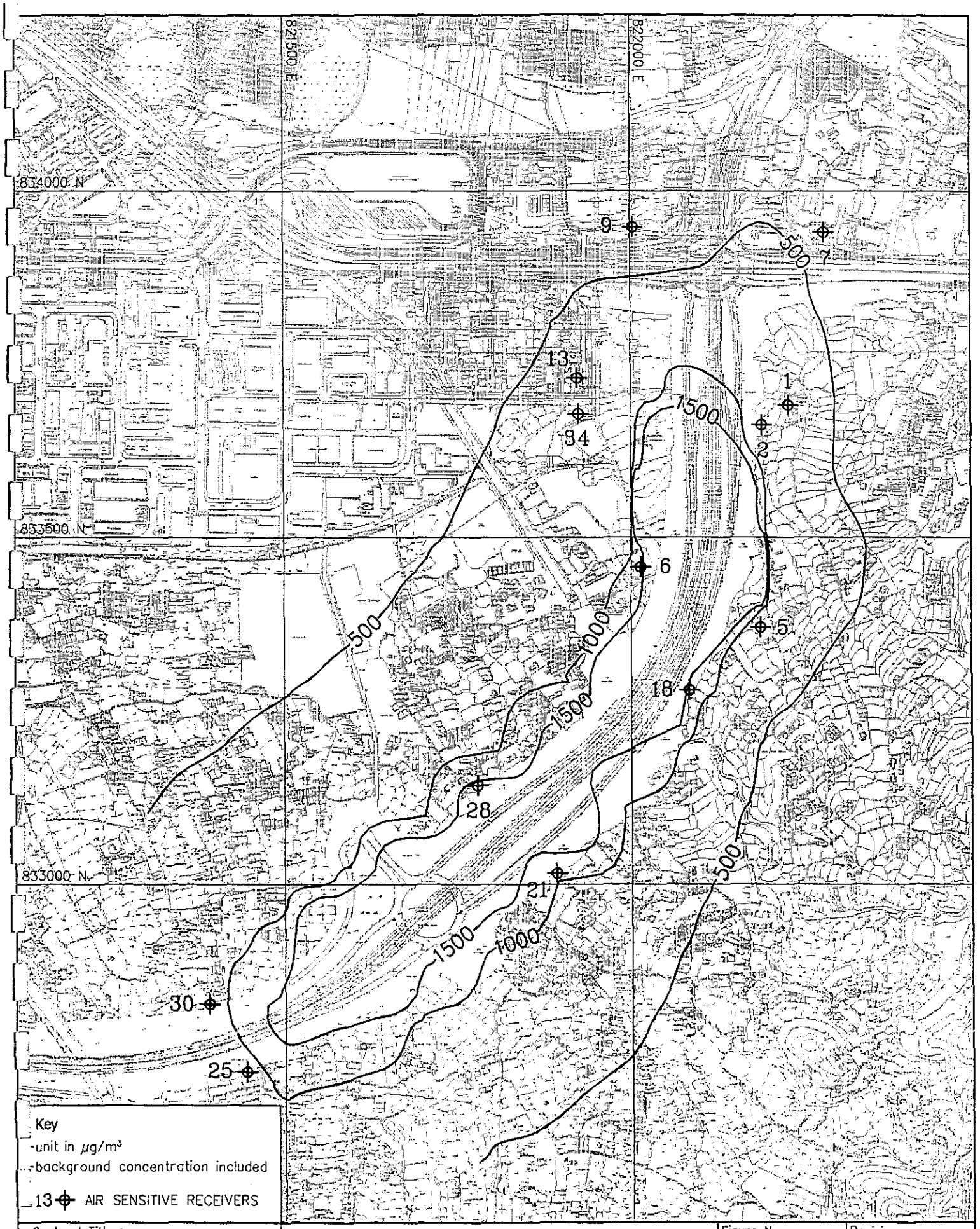
Date	Scale
APR. 97	N.T.S.



Contract Title :
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BINNIE CONSULTANTS LIMITED
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Title :

SCENARIO 2 –
MAXIMUM TSP CONCENTRATIONS AT PEDESTRIAN LEVEL (1.5m above ground)
DAILY AVERAGE
(COMPLETELY UNMITIGATED)

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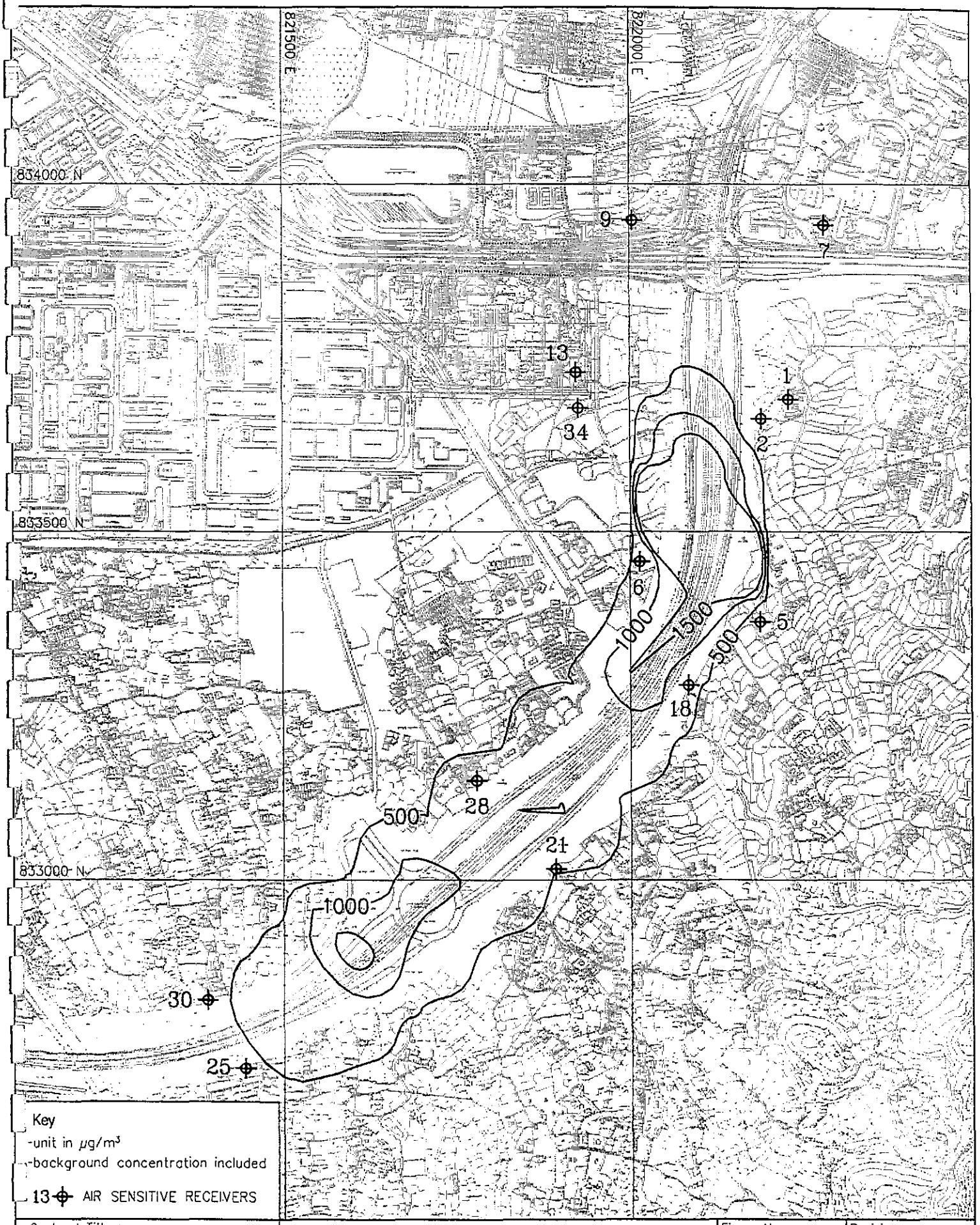

Key
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MAXIMUM RSP CONCENTRATIONS AT PEDESTRIAN LEVEL (1.5m above ground)
DAILY AVERAGE
(COMPLETELY UNMITIGATED)

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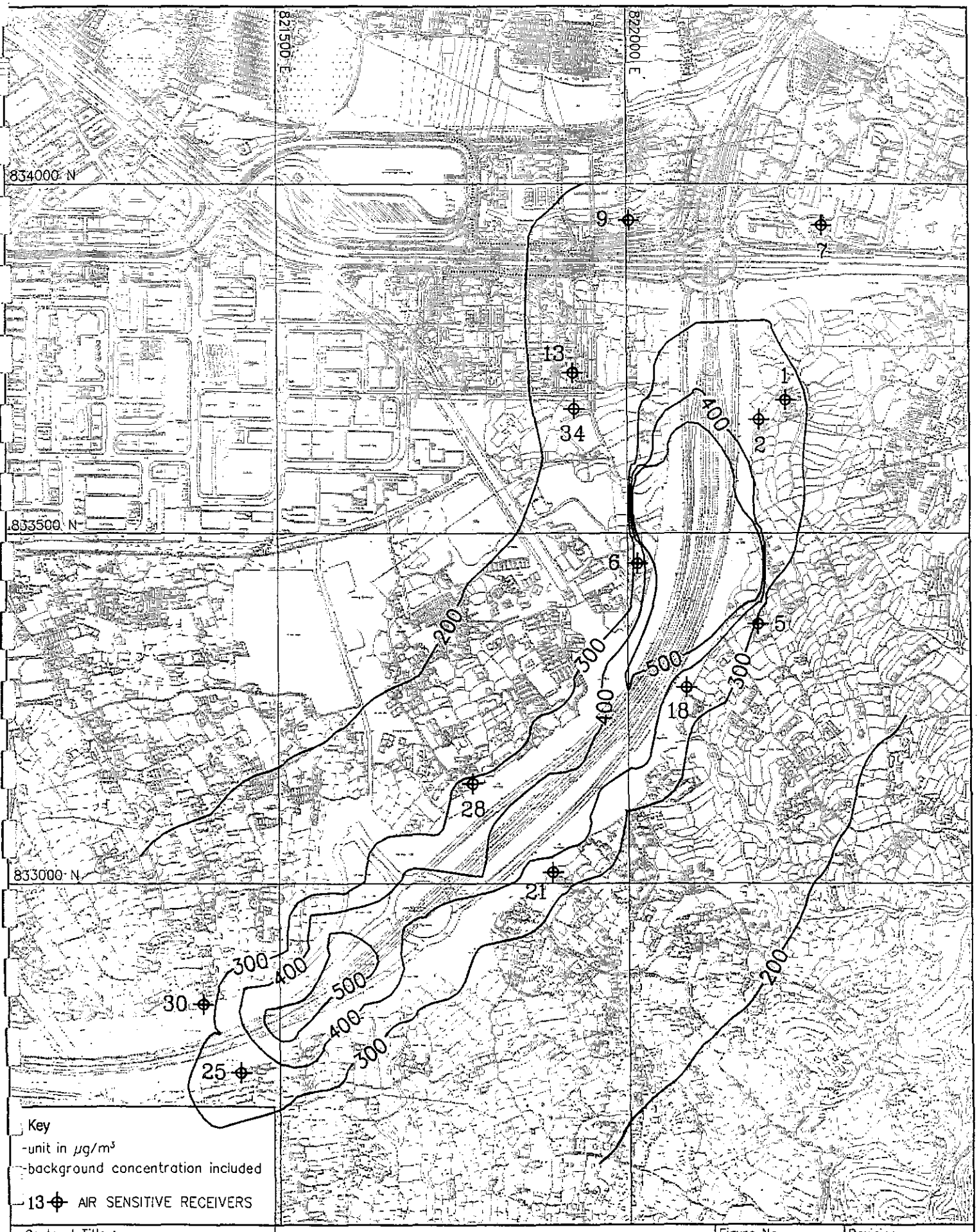

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BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼
ENGINEERS AND SCIENTISTS

Title :
SCENARIO 2 –
MAXIMUM TSP CONCENTRATIONS AT PEDESTRIAN LEVEL (1.5m above ground)
HOURLY AVERAGE
(95% REDUCTION IN DUST FROM DIRT ROADS)

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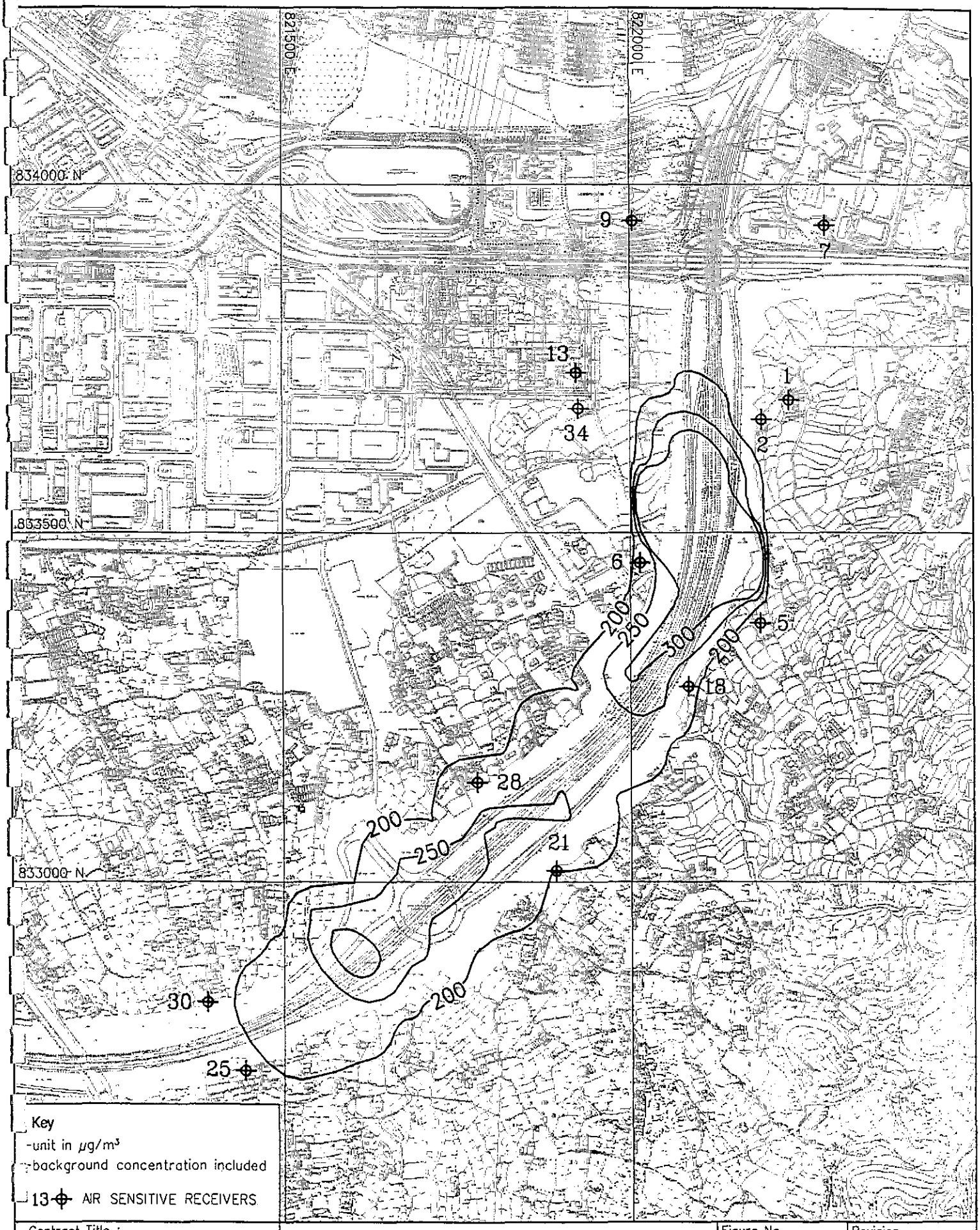

Key
- unit in $\mu g/m^3$
- background concentration included

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DAILY AVERAGE
(95% REDUCTION IN DUST FROM DIRT ROADS)

Figure No.	Revision
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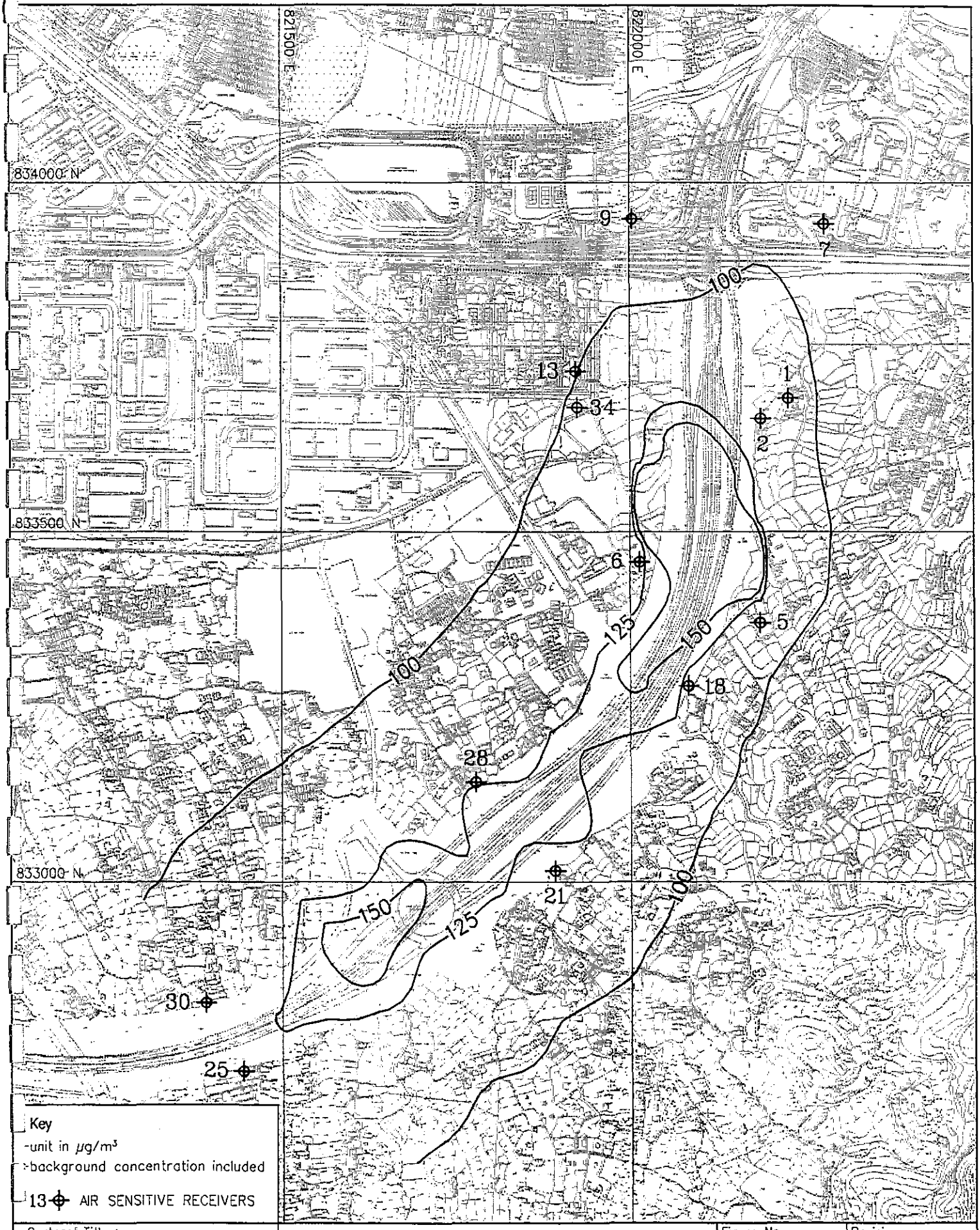
APR. 97	N.T.S.



Key

-unit in $\mu g/m^3$

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DAILY AVERAGE
(95% REDUCTION IN DUST FROM DIRT ROADS)

Figure No.	Revision
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Reference	File Name
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Prepared	Checked
WKY	YWL
Date	Scale
APR. 97	N.T.S.

8 SUMMARY AND RECOMMENDATIONS

Introduction

8.1 This report addresses the potential noise and air quality impacts associated with the construction and operation of the flyover linking Route 3 and Yuen Long Highway at Pok Oi Interchange.

8.2 Background studies to identify, collect and analyse existing information relevant to the EIA Study have been undertaken. Potential short- and long-term impacts of the Project on present and future sensitive receivers have been predicted and quantified, using mathematical models where appropriate, and assessed relative to the *Hong Kong Planning Standards & Guidelines* and other statutory requirements.

8.3 Practicable, effective and enforceable methods, measures and standards to mitigate adverse impacts to acceptable levels have been proposed.

Traffic Noise

8.4 Sensitive receivers within the Study Area are already impacted by high levels of traffic noise from the existing Castle Peak Road and Yuen Long Highway. The traffic noise impact assessments have identified a number of locations where potential traffic noise impact from the new roads (Route 3 CPS, Pok Oi Flyover and the Remaining Works) exceeding the HKPSG requirement of 70 dB(A) will be experienced by existing or planned NSRs.

8.5 The assessment of the Pok Oi Flyover project, based on the 2001 traffic figures, has confirmed that the use of friction course and installation of a 2.7 m noise barrier lined with sound absorptive material on the 0.8 m parapet either side of the flyover linking Route 3 CPS and Yuen Long Highway at Pok Oi Interchange will provide adequate traffic noise mitigation for most of the existing and proposed noise sensitive receivers.

8.6 For protection of the remaining affected NSRs, which are mainly low rise properties lying to the east and west of the temporary distributor roads, it is recommended that temporary noise barriers of between 0.8-3.5 m high are constructed along the temporary link roads. There are some cases where NSRs will still experience noise levels exceeding 70 dB(A); in all cases this problem is due to the traffic on existing roads.

8.7 The assessment of the completed Pok Oi Flyover and Remaining Works, based on the 2011 traffic figures, has established that the 2.7 m high noise barrier constructed on the 0.8 m high flyover parapet, together with sections of noise barrier ranging from between 1.4-3.5 m along part of the trunk road constructed under the Remaining Works project, will be required to protect existing and future noise sensitive receivers.

8.8 Installation of the noise barriers will minimise the constraint on nearby residential developments, allowing developers maximum flexibility to develop adjacent or nearby sites to their full potential.

Traffic Emissions

8.9 Air quality modelling of emissions from peak hour traffic levels in the year 2011 indicates that the main source of air pollutants within the Study Area will be from Castle Peak Road. Traffic emissions from the Pok Oi Flyover and Remaining Works will be within the AQOs and no mitigation measures are required.

Ecology

8.10 The ecological assessment indicates that given the heavily and recently modified nature of the environment, the lack of species diversity, immaturity and commonness of flora and species found in the area, it is concluded that the construction works associated with the Pok Oi Flyover and Remaining Works will have little ecological impact.

Construction Impacts

8.11 Construction of the road embankments and flyover structure has the potential to generate adverse impacts to nearby sensitive receivers. Proven site management measures to reduce construction noise, construction dust, water quality, solid waste, traffic disruption and visual impacts to within acceptable levels have been proposed. An EM&A Manual has been developed.

Conclusion

8.12 The Highway between Shap Pat Heung Interchange and Pok Oi Interchange - Pok Oi Flyover and Remaining Works is an integral and essential part of Highways Department's on-going programme to improve Hong Kong's road transport network.

8.13 Provided that the recommendations of this report are carried out, particularly with respect to the installation of appropriately designed noise barriers and construction noise and dust control, the works can be implemented with a minimum of impact on the environment to the ultimate benefit of current and future residents in the Study Area and users of Route 3, Yuen Long Highway and the new Pok Oi Flyover.

END OF TEXT

Appendix A

Detailed Calculation of Emission Rates for Each Dust Source

Appendix A The Detailed Calculations of Emission Rates for Each Dust Sources

Loading and unloading

The dust sources associated with the loading and unloading at the excavation sites will be considered as area sources. The quantity of particulate emissions generated by a batch drop or continuous drop operation, per ton of material transferred, may be estimated with an emission factor rating of C using the following empirical expression (USEPA 1994; p. 2.2-3):

$$E=k(0.0016)\frac{(\frac{U}{2.2})^{1.3}}{(\frac{M}{2})^{1.4}}(kg/Mg)...(A.1)$$

where:

E = emission factor,
k = particle size multipler (dimensionless),
U = mean wind speed, m/s, (mph)
M = material moisture content (%),

Equation (A.1) can be rewritten as following:

$$E'=Q_o U'^{w}.....(A.2)$$

where Q_o is the "unadjusted" emission factor which does not consider the change of hourly wind speed and direction, U' is hourly wind speed and w is the wind dependent factor. E is the mean value of E's. It is noted that equation (A.2) is a general equation for all emission factors. In equation A.1, the power of U is 1.3, i.e. w is 1.3.

Using equation (A.1) and (A.2), the emission factors for TSP and RSP can be estimated by the required data listed in Table A.1.

Table A.1
Physical Data for Evaluation the Impact of Loading and Unloading

Parameters of Equation (1)	TSP	RSP
Particle Size Multiplier (k)	0.74 (USEPA 1994: page 13.2.2-3)	0.35 (USEPA 1994: page 13.2.2-3)
Material Moisture Content (M)	18% (USEPA 1994: page 13.2.2-3)[1]	18% (USEPA 1994: page 13.2.2-3)[1]

[1] 18% moisture content is based on the Yuen Long SI data

By the use of equation (A.1), the "unadjusted" emission factor for TSP becomes:

$$Q_o = 0.74(0.0016)\frac{(\frac{1}{2.2})^{1.3}}{(\frac{18}{2})^{1.4}}(kg/Mg)...(A.3)$$

$$= 1.96x\ 10^{-5}\ kg/T$$

The "unadjusted" emission factor for RSP becomes:

$$Q_o = 0.35(0.0016)\frac{(\frac{1}{2.2})^{1.3}}{(\frac{18}{2})^{1.4}}(kg/Mg)...(A.4)$$

$$= 9.27\ x\ 10^{-6}\ kg/T$$

The wind dependent factor, w, in this case is 1.3.

Assuming a density of $1.987x10^3$ kg/m^3 and 9 hour working day, 26 days a month and 390 days, the material to be shifted per hour is 101. T/hr, i.e.,

$$\frac{180000m^3x1.987x10^3kg/m^3}{390x9hr} = 101897.4(kg/hr)...(A.5)$$

The unadjusted emission rate for TSP is 0.0005g/sec,

$$\frac{1.96x10^{-5}kg/Tx101.T/hr}{3.6}=0.0005(g/\text{sec})...(A.6)$$

where 3.6 is the conversion factor for the change of kg/hr to g/sec. The unadjusted emission rate for RSP is 0.0002 g/sec.

$$\frac{9.27x10^{-6}kg/Tx101.T/hr}{3.6}=0.0002(g/\text{sec})...(A.7)$$

An area of 19000 m^2 has been used as the loading area for the Study Site. Consequently, the unadjusted emission rate per unit area can be calculated from equation (A.6) and (A.7) and then substituted into equation (A.2). The emission rate for:

TSP: $= 2.92 \times 10^{-8}$ g/s/m^2,
RSP: $= 1.38 \times 10^{-8}$ g/s/m^2.

Unpaved road and haul routes

The top soil and other fill materials at the excavation site will be transported by dump trucks that will cause dust emission when they travel over unpaved roads and haul routes. The emission factor to be used is from AP-42 (USEPA 1985; equation 1, p 2.1-1) with emission factor rating A:

$$E=k(1.7)(\frac{s}{12})(\frac{S}{48})(\frac{W}{2.7})^{0.7}(\frac{w}{4})^{0.5}(\frac{365-p}{365})(kg/VKT)..(A.8)$$

where

E	=	emission factor
k	=	particle size multiplier (dimensionless)
s	=	silt content of road surface material (%)
S	=	mean vehicle speed, km/hr
W	=	mean vehicle weight, Mg(ton)
w	=	mean number of wheels
p	=	number of days with at least 0.254 mm of precipitation per year.
VKT	=	vehicle kilometre travelled

The data for estimating the emission rates of unpaved road and haul routes due to construction are summarized in Table A.2:

Table A.2
Physical Data for Evaluating the Impact of Unpaved road and Haul road.

Parameters	TSP	RSP
Particle size Multiplier (k)	0.8	0.36
Silt content of Road Surface Material (s)	20%*	20%*
Mean Vehicle Speed (S) km/hr	20	20
Mean vehicle Weight (W) tonnes	24	24
Mean number of Wheels (w) (Nissan Motor Co. and Caterpiller Inc. USA)	10	10
Number of Rainy Days per year (Royal Observatory)	100 days	100 days

* Based on Yuen Long SI data.

The locations of the haul roads have been based on the engineering study. There is a deficit volume of about 180,000 m^3.

The calculation of the emission rates due to haul road are described below. The calculations assumed the works to proceed 9 hours per day and 26 days per month. The dump truck was taken to have a capacity of $6m^3$ with the maximum speed of 15 km/h. The distance that the dump trucks travel on haul road is Study Area coincide with the length of the proposed road: roughly 1.0 km for a single trip. The round trip distances have been simulated by modelling the line sources twice in the FDM run. The dust source due to dump truck traffic on dirt roads is identified as a line source.

VKT can be expressed as total vehicle movement per hour. Construction vehicle movement per hour has been calculated by dividing the total material to be moved by 6.0 m^3 dump truck. This is the average load carried by the dump trucks planned for the site. The number of vehicle roundtrips per hr is roughly 18 veh/hr.

The wind dependent factor, in this case, is zero. So the emission factor becomes:

$$E=0.8(1.7)(\frac{20}{12})(\frac{20}{48})(\frac{24}{2.7})^{0.7}(\frac{10}{4})^{0.5}(\frac{365-100}{365})(kg/VKT)..(A.9)$$

i.e., E = 4.88 kg/VKT.

With 18 Veh/hr and kg/VKT in terms of g/m/s by a conversion factor of

$$(\frac{vehicle/hour}{3.6x1000}),$$

the emission rate for TSP on the Study Area becomes:

$$(\frac{4.88}{3.6x1000})x18=0.024g/m/s..(A.10)$$

For RSP, the emission rate is 0.011 g/m/s.

Top soil removal

The emission factor for top soil removal is 0.02 kg/Mg (USEPA 1985, Table 11.24-4). For example, the surface area of Study Area is 19000.m^2. Assuming the depth of top soil to be 0.1 metre, the volume of top soil is 1900 m^3. Assuming the relative density of topsoil is 1.987 x 10^3 kg/ m^3, then the mass of the soil removed is given by

$$Mass(T)=(\frac{1900X1987}{1000})=3775.3(T)..(A.11)$$

The total volume of materials handled in Study Area is roughly 180000 m^3 while there is only 1900 m^3 top soil material. As the time required for the initial site formation works will beexpected to last for 15 months. Thus the time required is 390 days. So the rate of removal is

$$(\frac{3775.3.0}{390X9})=1.1(T/hr)..(A.12)$$

The TSP emission rate is 0.02 kg/T X 1.1 T/hr = 0.02 kg/hr (0.005 g/s).

The emission rates per unit area at site are

TSP : 3.14E-7 g/s/m^2
RSP : 1.57E-7 g/s/m^2.

Wind erosion of the whole exposed area

The TSP emission factor of wind erosion of exposed areas (USEPA 1985, Table 24-4) is 0.85 Mg/hectare/yr. Given 1 hectare = 10^4 m^2, the emission rate for TSP becomes

$$\frac{0.85x1000}{10^4x365x24x3.6} = 2.69E-6 g/s/m^2 .....(A.13)$$

Since the emission rate of RSP is not available in AP-42, 50 % of TSP is assumed to be the emission rate of RSP. Thus the emission rate of wind erosion of the whole exposed area is

for RSP = 2.69 x 10^{-6} g/s/m^2.
for RSP = 1.34 x 10^{-6} g/s/m^2.

Appendix B

Emission Rates for Dust Sources

Emission Rates for Dust Sources

Yuen Long Southern Bypass (Road Formation)

Loading & Unloading

	TSP	RSP
Particle size multiplier, k	0.74	0.35
Mean wind speed (m/s), U	1	1
Material moisture content (%), M	18	18
Unadjusted emission rate (kg/T), Qo	1.96E-05	9.27E-06
Volume of material (m3)	180000	180000
Density of material (kg/m3)	1987	1987
Days of work	390	390
Working hours	9	9
Unadjusted emission rate (g/s)	0.000555	0.000262
Surface area (m2)	19000	19000
Unadjusted emission rate (g/s/m2)	2.92E-08	1.38E-08

Unpaved Road and Haul Routes (2 way)

	TSP	RSP
Particle size multiplier, k	0.8	0.36
Silt content of road surface material (%), s	20	20
Mean vehicle speed (km/hr), S	15	15
Mean vehicle weight (T), W	35	35
Mean number of wheels, w	10	10
Number of days with at least 0.254 mm rainfall per year, p	100	100
Number of vehicle roundtrips per hr	18	18
E (kg/VKT)	4.887128	2.199207
E (g/s/m)	0.024436	0.010996

Stock Piling

Silt content of aggregate (%), s	6
% of time with wind speed > 5.4 m/s at mean pile height	7
Number of days with at least 0.254 mm rainfall per year, p	100
E (kg/day/hectare)	3.999433
E (g/s/m2) for TSP	4.63E-06
E (g/s/m2) for RSP	2.31E-06

Top Soil Removal

Depth of top soil (m)	0.1
Surface area (m2)	19000
Density of material (kg/m3)	1987
Mass of material (T)	3775.3
Days of work	390
Working hours	9
Rate of removal (T/hr)	1.075584
E (g/s) for TSP	0.005975
E (g/s) for RSP	0.002988
E (g/s/m2) for TSP	3.14E-07
E (g/s/m2) for RSP	1.57E-07

Wind Erosion

E (g/s/m2) for TSP	2.70E-06
E (g/s/m2) for RSP	1.35E-06