路政署
HIGHWAYS DEPARTMENT

Route 16
Investigation Assignment

Environmental Impact Assessment
Final Assessment Report

January 1998

Scott Wilson / Parsons Brinckerhoff

in association with
ERM Hong Kong, MVA Asia

路政署
HIGHWAYS DEPARTMENT

Agreement No. CE 42/96

Route 16 Investigation Assignment from West Kowloon to Sha Tin - Environmental Impact Assessment

Final Assessment Report

January 1998

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Scott Wilson/Parsons Brinckerhoff

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1. INTRODUCTION

1.1 Preamble

Scott Wilson (Hong Kong) Ltd and Parsons Brinckerhoff (Asia) Ltd in joint venture, in association with ERM Hong Kong and MVA Asia, have been commissioned by Highways Department to undertake the Investigation Assignment for Route 16 from West Kowloon to Shatin (Agreement No. CE 42/96) (hereafter called the Assignment). An Environmental Impact Assessment (EIA) is required as part of the Assignment.

The need for Route 16 was established in the Updating of the Second Comprehensive Transport Study to overcome anticipated traffic problems at the Lion Rock Tunnel, Tate's Cairn Tunnel and Tai Po Road, and has been committed in the Sha Tin Outline Zoning Plan (S/ST/6). The Route 16 will connect the Lai Wan Interchange in West Kowloon to the future Trunk Road T3 and Che Kung Miu Road in Shatin. A Feasibility Study for the Route 16 Dual-2 Scheme was completed in June 1996 including an Environmental Impact Assessment (hereafter called the Previous EIA). A number of alternative alignment options were developed and evaluated (refer to *Section 2.1*), and the preferred alignment with the least environmental impacts and the Dual-2 Scheme Preliminary Design subsequently endorsed by the Government.

In view of the latest anticipated increase in traffic demand, the Government has now committed to consider constructing a Dual-3 Scheme in the present Assignment (see *Figure 2.1a*), based on the previous alignment endorsed. ERM Hong Kong is undertaking the EIA which includes updating the Previous EIA, based on the proposed Route 16 Dual-3 Scheme, construction programme, traffic forecasts for the year 2019, and engineering design; and identifying broad environmental control requirements for incorporation into the Preliminary Design to comply with environmental legislation and guidelines.

The current EIA Study commenced on 7 April 1997 and an Initial Assessment Report (IAR) was issued on 27 June 1997 to provide a preliminary assessment of the Dual-3 Scheme, reviewing initial engineering information of the Assignment against the findings of the Previous EIA. Key environmental issues that arised as a result of significant changes in the Project scope, engineering design and traffic forecasts were highlighted for more detailed assessment in this Final Assessment Report (FAR).

1.2 EIA Study Area

The boundary of the Study Area for the purpose of this EIA is 300 m either side and along the full stretch of the proposed alignment (see *Figure 1.2a*). Except in the case of landscape impact and air quality assessment, where the study area is defined by a distance of 500 m from the proposed alignment. All visually sensitive receivers will be assessed where necessary, regardless of the distance from the proposed alignment as part of visual impact assessment.

With respect to noise impact assessment, the study area could be reduced accordingly, if the first layer of Noise Sensitive Receivers (NSRs), closer than 300m from the road, provide adequate acoustic shielding to those NSRs located further behind.

1.3 Objective of the EIA

The objective of the EIA is to assess the potential environmental impacts associated with the construction and operation of the proposed Route 16 Dual-3 Scheme. The environmental issues are discussed and assessed based on the Preliminary Design for the Assignment. Preliminary environmental control measures are recommended for incorporation into the design where appropriate to minimise environmental impacts to meet the Hong Kong Government's environmental legislation and the Hong Kong Planning Standards and Guidelines (HKPSG).

This EIA updates the findings of the Previous EIA, based on the conforming alignment given in the Brief, using information from the previous study where appropriate and adding information to address the significant changes in design.

1.4 Structure of the Report

After this introductory section, the remainder of this report is arranged as follows:

- *Section 2* presents a description of the Project, highlighting the key changes in the Project scope, engineering design and traffic forecasts;
- *Section 3* assesses the environmental impacts likely to occur during the construction phase, together with appropriate recommendations for their mitigation;
- *Section 4* assesses the environmental impacts likely to occur during the operation of the alignment and recommends appropriate mitigation measures;
- *Section 5* summarises the environmental monitoring and audit requirements; and
- *Section 6* presents an overall conclusion of this report.

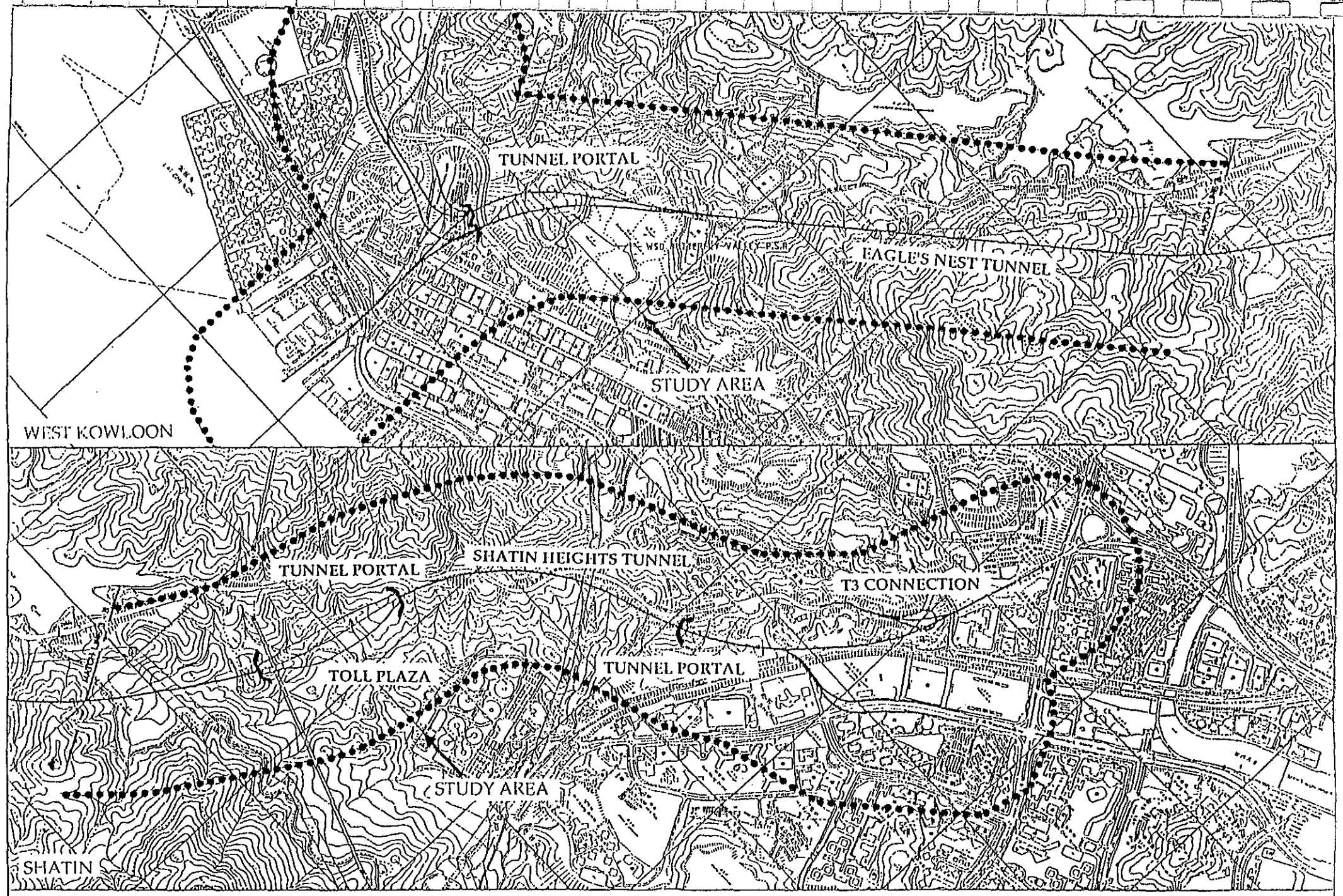


FIGURE 1.2a - ROUTE 16 ALIGNMENT

2. PROJECT DESCRIPTION

2.1 Route Alignment

As discussed in Section 1.1, the Route 16 Dual-3 Scheme main alignment is basically the same as the Dual-2 Scheme endorsed by the Government. The route will connect the Lai Wan Interchange in West Kowloon to the future Trunk Road T3 and Che Kung Miu Road in Shatin. A number of engineering feasible alternative alignment options were identified and compared in the Previous Feasibility Study, considering engineering, traffic, structures, tunnelling, geotechnics, environmental, planning and costs factors. The preferred alignment had the least environmental impacts compared to the other options, as summarised below:

- the least number of noise and air sensitive receivers affected with less extensive mitigation measures;
- tunnel section maximised (with the exception of the Toll Plaza area which has to be open) at the sensitive secondary woodland areas below Tai Po Road, to minimise impacts on the woodland;
- the use of one more tunnel section considerably reduce visual and landscape impact by restricting visibility and reducing clearance of woodlands and cutting of natural slope profiles; and
- no direct effect on residential properties at Keng Hau Road.

The selected Route 16 alignment is described in more detail below.

At the West Kowloon end, the main alignment starts at Lai Wan Interchange with connections to the primary distributor P1 on the West Kowloon Reclamation. The Route rises up over the elevated structure at Lai Chi Kok Interchange, continues alongside Butterfly Valley Road and the carriageways separate before passing into Eagle's Nest Tunnel under Ching Cheung Road. There are slip road connections to Ching Cheung Road, Castle Peak Road and Butterfly Valley Road on the western side of Butterfly Valley.

The main tunnel section (Eagle's Nest Tunnel), approximately 2700m long, runs underneath the Lion Rock Country Park and surfaces at the western end of Shatin. The northbound and southbound carriageways are separated in the tunnel. After emerging from tunnel the route continues on a relatively horizontal profile, before entering into a second tunnel. The toll plaza is positioned between the Eagle's Nest Tunnel and Shatin Heights Tunnel. A ventilation building for the main tunnel is located at the Kowloon side of Tai Po Road.

The second tunnel (Shatin Heights Tunnel) is approximately 950m long and passes beneath Tai Po Road curving to the east before passing back under Tai Po Road and emerging close to the valley floor just beyond Keng Hau Road, between the KCRC railway and private developments adjacent to Tai Po Road. Approaching the T3 Interchange the alignment rises pass over Chik Wan Street and ties into the redesigned Tai Po Road at T3. Two slip roads branch out over the Hong Kong School of Motoring and join with Che Kung Miu Road.

Figures 2.1a-b show the route of the Route 16 alignment and the ventilation building location respectively.

2.2 Key Changes in Dual-3 Scheme

Compared to the previous Dual-2 Scheme, the Dual-3 Scheme will also require additional slip road connections to Ching Chueng Road and Castle Peak Road. The main differences of the two schemes are presented in Table 2.2a below.

Table 2.2a Main Differences Between Dual-3 and Dual-2 Schemes

	Dual-2	Dual-3
From Lai Wan Interchange to southern portals of Eagle's Nest Tunnel	Approximately 570m long viaduct passing over the existing Lai Chi Kok Interchange and above Butterfly Valley Road. Towards the end of the viaduct, the carriageways separate before passing into the tunnel under Ching Cheung Road (CCR).	Same alignment. Additional slip road connections from the tunnel portals to CCR, Castle Peak Road and Butterfly Valley Road. These connections are on viaducts.
Eagle's Nest Tunnel	Approximately 2700m long, with about 800,000m^3 of surplus good quality rock requiring off-site disposal.	Same length but Dual-3 tunnel, with roughly 50% increase in excavated rock, but only 529,000m^3 surplus rock requiring off-site disposal
Toll Plaza	It is positioned between the Eagle's Nest and Shatin Height tunnels.	Same location and size.
Shatin Heights Tunnel	Approximately 950m long, Dual 2 tunnel.	Same length but Dual-3 tunnel.
Sections after the northern portals of Shatin Heights Tunnel	The route passes along the side of the Shatin Valley on embankments with retaining structures before connecting to Trunk Road T3.	Same alignment but with extended embankment.
	Connections to Che Kung Mui Road by viaducts	Same.
Tunnel Ventilation	A ventilation building at Tai Po Road	Similar location, but significantly larger
Worst Case peak hour traffic forecasts of main alignment	Approximately 5,500 vehicles per hour by 2011	Generally similar traffic flow on main alignment by 2019, but significantly higher background traffic (with Shatin Bypass)

2.3 Construction Activities

The main construction activities of the Dual-3 comprise:

- Earthworks excavation;
- Tunnel portal construction;
- Tunnel excavation; and
- Viaduct construction.

A preliminary construction programme of Route 16 is shown in Figures 2.3a-d, covering a total period of approximately four years. Details of the construction methods including plant and equipment are given in the noise and air quality assessment.

Earthworks excavation will take place at the Toll Plaza site and at the portals, and filling operations undertaken for the Lai Wan approach viaduct embankment and Wai Man Tsuen cottage area filling. The excavated material will be 90% good quality rock, the majority of which will be used as fill material on site. It is estimated that there will be a surplus of material approximately 529,000m^3. Temporary stockpiles are expected at the toll plaza, Pak Shek Village squatter area and Wai Man Tsuen cottage area. It is understood that the squatter and cottage areas will be resumed for the construction work.

Portals will be constructed for the two rock tunnel sections which will be excavated by drilling and blasting.

Piling activities for viaduct foundation works will mainly take place at the West Kowloon end.

Main works sites are anticipated to be at the Toll Plaza, Wai Man Tsuen and other portal areas.

Tunnel excavation are expected to be 24 hour working and the other construction activities are likely to be between 0700 to 1900 hours.

2.4 Operation Phase

Traffic Forecasts

For the purpose of this study, the worst case scenario for the Dual-3 Scheme in relation to traffic emission and noise impact is identified as the traffic forecasts for the year 2019, assuming Shatin Bypass and buses to Route 16 via Lai Wai Link. The existing traffic data and the 2019 traffic forecasts are presented in *Figures 2.4a-d* respectively.

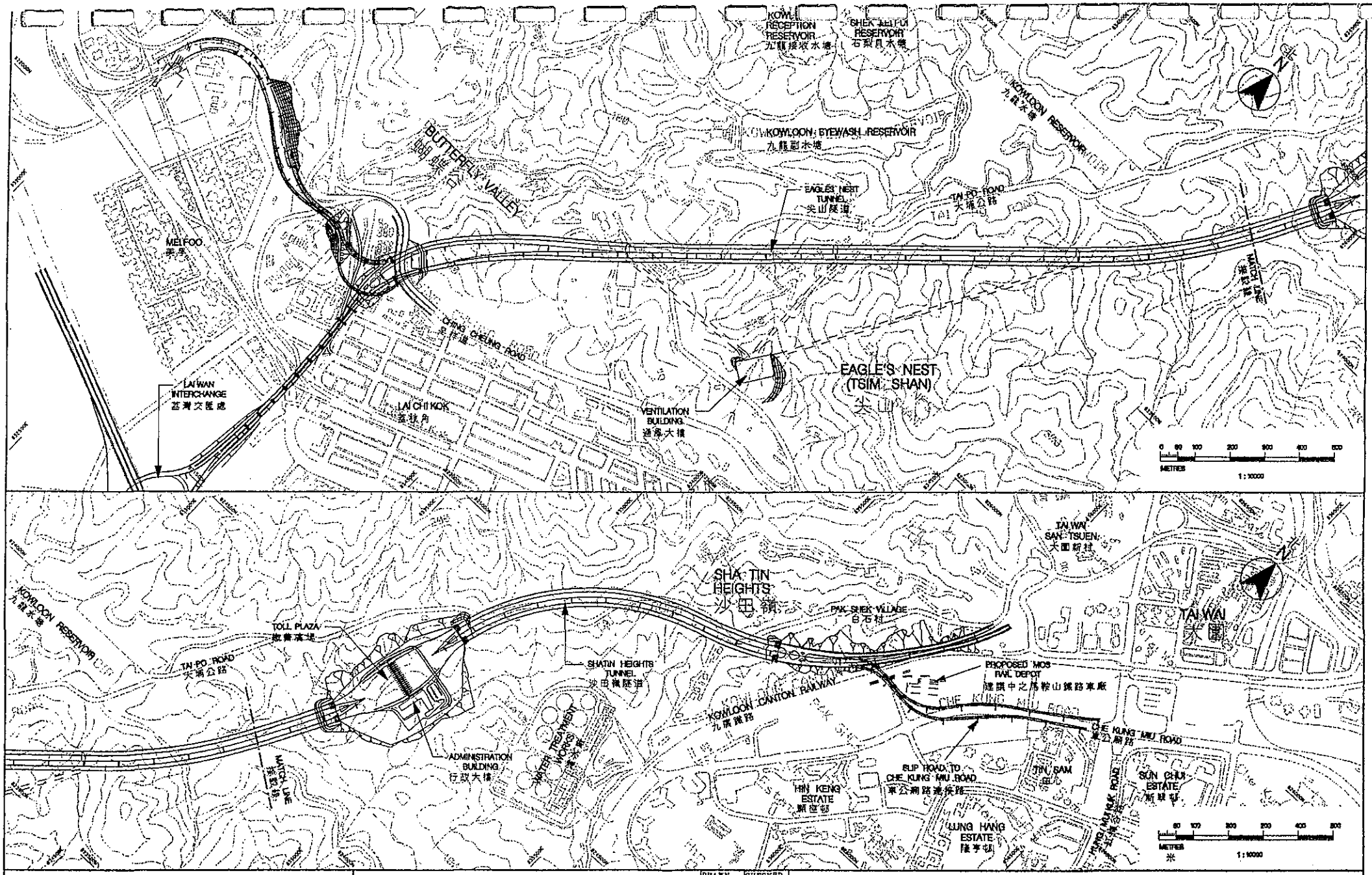
Toll Plaza

The location of the toll plaza is shown in *Figure 2.1a*. The basic site area requirement of the toll plaza has accounted for the manual collected toll, although it is envisaged that auto-toll may be introduced to replace manual tolls booths by 2006, reducing the actual operational area. The site area of the Dual-3 scheme is similar to that of the previous Dual-2 scheme which was minimised as far as engineering constraints allow.

Tunnel Ventilation

The ventilation systems for the two tunnel sections have been designed to meet the Tunnel Air Quality Guideline and the design details will be submitted to the Government for approval. The tunnel emission from the main tunnel section (Eagle's Nest Tunnel) will be

extracted and dispersed via a ventilation shaft, and there will be no tunnel emission at the West Kowloon end with a small amount of emission at the Shatin end. The ventilation building location is shown in *Figure 2.1b*. For the second tunnel, longitudinal venting with the aid of jet fans will be used. More details of the ventilation system and emission data are presented in the operational air quality assessment in *Section 4.2*.



Government of Hong Kong
Highways Department

Scott Wilson - Parsons Brinckerhoff
In Association with
M.V.A. Asia ERM Hong Kong

Route 16

CONTRACT CE 42/96
WEST KOWLOON TO SHATIN

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ROUTE 16 FROM WEST KOWLOON TO SHA TIN
16號幹線由西九龍至沙田段

DRG. TITLE: GENERAL LAYOUT PLAN
總發展藍圖

DRG. NO.: FIGURE 2.1a

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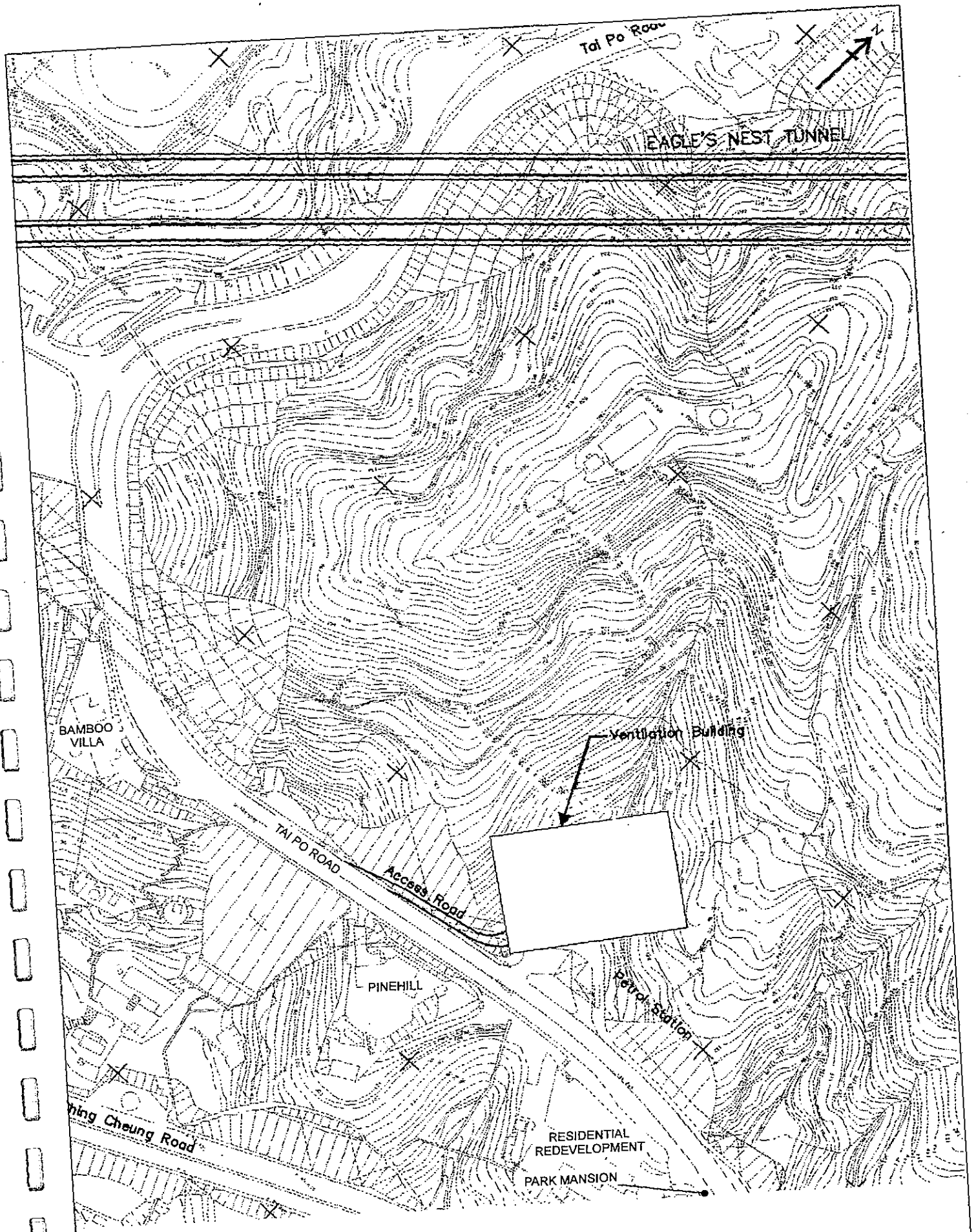
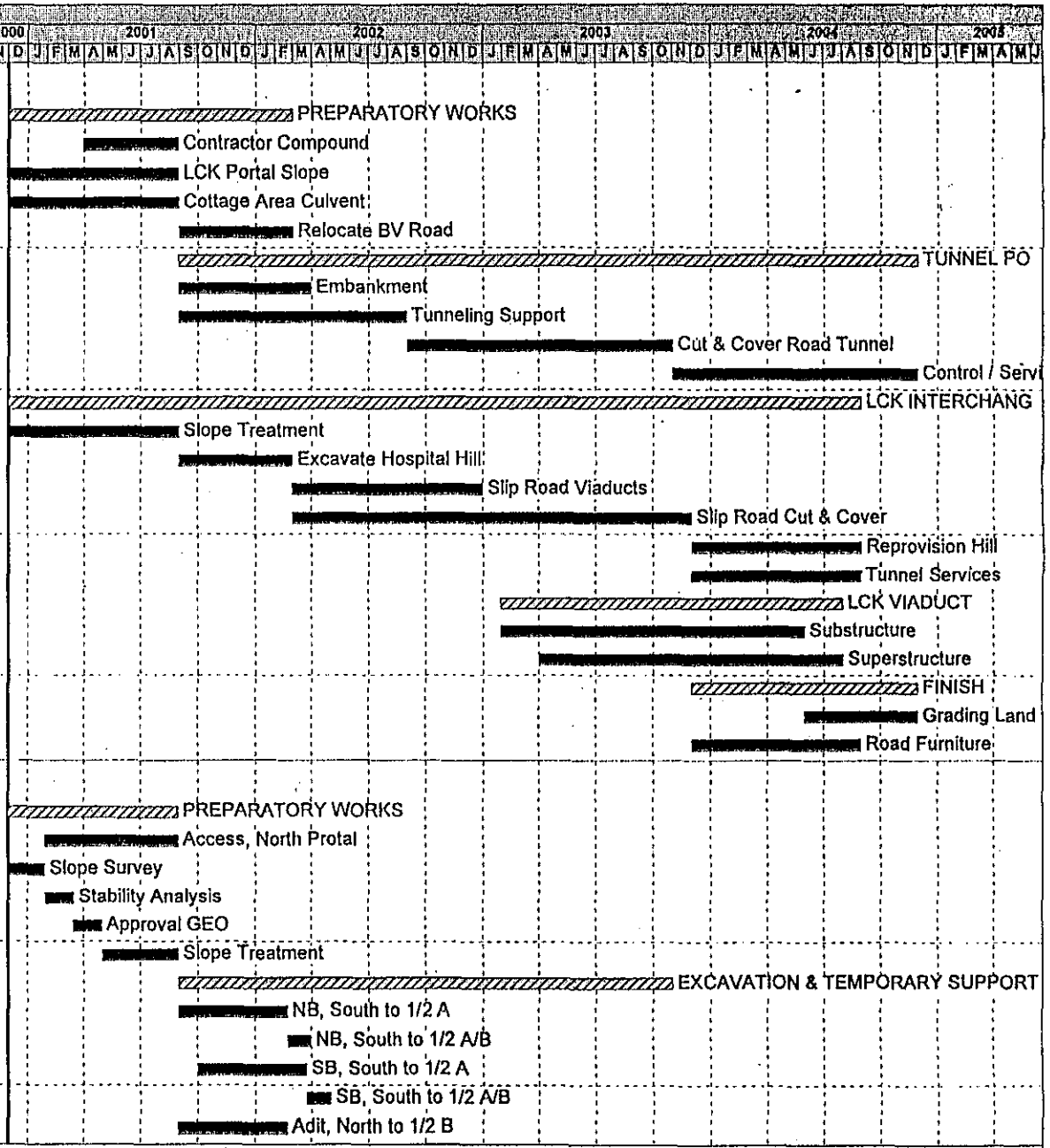


FIGURE 2.1b - LOCATION OF VENTILATION BUILDING

Act ID	Activity Description	Orig Dur	Early Start	Early Finish
WEST KOWLOON WORKS				
EA010	PREPARATORY WORKS	455 *	01/12/00	28/02/02
EA020	Contractor Compound	153	31/03/01	30/08/01
EA030	LCK Portal Slope	273	01/12/00	30/08/01
EA040	Cottage Area Culvent	273	01/12/00	30/08/01
EA050	Relocate BV Road	182	31/08/01	28/02/02
EB010	TUNNEL PORTAL	1188 *	31/08/01	30/11/04
EB020	Embankment	212	31/08/01	30/03/02
EB030	Tunneling Support	365	31/08/01	30/08/02
EB040	Cut & Cover Road Tunnel	427	31/08/02	31/10/03
EB050	Control / Services Building	396	01/11/03	30/11/04
EC010	LCK INTERCHANGE	1369 *	01/12/00	30/08/04
EC020	Slope Treatment	273	01/12/00	30/08/01
EC030	Excavate Hospital Hill	182	31/08/01	28/02/02
EC040	Slip Road Viaducts	306	01/03/02	31/12/02
EC050	Slip Road Cut & Cover	641	01/03/02	01/12/03
EC060	Reprovision Hill	273	02/12/03	30/08/04
EC070	Tunnel Services	273	02/12/03	30/08/04
ED010	LCK VIADUCT	549 *	30/01/03	31/07/04
ED020	Substructure	487	30/01/03	30/05/04
ED030	Superstructure	488	01/04/03	31/07/04
EE010	FINISH	365 *	02/12/03	30/11/04
EE020	Grading Landscaping	184	31/05/04	30/11/04
EE030	Road Furniture	273	02/12/03	30/08/04
EAGLE'S NEST TUNNEL				
AA010	PREPARATORY WORKS	273 *	01/12/00	30/08/01
AA020	Access, North Protal	214	29/01/01	30/08/01
AA030	Slope Survey	59	01/12/00	28/01/01
AA040	Stability Analysis	46	29/01/01	15/03/01
AA050	Approval GEO	46	16/03/01	30/04/01
AA060	Slope Treatment	122	01/05/01	30/08/01
AB010	EXCAVATION & TEMPORARY SUPPORT	792 *	31/08/01	31/10/03
AB020	NB, South to 1/2 A	175	31/08/01	21/02/02
AB030	NB, South to 1/2 A/B	37	22/02/02	30/03/02
AB040	SB, South to 1/2 A	174	01/10/01	23/03/02
AB050	SB, South to 1/2 A/B	38	24/03/02	30/04/02
AB060	Adit, North to 1/2 B	175	31/08/01	21/02/02



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Project name	WO02
Page number	1A

Figure 2.3a

Agreement No. CE 42/96
Route 16 From West Kowloon to Sha Tin
Construction Programme

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Act ID	Activity Description	Orig Dur	Early Start	Early Finish
AB070	Adit, South to 1/4 B	174	01/10/01	23/03/02
AB080	Adit, South to 1/4 B	37	01/05/02	06/06/02
AB085	Adit North to 3/4 B	230	31/03/02	15/11/02
AB087	Adit 3/4 to South B	169	31/05/02	15/11/02
AB090	NB, South 1/2 to 1/4 A	305	31/03/02	29/01/03
AB100	SB, South 1/2 to 1/4 A	305	01/05/02	01/03/03
AB110	NB, South 1/4 to 0 B	320	16/11/02	01/10/03
AB120	SB, South 1/4 to 0 B	320	16/12/02	31/10/03
AC010	FITTING OUT TUNNEL	761 *	01/08/02	30/08/04
AC020	Membrance & Shutter Track	457	01/08/02	31/10/03
AC030	Concrete Lining	366	01/12/02	01/12/03
AC040	Inv Slab, Barrier / Walkway	276	01/04/03	01/01/04
AC050	Cladding Support	245	02/05/03	01/01/04
AC060	Wall Cabling	274	01/06/03	29/02/04
AC070	Suspended Ceiling	215	01/06/03	01/01/04
AC080	Ceiling Cabling	182	01/09/03	29/02/04
AC090	Cladding Panels	242	02/10/03	30/05/04
AC100	M&E Equipment	334	02/10/03	30/08/04
AC110	Paving	45	17/07/04	30/08/04
AD010	VENTILATION BUILDING	579 *	30/01/03	30/08/04
AD020	Structure	365	30/01/03	29/01/04
AD030	M&E Equipment	273	02/12/03	30/08/04
AE010	FITTING OUT ADITS	458 *	01/05/02	01/08/03
AE020	Shotcrete Lining Mid	153	01/05/02	30/09/02
AE025	Shotcrete Lining South	152	01/10/02	01/03/03
AE030	Shotcrete Lining North	153	02/03/03	01/08/03
AF010	Testing and Commissioning	92	31/08/04	30/11/04
AF020	Systems Operation	92	31/08/04	30/11/04
TOLL PLAZA WORKS				
DA010	PLATFORM	1096 *	31/08/01	30/08/04
DA020	Earthworks	304	31/08/01	30/06/02
DA030	Services Roads	548	31/08/01	01/03/03
DA040	Paving	122	01/05/04	30/08/04
DB010	BUILDINGS	548 *	02/03/03	30/08/04
DB020	Administration Building	548	02/03/03	30/08/04
DB030	Eagle's Nest Portal	426	02/07/03	30/08/04
DB040	Shatin Height Portal	426	02/07/03	30/08/04

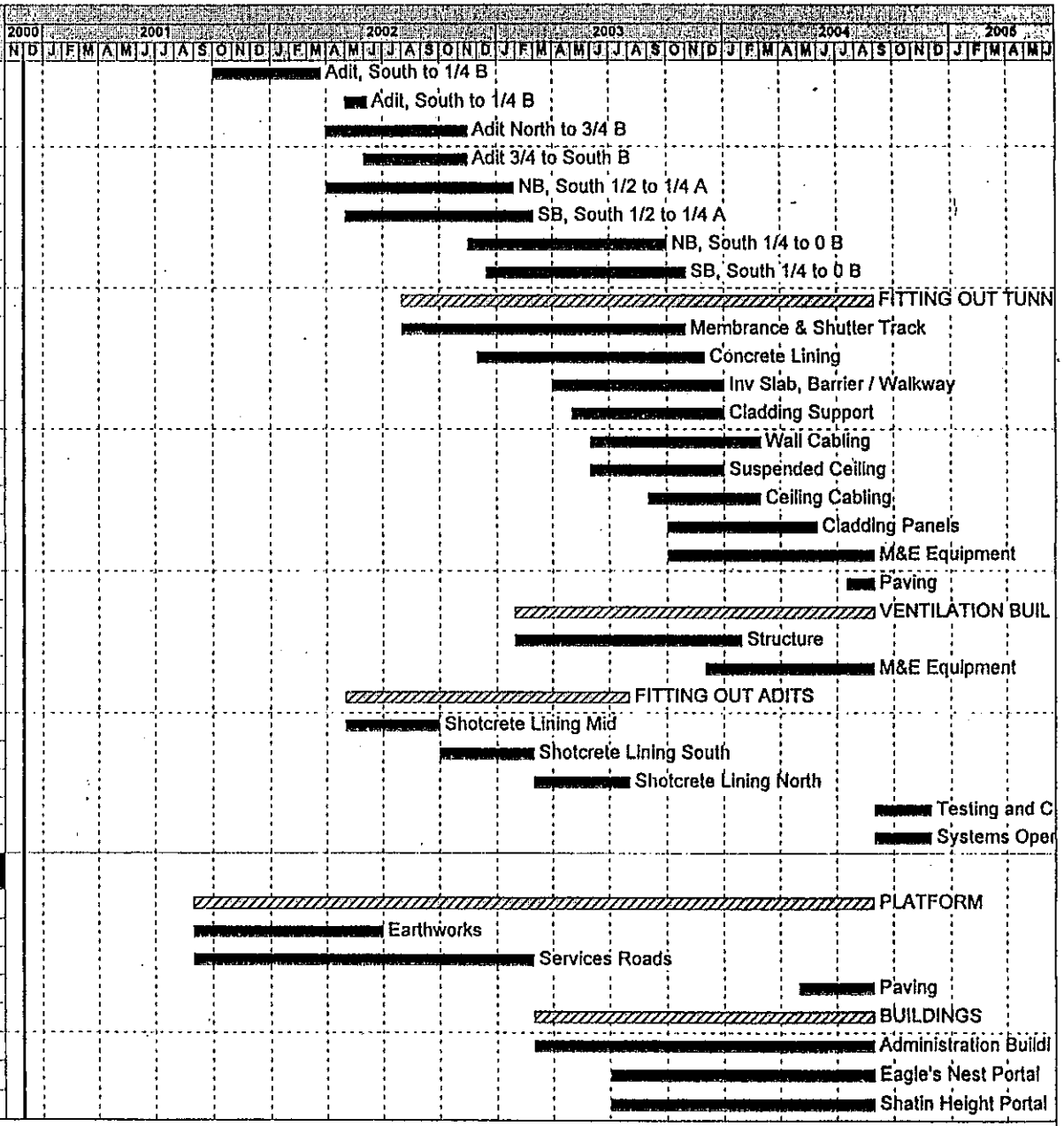

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Figure 2.3b

Agreement No. CE 42/96
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Act ID	Activity Description	Orig Dur	Early Start	Early Finish
DC010	FINISH	396 *	01/11/03	30/11/04
DC020	Toll Booths / Canopy	304	01/11/03	30/08/04
DC030	Road Furnature	214	30/01/04	30/08/04
DC040	Landscape	306	30/01/04	30/11/04
SHATIN HEIGHT TUNNEL				
BK010	PREPARATORY WORKS	273 *	01/12/00	30/08/01
BK020	Access, North / South Portal	214	29/01/01	30/08/01
BK030	Slope Survey	59	01/12/00	28/01/01
BK040	Stability Analysis	46	29/01/01	15/03/01
BK050	Approval GEO	46	16/03/01	30/04/01
BK060	Slope Treatment	122	01/05/01	30/08/01
BL010	EXCAVATION & TEMPORARY SUPPORTS	670 *	31/08/01	01/07/03
BL020	Southbound	670	31/08/01	01/07/03
BL030	Northbound	486	01/10/01	29/01/03
BM010	FITTING OUT TUNNEL	853 *	01/05/02	30/08/04
BM020	Membrane & Shutter Track	458	01/05/02	01/08/03
BM030	Concrete Lining Northbound	228	01/07/02	13/02/03
BM040	Concrete Lining Southbound	230	14/02/03	01/10/03
BM050	Inv Slab Barrier / Walkway Northbound	121	16/11/02	16/03/03
BM060	Inv Slab Barrier / Walkway Southbound	122	02/07/03	31/10/03
BM070	Cladding Supports Northbound	121	16/11/02	16/03/03
BM080	Cladding Supports Southbound	122	02/07/03	31/10/03
BM090	Wall/Ceiling Cabling Northbound	122	17/03/03	16/07/03
BM100	Wall/Ceiling Cabling Southbound	123	01/09/03	01/01/04
BM110	Cladding Panels Northbound	122	17/07/03	15/11/03
BM120	Cladding Panels Southbound	120	02/01/04	30/04/04
BM130	M&E Equipment	273	02/12/03	30/08/04
BM140	Paving	30	01/08/04	30/08/04
BN010	TESTING & COMMISSIONING	92 *	31/08/04	30/11/04
BN020	System Operation	92	31/08/04	30/11/04
SHATIN WORKS				
CA010	ROADS	1035 *	31/08/01	30/06/04
CA020	Earthworks	639	31/08/01	31/05/03
CA030	Drainage / Paving	396	01/06/03	30/06/04
CB010	SLIP ROAD VIADUCTS	670 *	31/10/02	30/08/04
CB020	Substructure	578	31/10/02	30/05/04
CB030	Superstructure	608	01/01/03	30/08/04

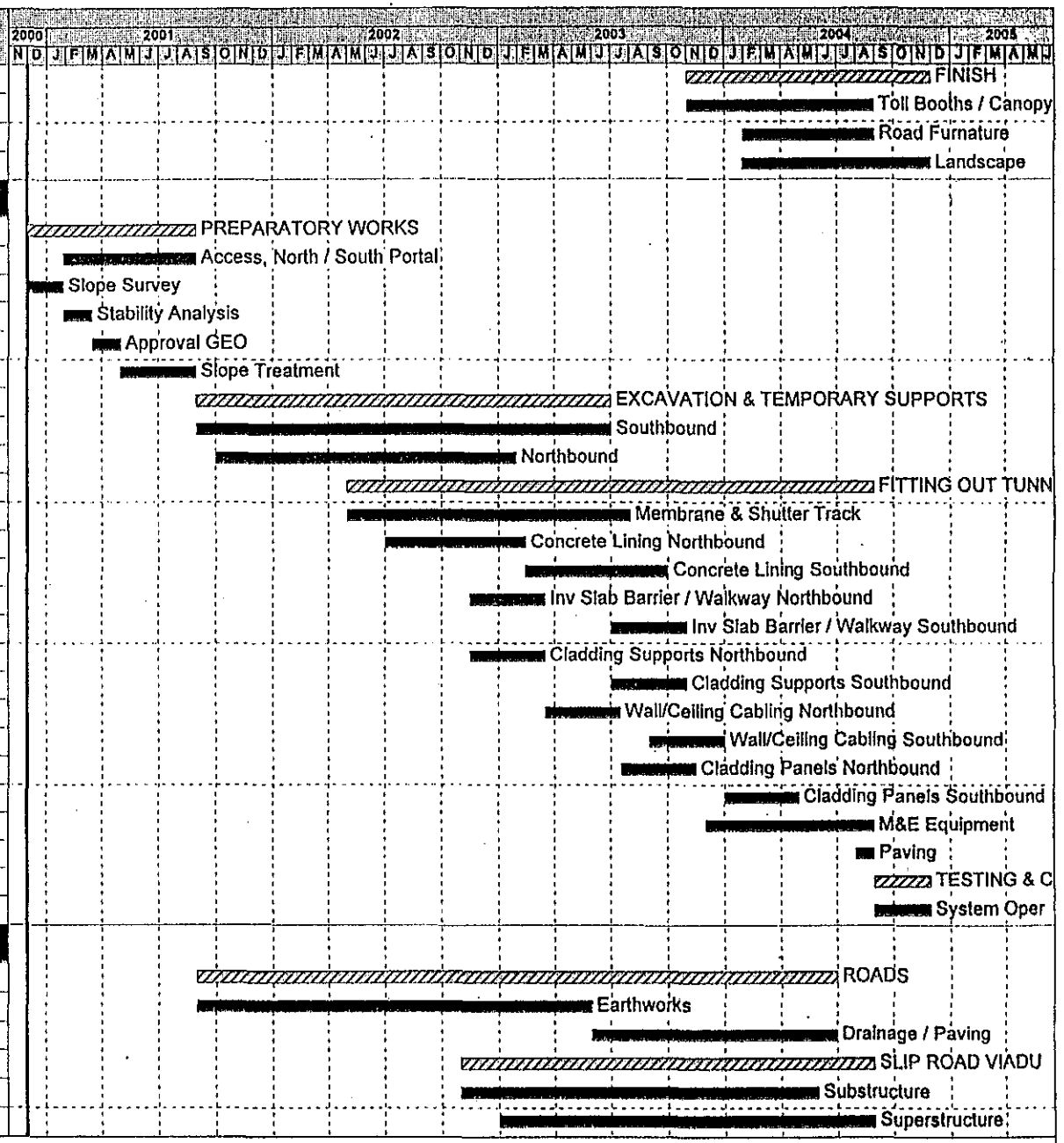

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Figure 2.3c

Agreement No. CE 42/96
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Act ID	Activity Description	Orig Dur	Early Start	Early Finish
CC010	BUILDING	426 *	02/07/03	30/08/04
CC020	Shatin Portal	426	02/07/03	30/08/04
CD010	FINISH	426 *	02/10/03	30/11/04
CD020	Grading Landscaping	334	02/01/04	30/11/04
CD030	Road Furnature	334	02/10/03	30/08/04

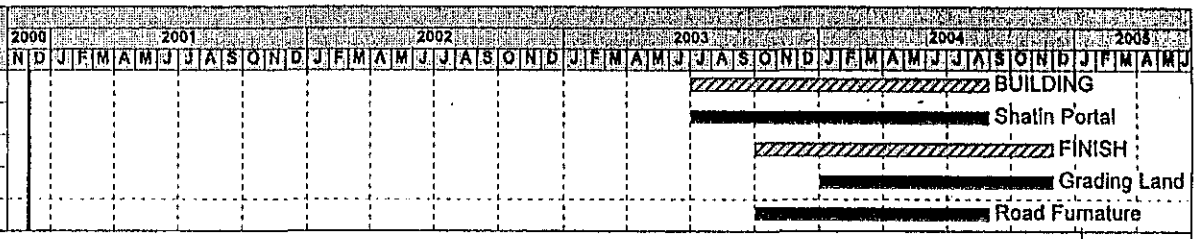

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Figure 2.3d

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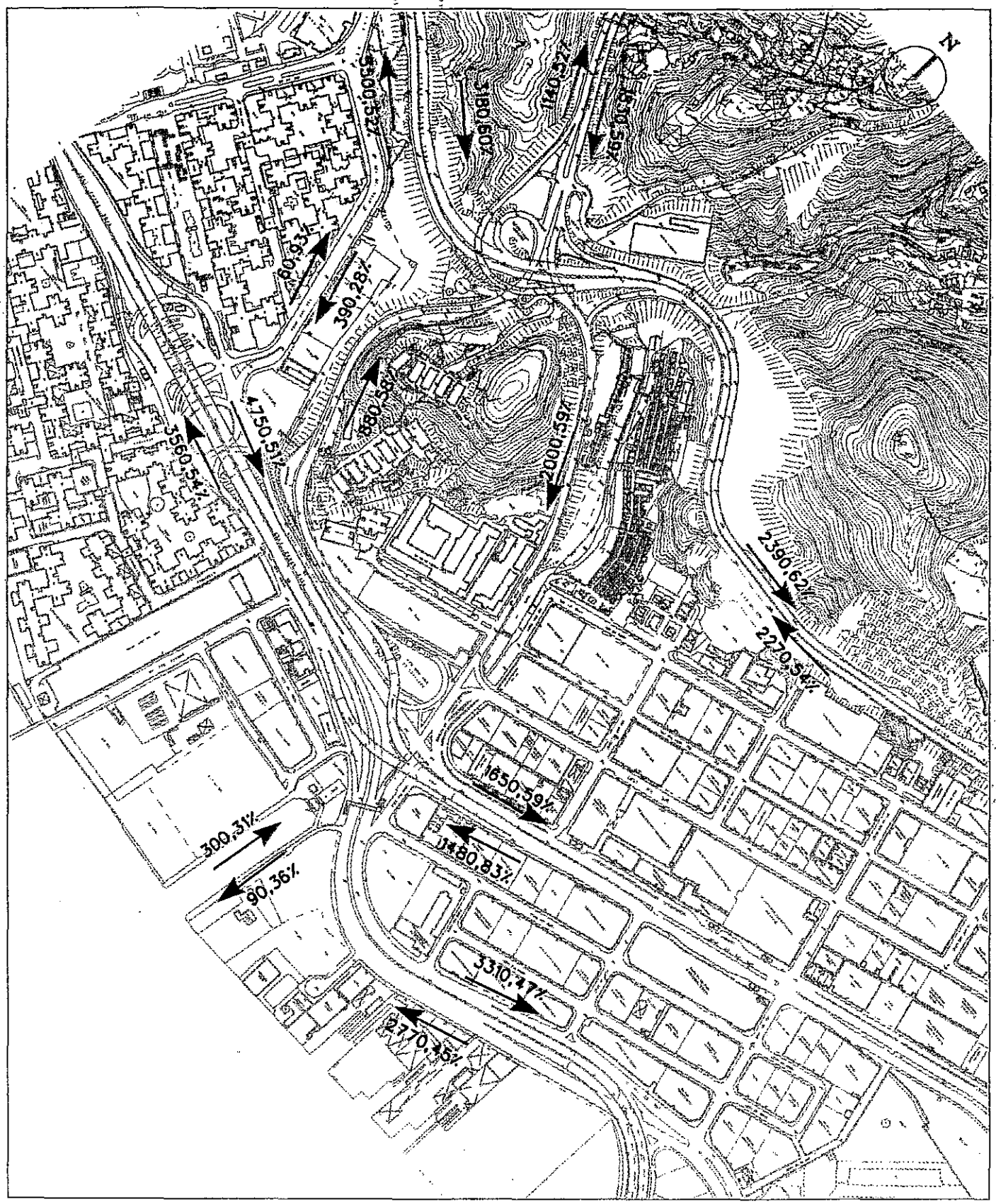

FIGURE 2.4a - EXISTING PEAK HOUR TRAFFIC FLOW

Date : Oct 97

Drawing No. /Contract/C1641/etf2

KEY

1620,50% → Traffic flow in veh/hr, % heavy vehicle

ERM Hong Kong
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

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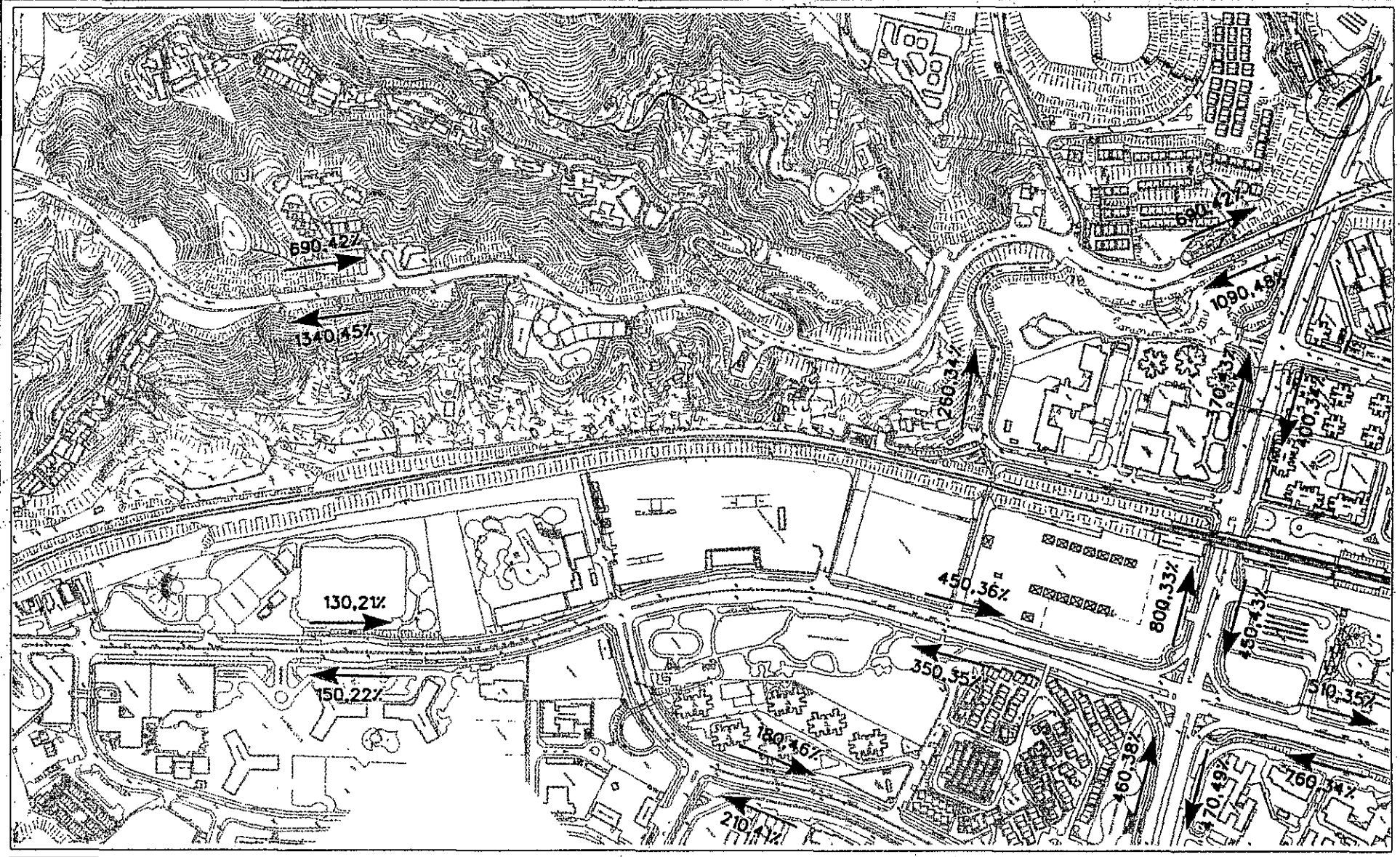

FIGURE 2.4b - PEAK HOUR TRAFFIC FLOW
FOR THE YEAR 2000

Date : Oct 97

Drawing No. /Contract/C1641/etf4

Prepared by ERM's GIS & MAPPING Group

KEY

250,20% Traffic flow in veh/hr, % heavy vehicle

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6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

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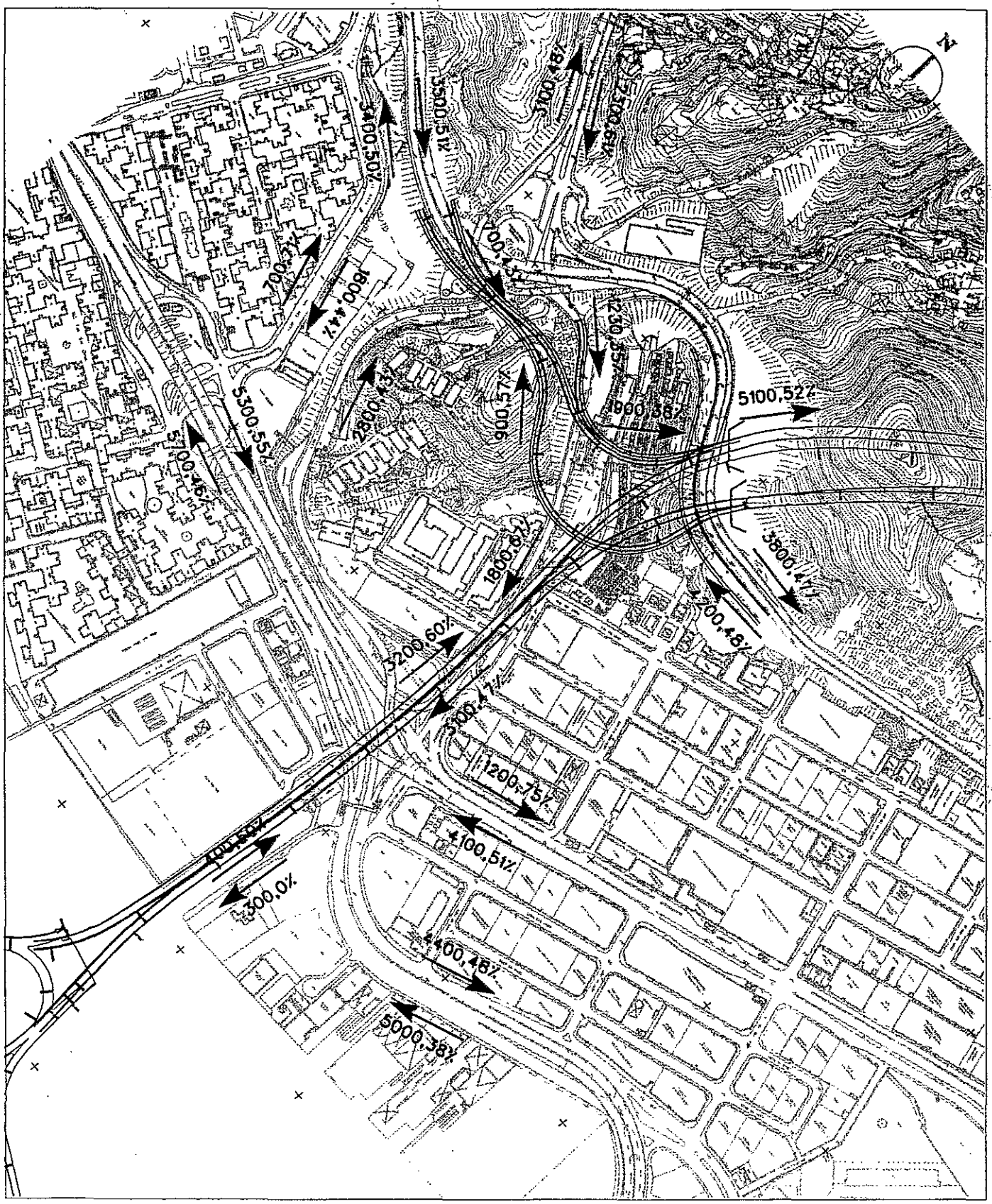

FIGURE 2.4c - PM PEAK HOUR TRAFFIC FORECASTS FOR THE YEAR 2019

Date : Oct 97

Drawing No. /Contract/C1641/etf1

KEY

1620,50% → Traffic flow in Veh/hr, % heavy vehicle

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6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

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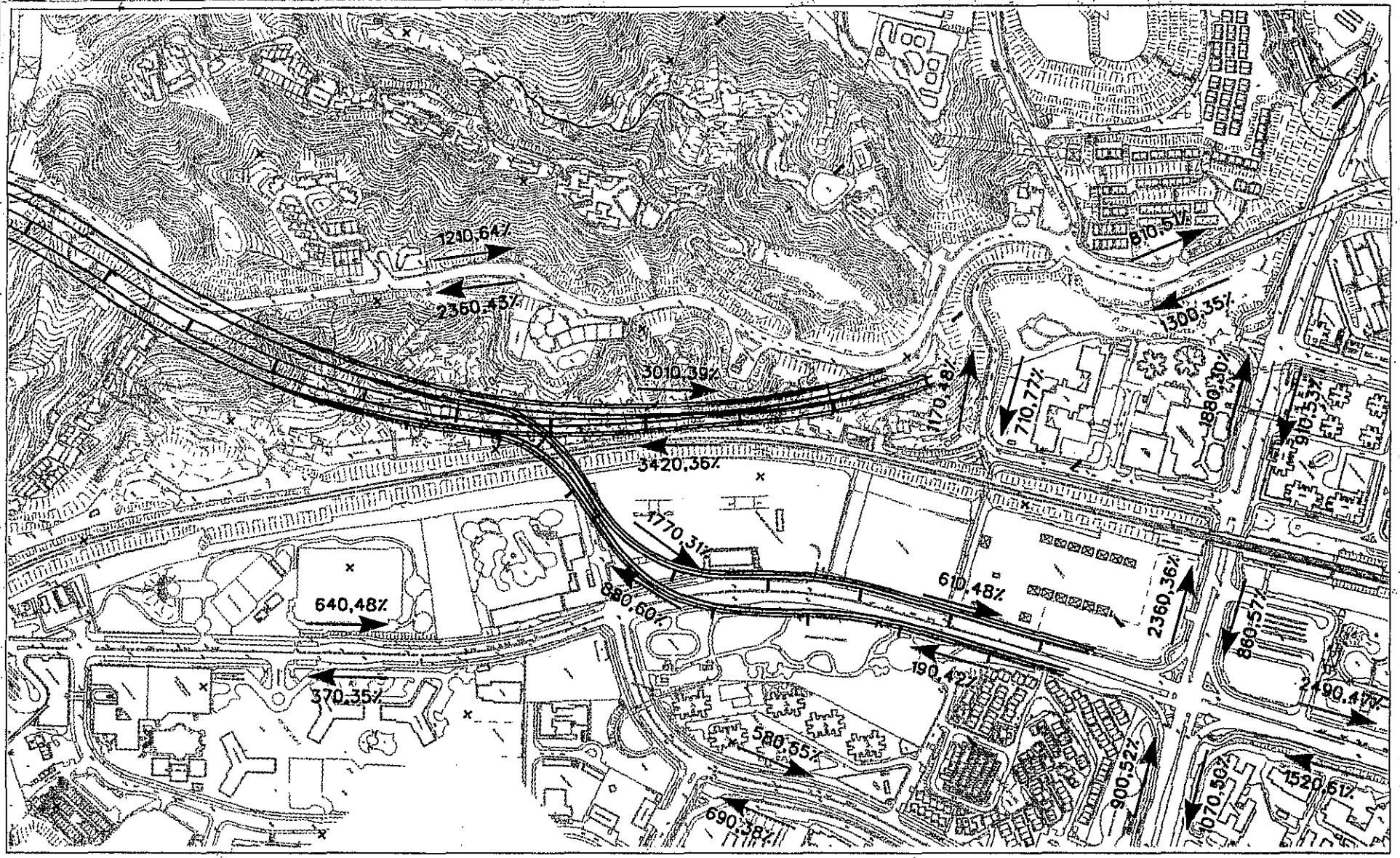

FIGURE 2.4d - PM PEAK HOUR TRAFFIC FORECAST FOR THE YEAR 2019

Date : Oct 97

Drawing No. /Contract/C1641/etf3

Prepared by ERM's GIS & MAPPING Group

KEY

250,20% Traffic flow in veh/hr, % heavy vehicle

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6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

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3. CONSTRUCTION PHASE: APPRAISAL OF ENVIRONMENTAL IMPACTS

3.1 Noise

3.1.1 Introduction

This section assesses the potential noise impact associated with the Route 16 construction based on preliminary engineering design. Practical mitigation measures are recommended, where necessary, to reduce the noise impacts at the nearby noise sensitive premises to acceptable levels.

3.1.2 Environmental Legislation and Guidelines

In Hong Kong the control of construction noise other than percussive piling during restricted hours (19:00 - 07:00 hours and all day on Sundays and Public Holidays), is governed by the Noise Control Ordinance (NCO) and the subsidiary technical memoranda namely *Technical Memorandum on Noise From Construction Work Other Than Percussive Piling* (TM1). The control of percussive piling (all day) is governed by the Technical Memorandum on Noise From Percussive Piling (TM2). These technical memoranda prescribe the permitted noise levels for construction work depending upon working hours and the existing noise climate.

A subsidiary technical memorandum, *Technical Memorandum on Noise From Construction Work in Designated Areas* (TM3), applies to Construction Works during restricted hours, within designated areas, as defined by the Noise Control (Construction Work Designated Areas) Notice, Legal Supplement No. 2 to Gazette No. 2/1996, 12 January 1996.

TM3 covers the use of the following specified powered mechanical equipment (SPME): hand-held breaker; bulldozer; concrete lorry mixer; dump truck; and hand-held poker vibrator. The prescribed construction works are: erection or dismantling formworks or scaffolding; loading, unloading or handling or rubble, wooden boards, steel bars, wood or scaffolding material; and hammering. As the project site is within the noise control designated area, TM3 will be applicable in the event of evening and night-time working.

The construction activities of the Project should be planned and controlled in accordance with the NCO. Works requiring the use of powered mechanical equipment (PME), SPME and prescribed construction works during restricted hours will require a Construction Noise Permit (CNP) and will need to achieve the applicable Acceptable Noise Levels (ANL) as stated in the TM1 & TM3 (see *Table 3.1 a & b*).

Table 3.1a Acceptable Noise Levels for Construction Noise Other Than Percussive Piling ($L_{eq,5\,min}$ dB(A))

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

Table 3.1b Acceptable Noise Levels for Construction Noise in Designated Areas ($L_{eq,5min}$ dB(A))

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

It is anticipated that the construction works will only be undertaken within the period of 07:00 to 19:00 hours Monday to Saturday except public holidays, ie normal working hours. There are currently no legislative standards in Hong Kong for the control of construction activities during normal working hours. A limit of $L_{eq,30min}$ 75 dB(A) for dwellings and 70 dB(A) for educational institutions (65 dB(A) during examination period) have been proposed in *the Practice Note for Professional Persons - Noise from Construction Activities - Non-statutory Controls, Environmental Protection Department, June 1993* (ProPECC PN2/93) for Noise Sensitive Receivers (NSRs) and will be adopted in this assessment in order to protect NSRs to an appropriate extent.

There are further subsidiary regulations, Noise Control (Hand Held Percussive Breakers) Regulations and Noise Control (Air Compressors) Regulations controlling the noise from hand held breakers and air compressors which required compliance with the relevant noise emission standards and the fixing of Noise Emission Labels to the plant (ie 114 dB(A) for hand-held breakers and 109 dB(A) for air compressors).

Percussive piling is only permitted within the constraints of a CNP. TM2 sets out the requirements for working under a CNP and determination of permitted hours of operations and other conditions, where necessary. Percussive piling is prohibited during the restricted periods unless specifically exempted. ANLs for percussive piling are set out in TM2 and are dependent on the type of NSR. However, the use of percussive pile driver is not expected in this Project and the criteria stated in TM2 would not be applicable in this assessment.

3.1.3 Baseline Conditions

3.1.3.1 Existing Conditions

The West Kowloon area surrounding the Route 16 consists of both residential and industrial buildings, with the main residential building complex and industrial buildings located on the western and eastern side of the alignment respectively. To the northern end, an existing knoll, the Lai Chi Kok Hospital and Lai Chi Kok Reception Centre and its Staff Quarters are located west of Butterfly Valley Road. The Butterfly Valley Cottage Area (Wai Man Tsuen), mainly consists of one to two storeys high village type housing, is located east to Butterfly Valley Road, with a number of existing industries and godowns located on the far eastern part of the Valley.

The noise environment of the southern end is dominated by road traffic and industrial activities. Two trunk roads, Kwai Chung Road and Ching Cheung Road, are the major traffic noise sources. The Cheung Sha Wan industrial area also have considerable noise impact upon the area.

Noise from the traffic, industry and construction all contribute to the daytime background noise levels in the area. Traffic noise is the major nighttime noise source as industrial and construction activities decreases.

The Shatin area surrounding the western end of the alignment is currently rural in nature with scattered low rise residential buildings along Tai Po Road (Woodcrest Hill, Shatin Heights) and Keng Hau Road. To the eastern end of the alignment, there are high rise residential developments along Che Kung Miu Road (Grandway Gardens, Holford Gardens, Hing Keng Estate, Carado Gardens and Sun Chiu Estate).

For the Shatin section, traffic is the major noise source, with Tai Po Road and Che Kung Miu Road being the major roads within the Study Area. In addition, train noise from KCRC railway also contributes to the ambient noise environment.

3.1.3.2 Future Conditions

In the West Kowloon area, major developments on the West Kowloon Reclamation such as the construction of Lai Wan interchange are currently in progress. It is expected that the road traffic on the West Kowloon Reclamation and Route 16 will increase the ambient noise levels in the area.

In the Shatin area, the T3 connection is proposed at the area north of Christian Alliance Cheng Wing Chee College joining to proposed Route 16 alignment. The temporary bicycle park and Hong Kong School of Motoring sites have been zoned as (OU) Other Specified Uses for 'Possible Railway Depot with Commercial/Residential Development above' (Pak Shek Layout Plan L/ST 17/1C and Sha Tin OZP. As a result, road traffic noise from Route 16 and possible train noise levels are expected to increase the future ambient noise levels.

3.1.4 Noise Sensitive Receivers

NSRs as defined by Hong Kong Planning Standard and Guideline (HKPSG) and the NCO, have been identified. List of NSRs are presented in *Table 3.1c* below. Locations of the NSR are shown in *Figures 3.1a* to *3.1d*.

Table 3.1c Location of Worst Case Representative Noise Sensitive Receivers

Section	NSR	Location
West Kowloon	WK - N1	Haking Wong T T
	WK - N2	Mei Foo Sun Chuen, Phase 4 (Block 113)
	WK - N3	LCK Reception Centre Staff Quarters
	WK - N4	LCK Hospital
	WK - N5	Mei Foo Sun Chuen, Phase 6 (Block 9)
Ventilation Building	VB - N1	Bamboo Villa
	VB - N2	Pinehill
	VB - N3	Park Mansion
	VB - N4	Residential development
Toll Plaza	TP - N1	Lot 525

Section	NSR	Location
	TP - N2	Lot 561
Shatin	ST - N1	Woodcrest Hill
	ST - N2	Keng Hau Tsuen
	ST - N3	Shatin Garden
	ST - N4	Christian Alliance Cheng Wing Chee College
	ST - N5	Carmel Alison Lam Primary School
	ST - N6	Carado Garden
	ST - N7	Tin Sam Village

3.1.5 Assessment Methodology

A methodology for assessing construction noise other than percussive piling has been developed based on TM1. In general, the methodology is as follows:

- locate representative NSRs that may affected by the works;
- calculate distance attenuation to NSRs from the notional noise source point position; and
- predicted construction noise levels at NSRs in the absence of any mitigation measures.

The distance correction for each NSRs with respect to each construction activity is calculated from the distance between the NSR and the worksite notional point. The notional point is established in accordance with TM1.

If the predicted construction noise levels are exceeded at NSRs, mitigation measures will be considered. A re-evaluation of the total SWL for activities will be made assuming the use of practicable mitigation measures such as quiet PME, movable barriers and reducing the number of noisy plant working simultaneously.

3.1.6 Source of Impact

The construction sites could be separated into six main area. These areas are as follows:

- Lai Wan to Butterfly Valley viaduct area;
- Butterfly Valley tunnel portal;
- Ching Cheung Road slip road connections;
- Ventilation building area;
- Toll plaza area; and
- Shatin area.

Based on available information, seven main construction activities associated with the construction of Route 16 have been identified to generate potential impacts at nearby NSRs. These categories are as follows:

- preparatory works
- earth work excavation
- viaduct construction
- road pavement
- removal of spoil
- portal construction
- ventilation building construction

Each construction activities will involve the use of different PME. An assumed plant inventory has been identified and is summaries in *Annex A* (*Table A1*), together with SWLs obtained from TM1.

3.1.7 Evaluation of Impacts

The unmitigated predicted noise levels at the worst case representative NSRs for each construction stage have been predicted and are shown in *Table B1* (*Annex B1*) taking into account the distance attenuation and screening effect due to natural topographical features. Considering the site geometry, a 10 dB(A) reduction has been applied to the predicted noise levels on Woodcrest Hill and on the NSRs in the Toll Plaza Areas for portal construction due to screening from natural topography.

West Kowloon section

Owing to the proximity of the construction activities, all NSRs except for Haking Wong TT and Mei Foo Sun Tsuen (Phase 4) are exposed to high levels of construction noise, up to 93 dB(A). Mitigation measures are therefore required for these NSRs in order to alleviate the noise impacts during the construction phase.

Ventilation Building

Assessment indicated that unmitigated construction activities such as removal of spoil and ventilation building foundation would only cause daytime construction exceedances, up to 78 dB(A), at Pinehill. Mitigation measures are therefore required to alleviate the noise impacts.

Toll Plaza

Exceedances of the daytime construction noise criteria, up to 96 dB(A), are predicted at both NSRs from all construction activities. Mitigation measures are therefore required to alleviate the noise impacts.

Shatin section

Owing to the proximity of the construction activities, all NSRs are exposed to high levels of construction noise, up to 97 dB(A). Mitigation measures are therefore required in order to alleviate the noise impacts during the construction phase.

3.1.8 Mitigation Measures

3.1.8.1 Recommended Mitigation Measures

Mitigation measures for each construction site are detailed below, and the following forms of mitigation measures are recommended and should be incorporated into the Contract Specifications:

- good site practice to limit noise emissions at source;
- selection of quieter plant and working methods; and
- reduction in number of plant operating in critical areas close to NSRs.

3.1.8.2 General Mitigation Measures

The Contractor may develop a different package of mitigation measures to meet the required noise standards, but the following illustrates one such package to demonstrate an approach to mitigation that would be feasible.

3.1.8.3 Good Site Practice

Good site practice and noise management can considerably reduce the impact of the construction sites' activities on nearby NSRs. The following package of measures should be followed during each phase of construction:

- only well maintained plant should be operated on-site and plant should be serviced regularly during the construction works;
- machines and plants (such as trucks, excavators) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- plant known to emit noise strongly in one direction, should, where possible, be orientated so that the noise is directed away from nearby NSRs;
- silencers or mufflers on construction equipment should be utilised and should be properly maintained during the construction works; and
- mobile plant should be sited as far away from NSRs as possible.

3.1.8.4 Selecting Quieter Plant and Working Methods

The Contractor may be able to obtain particular models of plant that are quieter than standard types given in TM1. The benefits achievable in this way will depend on the details of the Contractor chosen methods of working, and it is considered too restrictive to specify that a Contractor has to use specific items of plant for the construction operations. It is therefore both preferable and practical to specify an overall plant noise performance specification to apply to the total sound power level of all plant on the site so that the Contractor is allowed some flexibility to select plant to suit his needs.

Quiet plant is defined as PME whose actual SWL is less than the valued specified in TM1 for the same piece of equipment. Examples of SWLs for specific silenced PME, which are known to be used, are given below:

Bulldozer:	110 dB(A) max;
Breaker (Hand):	110 dB(A) max;

Compressors:	100 dB(A) max;
Concrete Pumps:	105 dB(A) max;
Dump Truck:	109 dB(A) max;
Excavator:	105 dB(A) max;
Generator:	100 dB(A) max;
Lorry:	105 dB(A) max;
Loader:	105 dB(A) max; and
Poker Vibrator:	110 dB(A) max.

It should be noted that various types of silenced equipment can be found in Hong Kong. However, EPD, when processing a CNP application, will apply the noise levels contained in the relevant statutory TM unless the noise emission of a particular piece of equipment can be validated by certificate or demonstration.

With the above quiet plant substituted in the equipment inventories given in *Table A2* (*Annex A*), the mitigated noise levels at each NSR would be shown in *Table B2*.

With the use of the above quiet plant, the noise levels could be reduced by 1 to 8 dB(A), depending on the type of construction activities operating. The construction noise levels at the NSRs have generally been reduced.

West Kowloon section

With the use of quiet plant, assessment indicates that high levels of construction noise levels, in the region of 77 to 91 dB(A), are still predicted during all construction stages at the Lai Chi Kok Reception Centre Staff Quarters.

With the use of quiet plant, assessment indicates that exceedance of the daytime construction criteria, up to 79 dB(A), is still predicted at Mei Foo Sun Chuen (Phase 6) during the construction of Lai Chi Kok Interchange.

With the use of quiet plant, construction noise levels of 71 and 74 dB(A) are still predicted at the Lai Chi Kok Hospital during the road pavement and construction of Lai Chi Kok Interchange respectively.

Further mitigation measures are therefore necessary to alleviate the noise impacts.

Ventilation building

With the use of quiet plant, the noise impacts from all construction activities could be mitigated to comply with the daytime construction noise criteria at all NSRs.

Toll Plaza

With the use of quiet plant, the noise impacts from all construction activities could be mitigated to comply with the daytime construction noise criteria at Lot 561. However, exceedances of the daytime construction noise criteria, up to 88 dB(A) are still predicted at Lot 525 during the all construction stages except for road pavement activity. Further mitigation measures are therefore necessary to alleviate the noise impacts.

Shatin section

Owing to the proximity of Tin Sam Tsuen, high levels of construction noise levels are predicted, up to 95 dB(A), during the slip road viaducts and road pavement construction stage. Further mitigation measure are therefore necessary to alleviate the noise impacts.

For Woodcrest Hill, exceedances of the daytime noise criteria, up to 79 dB(A), are still predicted during the removal of spoil construction stage. Further mitigation are therefore required.

For the residential developments along Keng Hau Road, the noise impacts from all construction activities could be mitigated to comply with the daytime construction noise criteria except for the removal of spoil and tunnel portal construction. Construction noise levels of 77 and 79 dB(A) are predicted during the removal of spoil and tunnel portal construction stage.

For Shatin Heights, the noise impacts from all construction activities except for earthwork excavation could be mitigated to comply with the daytime construction noise criteria. Construction noise levels of 80 dB(A) are predicted during the earthwork excavation construction stage.

For Carado Garden, the noise impacts from all construction activities except for slip road construction could be mitigated to comply with the daytime construction noise criteria. Construction noise levels of 77 dB(A) are predicted during the slip road construction stage.

With the use of quiet plant, the noise impacts from all construction activities could be mitigated to comply with the daytime construction noise criteria at the Cheng Wing Chee College and Carmel Alison Lam primary school.

3.1.8.5 Reducing the Number of Plant Operating in Critical Areas Close to NSRs

In general the number of plants should be left to the choice of the Contractor. However, in some cases it may be appropriate to restrict the number of particularly noisy plant operating within certain parts of the site that are very close to the NSRs. The effect of limited the number of plants working concurrently have been investigated and the results are presented in *Table B3*.

West Kowloon section

Results indicated that with the incorporation of quiet plant and limiting the number of plant operating concurrently, the noise impacts from the preparatory works and portal construction could be mitigate to comply with the daytime construction noise criteria at all NSRs.

However exceedances of the daytime construction noise criteria are still predicted at Mei Foo Sun Chuen, Phase 6, Lai Chi Kok Reception Centre Staff Quarters and Lai Chi Kok Hospital during the interchange, viaduct and road pavement construction activities. Further mitigation measures are therefore required.

Toll Plaza

Exceedances of the daytime construction noise criteria are still predicted at Lot 525 during all construction activities except portal construction activities. Further mitigation measures are therefore required.

Shatin section

Exceedances of the daytime construction noise criteria are still predicted at Woodcrest Hill, Keng Hau Road, Shatin Heights, Tin Sam Tsuen and Carado Garden during all construction activities. Further mitigation measures are therefore required.

3.1.8.6 Constructing Temporary and Movable Noise Barriers

In general, vertical noise barriers between 3m to 5m high located along the site boundaries between noisy construction activities and NSRs could give up to 5 dB(A) reduction from screening (estimated in accordance with TM1). Owing to the low rise nature of Tin Sam Tsuen and Lot 525, a 5 dB(A) reduction is considered to be achievable by using 5m high temporary noise barrier, in the form of site hoardings, located along worksite boundary.

Predicted noise levels indicated that with the incorporation of quiet plant and temporary noise barriers, exceedances of the daytime onstruction noise criteria are still predicted at Lot 525 and Tin Sam Tsuen. Further mitigation measures are considered

Based on the site geometry, other NSRs in the vicinity of the worksite are not expected to be protected by the use of temporary noise barriers located along site boundaries. However, movable barriers could be very effective in providing noise screening from a particular plant. It is anticipated that a 3m high movable noise barrier with a skid footing and a small cantilevered upper portion can be located with a few meters of static plant and within about 5m of more mobile plant such as excavators, bulldozers, loaders, etc. It is estimated that movable noise barrier of this types, if carefully located, can produce at least 10 dB(A) screening for static plant and 5 dB(A) for mobile plant. The noise screening benefit for each plant considered in this assessment is listed as follows:

- stationary plant - assuming 10 dB(a) reduction: vibratory poker, compressor, concrete pump, drilling rigs, generator, various hand tools; and
- mobile plant - assuming 5 dB(A) reduction: bulldozer, excavator, scraper, grader, lorry, roller, asphalt paver, loader and crane.

West Kowloon section

Results indicated that with the incorporation the use of quiet plant, limiting the number of plant and movable barriers, the noise impacts from all construction activities could be mitigate to comply with the daytime construction nose criteria at Mei Foo Sun Chuen (Phase 6) and Lai Chi Kok Hospital.

However, due to the proximity of the Lai Chi Kok Reception Centre Staff Quarters, exceedances of the daytime construction noise criteria are still predicted during the interchange, viaduct and road pavement construction stages.

Shatin section

Results indicated that with the incorporation the use of quiet plant, limiting the number of plant and movable barriers, the noise impacts from all construction activities could be mitigate to comply with the daytime construction nose criteria at Woodcrest Hill, Keng Hau Road and Carado Garden.

However, due to the proximity of Shatin Heights, exceedances of the daytime construction noise criteria are still predicted during the earthwork excavation construction stages.

As can be seen from *Table B4* in *Annex B*, the use of the above described mitigation measures are insufficient in reducing the construction noise levels to NSRs to below the daytime noise criteria. These predictions, however, represent the theoretically worst possible scenario, but are in fact unlikely as it would required all noisy plant to be operating concurrently at the nearest notional point of each works area (most worksites are long and thin) to the NSRs, and to be fully active at exactly the same time. However, it is possible that these levels of impact, or impacts approaching these, could occur for a short duration.

Therefore, additional mitigation measures such as avoidance of simultaneous noisy activities and further reduction in the numbers of plant teams operating in critical areas close to NSRs may be required from time to time. Since it is difficult to provide quantitative predictions for these effects and to identify when they will occur, regular monitoring of noise at the NSRs reported in *Table B4*, will be required during the construction phases. This will enable the contractor to react if the assessment criteria are approached and to reduce noise emission at specific areas. *Table 3.1d* below summarises the predicted noise levels from each construction activities.

Table 3.1d Predicted Construction Noise Levels

Construction Activties	No Mitigation	Mitigation 1	Mitigation 2	Mitigation 3
Haking Wong T T				
LCK viaduct	73	71	68	64
Road pavement	68	66	65	64
Mei Foo Sun Chuen - Block 110				
LCK viaduct	68	66	63	60
Road pavement	63	61	60	59
Mei Foo Sun Chuen - Block 9				
LCK interchange - substructure	82	79	77	73
LCK interchange - superstructure	72	72	72	67
Road pavement	77	75	74	73
LCK Reception Centre - Staff Quarters				
Preparatory works	82	75	72	70
Portal Construction	80	77	74	70
LCK interchange - substructure	93	90	88	85
LCK interchange - superstructure	83	83	83	78
LCK viaduct	93	91	88	85
Road pavement	88	86	85	84
LCK Hospital				
LCK interchange - substructure	77	74	73	69

Construction Activties	No Mitigation	Mitigation 1	Mitigation 2	Mitigation 3
LCK interchange - superstructure	68	68	68	63
Road pavement	72	71	70	69
Bamboo Villa				
Removal of spoil	71	64	61	61
Ventilation building foundation	70	63	60	60
Superstructure	63	62	58	56
Pinehill				
Removal of spoil	78	71	68	68
Ventilation building foundation	77	70	67	67
Superstructure	70	69	65	63
Park Mansion				
Removal of spoil	68	62	59	59
Ventilation building foundation	68	60	58	57
Superstructure	61	60	56	53
New residential building				
Removal of spoil	75	69	66	66
Ventilation building foundation	74	67	64	64
Superstructure	67	66	62	60
Lot 525				
Earthwork excavation	86	79	76	71
Removal of spoil	96	88	86	81
Road pavement	76	74	72	67
Portal construction	79	79	76	71
Lot 561				
Earthwork excavation	78	70	67	62
Removal of spoil	82	74	72	67
Road pavement	68	65	64	59
Portal construction	84	74	71	66
Woodcrest Hill				
Earthwork excavation	83	75	73	66

Construction Activties	No Mitigation	Mitigation 1	Mitigation 2	Mitigation 3
Road pavement	73	71	69	61
Removal of spoil	80	79	76	75
Portal construction	72	71	69	71
Keng Hau Road				
Earthwork excavation	76	69	67	66
Road pavement	67	65	63	61
Removal of spoil	78	77	74	73
Portal construction	80	79	76	71
Shatin Heights				
Earthwork excavation	87	80	78	77
Slip road viaducts - substructure	76	74	72	70
Slip road viaducts - superstructure	69	69	66	61
Road pavement	78	75	74	72
Removal of spoil	70	69	66	66
Portal construction	73	72	69	63
Cheng Wing Chee College				
Earthwork excavation	78	70	68	67
Slip road viaducts - substructure	69	67	64	63
Slip road viaducts - superstructure	62	62	59	54
Road pavement	68	66	64	62
Tin Sam Tsuen				
Slip road viaducts - substructure	97	95	92	87
Slip road viaducts - superstructure	90	90	87	82
Road pavement	93	91	89	84
Carado Garden				
Slip road viaducts - substructure	80	77	75	73
Slip road viaducts - superstructure	73	73	69	64
Road pavement	76	73	72	70
Carmel Alison Lam School				
Slip road viaducts - substructure	72	70	68	66

Construction Activties	No Mitigation	Mitigation 1	Mitigation 2	Mitigation 3
Slip road viaducts - superstructure	75	65	68	57
Road pavement	69	66	65	63

Summary of the noise exceedances are presented in *Table 3.1e* below.

Table 3.1e Summary of Noise Exceedances

NSR	Construction Activities	Predicted Noise Levels	Duration (months)
LCK Reception Centre - Staff Quarters	LCK interchange - substructure	85	6
	LCK interchange - superstructure	78	3
	LCK viaduct	85	4
	Road pavement	84	2
Lot 525	Removal of spoil	81	
Shatin Heights	Earthwork excavation	77	10
Tin Sam Tsuen	Slip road viaducts - substructure	87	6
	Slip road viaducts - superstructure	82	3
	Road pavement	84	2

It has been assumed in the assessment that each construction stage would last for 4 months at each works area. However, it is expected not all noisy plant assumed in this assessment would be operating concurrently during the full construction period at the nearest notional point of each works area. Therefore, the duration or the levels of noise impact at the affected NSRs listed in *Table 3.4b* only present the theoretically worst possible scenario.

If there is any construction work during the restricted hours, it is the responsibility of the contractors to comply with the NCO and relevant TMs. The contractor should submit CNPs application and will be assessed by the Noise Control Authority. Conditions stipulated in CNPs should be strictly followed.

A summary of the recommended mitigation measures for each construction activities is presented in *Table 3.1f* to *3.1i* below.

Table 3.1f Summary of Proposed Mitigation Measures for West Kowloon Works

Task	Mitigation Measures
Preparatory Works	Use of Quiet Plant and reducing the number of each type of PME
Portal Construction	Use of Quiet Plant and reducing the number of each type of PME
LCK interchange - substructure	Use of Quiet Plant, reducing the number of each type of PME, the use of movable noise barrier and EM&A monitoring
LCK interchange - superstructure	Use of Quiet Plant, reducing the number of each type of PME, the use of movable noise barrier and EM&A monitoring
Viaduct construction	Use of Quiet Plant, reducing the number of each type of PME, the use of movable noise barrier and EM&A monitoring
Road pavement	Use of Quiet Plant, reducing the number of each type of PME, the use of movable noise barrier and EM&A monitoring

Table 3.1g Summary of Proposed Mitigation Measures for Ventilation Building

Task	Mitigation Measures
Removal of spoil	Use of Quiet Plant
Building foundation	Use of Quiet Plant
Superstructure	Use of Quiet Plant

Table 3.1h Summary of Proposed Mitigation Measures for Toll Plaza

Task	Mitigation Measures
Earthwork excavation	Use of Quiet Plant, reducing the number of each type of PME and installation of 5m hoarding along site boundary
removal of spoil	Use of Quiet Plant, reducing the number of each type of PME and installation of 5m hoarding along site boundary
Road pavement	Use of Quiet Plant, reducing the number of each type of PME and installation of 5m hoarding along site boundary
Portal construction	No mitigation measures required

Table 3.1i Summary of Proposed Mitigation Measures for Shatin Works

Task	Mitigation Measures
Earthwork excavation	Use of Quiet Plant, reducing the number of each type of PME, the use of movable noise barrier and EM&A monitoring
Slip road construction - substructure	Use of Quiet Plant, reducing the number of each type of PME, the use of movable noise barrier and EM&A monitoring
Slip road construction - superstructure	Use of Quiet Plant, reducing the number of each type of PME, the use of movable noise barrier and EM&A monitoring
Road pavement	Use of Quiet Plant, reducing the number of each type of PME, the use of movable noise barrier and EM&A monitoring
Removal of spoil	Use of Quiet Plant, reducing the number of each type of PME and the use of movable noise barrier
Portal construction	Use of Quiet Plant, reducing the number of each type of PME and the use of movable noise barrier

3.1.9 EM&A Requirements

It is recommended that noise monitoring be carried out during the construction period of the Route 16 at Lai Chi Kok Reception Centre Staff Quarters, Mei Foo Sun Chuen (Phase 6), Lai Chi Kok Hospital, Pinehill, Lot 525, Shatin Heights, Ching Wing Chee college and Tin Sam Tsuen. The monitoring is required to ensure compliance with the ProPECC guidelines in providing feedback to the Contractors for the management of their operations. The EM&A programme for the Project has been developed and is presented in details in the separate EM&A Manual.

3.1.10 Conclusions

Unmitigated construction activities of Route 16 would cause exceedances of the daytime construction criteria of 75 dB(A) at most of the nearby NSRs during the weekday daytime hours as well as the 65 dB(A) noise criteria for schools for the portal construction, earthwork excavation, viaduct construction and removal of spoil. The worst affected NSRs in West Kowloon area are the Lai Chi Kok Reception Centre Staff Quarters, Mei Foo Sun Chuen (Phase 6) and Lai Chi Kok Hospital. For the toll plaza area the worst affected NSRs are the new residential development along Tai Po Road (Lot 525). For the Shatin area the worst affected NSRs are Shatin Heights, Woodcrest Hill, Christian Alliance Cheng Wing Chee College, Keng Hau Village, Carado Garden and Tin Sam Tsuen.

Therefore, adequate control measures will be necessary for the works to meet the criteria. Mitigation measures including the use of quiet plant, on-site movable noise barriers, limited the number of plant operating concurrently are required. It is also recommended that regular monitoring of noise at NSRs will be required during the construction phase.

If construction works are to be carried out during restricted hours (19:00 - 07:00 hours on weekdays and all hours on Sundays and Public Holidays), further mitigation measures will be required. Such work will require the granting of a Construction Noise Permit by the EPD.

3.2 Air Quality

3.2.1 Introduction

This section assesses the potential air quality impacts associated with the construction of Route 16 on air sensitive receivers. Dust impact upon the receivers is the key issue during construction and the worst case impacts on the receivers have been modelled. Mitigation measures required to protect the sensitive receivers are also recommended for any exceedance of environmental criteria.

3.2.2 Environmental Legislation and Guidelines

The criteria for evaluating air quality impacts is laid out in the *Technical Memorandum on Environmental Impact Assessment Process* (TM). The relevant criteria to this Study are given below.

The principal legislation for the management of air quality is the *Air Pollution Control Ordinance* (APCO) (Cap 311). The whole of the Hong Kong Territory is covered by the *Hong Kong Air Quality Objectives* (AQOs) which stipulate the statutory limits of some typical air pollutants and the maximum allowable numbers of exceedance over specific periods. The AQOs are shown in *Table 3.2a* below.

Table 3.2a Hong Kong Air Quality Objectives ($\mu g\ m^{-3}$) (i)

Pollutant	Averaging Time			
	1 Hour (ii)	8 Hours (iii)	24 Hours (iii)	1 Year (iv)
Total Suspended Particulates (TSP)	-	-	260	80
Respirable Suspended Particulates (v) (RSP)	-	-	180	55
Sulphur Dioxide (SO_2)	800	-	350	80
Nitrogen Dioxide (NO_2)	300	-	150	80
Carbon Monoxide (CO)	30,000	10,000	-	-
Photochemical Oxidants (as ozone (vi))	240	-	-	-

(i) Measured at 298K (25°C) and 101.325 kPa (one atmosphere).

(ii) Not to be exceeded more than three times per year.

(iii) Not to be exceeded more than once per year.

(iv) Arithmetic means.

(v) Respirable suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 10 micrometres and smaller.

(vi) Photochemical oxidants are determined by measurement of ozone only.

The TM stipulates that the hourly TSP of 500 $\mu g\ m^{-3}$, measured at 298K and 101.325 kPa, should not be exceeded for construction dust impact assessment.

3.2.3 Baseline Conditions

Air quality of the West Kowloon area is considered poor mainly attributed to the industrial emissions from Cheung Sha Wan and vehicle emissions from Ching Cheung Road, Lai Chi

Kok Road and associated network. Vehicle exhausts are the dominating pollutants in the Shatin area.

The nearest EPD air quality monitoring stations are the Sham Shui Po station (located at Yen Chow Street, Sham Shui Po) and the Shatin station (located at Man Lai Road, Tai Wai, Shatin). The latest available annual averages of pollutants for the year 1995 at the Sham Shui Po and Shatin monitoring station are presented in *Table 3.2b*. The high TSP level at the Sham Shui Po station suggested that the West Kowloon area was affected by the heavy construction of the West Kowloon Reclamation and its associated projects in 1995. It is likely that the dust levels of West Kowloon will be reduced with the completion of these major construction projects.

Table 3.2b Background Air Quality ($\mu g\ m^{-3}$)

Pollutant	Annual Average (1995)	
	Sham Shui Po	Shatin
TSP	99	73
RSP	60	50
SO_2	20	13
NO	54	33
NO_2	67	44
CO	1220[1]	1220[1]
O_3	29[2]	29[2]

(1) Monitored at the Mongkok Station.

(2) Monitored at the Kwai Chung Station.

3.2.4 Air Sensitive Receivers

Representative air sensitive receivers (ASRs) have been identified according to the criteria set out in the TM, through site inspections and review of landuse plans of the Study Area. The ASRs and their horizontal distances from kerbside of Route 16 alignment are listed in *Table 3.2c*. Locations of the ASRs are shown in *Figures 3.2a &b*.

It is understood that the Wai Man Tsuen will be resumed as a work areas and therefore will not be considered as an ASR for the construction of Route 16.

Table 3.2c Location of Air Sensitive Receivers

Section	ASR	Location	Horizontal Distance from Alignment (m)
West Kowloon	WK-A1	Tung Yuen Industrial Building	30
	WK-A2	Hop Hing Industrial Building	25
	WK-A3	Cheung Sha Wan Cooked Food Market	30
	WK-A4	Lai Chi Kok Reception Centre Staff Quarters	25

Section	ASR	Location	Horizontal Distance from Alignment (m)
	WK-A5	Yee Lee Industrial Building	110
	WK-A6	Mei Foo Sun Chuen, Phase 4	260
	WK-A7	Mei Foo Sun Chuen, Phase 5	70
	WK-A8	Lai Chi Kok Hospital	50
Shatin	ST-A1	Keng Hau Village	110
	ST-A2	Woodcrest Hill	80
	ST-A3	Shatin Heights	50
	ST-A4	Shatin Riding School	160
	ST-A5	Chik Wan Street Rest Garden	200
	ST-A6	Lau Pak Lok Secondary School	200
	ST-A7	Holford Garden	230
	ST-A8	Tai Wai New Village	240
	ST-A9	Tai Wai Public School	450
	ST-A10	Hin Tin Swimming Pool	40
	ST-A11	Hong Kong School of Motoring	15
	ST-A12	Che Kung Mui Road Playground	30
	ST-A13	Tin Sam Village	10
	ST-A14	Residential Development at DD 187 Lot 561	165
	ST-A15	Residential Development at DD 187 Lot 525	80
	ST-A16	Hin Tin Playground	100
	ST-A17	Hung Mui Kuk Road Playground	100

3.2.5 Potential Sources of Impact

Two work sites, Lai Chi Kok work area and toll plaza work area, have been identified for the construction of Route 16.

The excavation rates of the tunnel will vary with the wet/dry conditions and class of rock encountered. An advancement ranging from 1.5 m to 28 m per week per bore is expected. The excavated materials will be trucked directly to fill or off site for disposal. It is estimated that a maximum of 120 trucks per hour is required at the site. The Lai Chi Kok area will require 350,000 m^3 fill. Small amount of materials may be stockpiled in the toll plaza area.

Blasting is required for portal and tunnel construction. During blasting, hard material will be fragmented and flying rock together with dust are expected during the initial blasting around the partial areas. Fugitive dust will be dispersed within short period of time. High dust deposition and TSP levels are expected at the receptors downwind. It is understood that the blasting will not occur at the West Kowloon end of the Eagle's Nest tunnel.

The latest available information indicates that both concrete batching and rock crushing activities will not be conducted on-site.

The likely air quality impact arising from the construction works are related to dust nuisance and the likely dusty activities at the work sites are shown in *Table 3.2d* below. It is assumed that the road construction works will be conducted along the proposed alignment.

Table 3.2d Dust Generating Activities at the Work Area

Work Area	Dusty Activities
Butterfly Valley	Bulldozing
	Excavation
	Material handling
Toll plaza	Bulldozing
	Blasting
	Excavation
	Haulage of truck
	Material handling
	Stockpiling

It is expected that the haulage of trucks over unpaved roads will be the major dusty source. Bulldozing, excavation, blasting and materials handling will also be dusty. Wind erosion over the stock pile and stored in the open area could be very dusty especially in the dry period. As indicated in the construction programme in *Figure 2.3a*, the bulldozing and stockpiling will not be carried out in parallel. Also, it is expected that blasting will not occurred simultaneously with other construction activities.

Construction works will be carried out both inside and outside the tunnel. It is expected that the working hours per day are 12 hours outside the tunnels and 24 hours inside the tunnels.

SO_2 and NO_2 will be emitted from the diesel-powered equipment used. However, since the number of such plant required on-site will be limited, their gaseous emissions will be minor. It is therefore not expected to cause the AQO of these gases to be breached from the limited construction plant.

3.2.6 Assessment Methodology

The *Fugitive Dust Model (FDM)* was used to predict the likely dust impacts at the ASRs from the construction of Route 16. Particulate emission rates and particle size distributions for the identified potential dusty sources were determined based on the US EPA publication *Compilation of Air Pollutant Emission Factors* (AP-42) *5th Edition*, as shown in *Table 3.2e*. Average dust density of 2,500 kg m^{-3} was assumed in this study.

Table 3.2e Emission Rates for Identified Dusty Source

Activity	Emission Rate	Remarks
Bulldozing	0.5 g s^{-1}	• 30% of the site is active • silt content: 6.9% • moisture content: 7.9%
Excavation	0.4 g Mg^{-1}	
Material Handling	0.169 g Mg^{-1}	• moisture content: 4.8%
Stockpiling	0.85 Mg $hectare^{-1}$ yr^{-1}	
Blasting	$0.0022A^{1.5}$ kg/blast	• blasting area: 80 m^2
Truck Haulage	4.377 g hr^{-1} m^{-1}	• silt content: 8.4% • vehicle speed: 30 km hr^{-1} • vehicle weight: 30 Mg
Infrastructure Construction	7.2×10^{-6} g s^{-1} m^{-2}	• 30% of the site is active

Meteorological data (wind speed, wind direction, stability class, temperature and mixing height) were obtained from the Hong Kong Observatory's station at Cheung Sha Wan and Shatin. It is understood that the works outside tunnel will be carried out between 07.00 - 19.00 hours, and hence only meteorological data within that construction period were used for the modelling of hourly maximum pollutants levels. The 24 hour meteorological data (00.00 - 24.00 hours) are used to model the daily average pollutant concentration.

3.2.7 Evaluation of Impacts

The predicted cumulative dust levels at the West Kowloon and Shatin areas are shown in *Tables 3.2f & g*. The dust impacts are determined by the extent of construction activities as well as the separation of the ASRs and work sites. Dusty construction activities including bulldozing, excavation, materials handling, stockpiling, blasting, truck haulage and infrastructure construction are included in the model. It is expected that there will be two blasts per day with time lapse of at least four hours. During blasting, all other activities will be stopped. As fugitive dust from blasting will be dispersed within short period of times, dust levels at the ASRs, attributed to blasting, is low. The modelled results show that dust levels at some ASRs would exceed the AQO.

West Kowloon

The dust criteria will be satisfied at all ASRs in West Kowloon except for WK-A4 (Lai Chi Kok Reception Centre). The high dust level at the ASRs is attributed to its proximity to the Lai Chi Kok Work site. Highest hourly and daily dust level of 769 and 219 μg m^{-3} were predicted at the ASRs.

Table 3.2f Predicted Dust Levels at ASRs (West Kowloon)

ASR	Height (mPD)	Concentration of TSP (μg m^{-3}) (1)	
		Hourly average (2)	Daily average
WK-A1	7	383	150
	15	358	143
	25	265	130
WK-A2	57	418	159
	15	426	155
	25	310	137
WK-A3	7	356	138
	15	301	133
	25	229	124
WK-A4	7	518	178
	15	769	219
	25	375	155
WK-A5	7	403	159
	15	441	154
	25	328	141
WK-A6	7	285	126
	15	249	123
	25	213	118
WK-A7	7	418	157
	15	379	150
	25	309	136
WK-A8	28	201	133
	38	164	117
	48	147	109

(1) Predicted concentration included background TSP level of 99 μg m^{-3}

(2) Figures in **underline** exceed the dust criteria.

Shatin

The predicted dust levels at the ASRs in Shatin are high. The hourly criteria of 500 μg m^{-3} will be exceeded at a number of ASRs. Highest hourly and daily dust level of 893 and 193 μg m^{-3} were predicted at ST-A3 and ST-A11 respectively. The high dust impacts at the receivers are attributed to the high volume of haul road traffic and proximity of the ASRs to the work site.

Table 3.2g Predicted Dust Levels at ASRs (Shatin)

ASR	Height (mPD)	Concentration of TSP ($\mu g\ m^{-3}$)[1]	
		Hourly Average[2]	Daily Average
ST-A1	51.5	773	156
	60	658	147
	70	535	135
ST-A2	36.5	830	163
	45	744	155
	55	643	146
ST-A3	21.5	893	187
	30	820	176
	40	729	164
ST-A4	40	521	132
	48	482	128
	53	459	125
ST-A5	1.5	672	148
	10	674	147
	20	624	138
ST-A6	1.5	597	142
	10	608	141
	20	571	134
ST-A7	1.5	563	137
	10	577	137
	20	544	130
ST-A8	11.5	549	141
	20	525	135
	30	492	128
ST-A9	1.5	455	129
	10	473	130
	20	453	125
ST-A10	1.5	799	162
ST-A11	1.5	797	193
ST-A12	1.5	612	141
ST-A13	1.5	509	118
	10	526	117
	20	498	112
ST-A14	1.5	339	111
	10	281	105

ASR	Height (mPD)	Concentration of TSP ($\mu g\ m^{-3}$)[1]	
		Hourly Average[2]	Daily Average
	20	225	100
ST-A15	1.5	307	98
	10	283	93
	20	259	89
ST-A16	1.5	322	266
ST-A17	1.5	186	170

(1) Predicted concentration included background TSP level of 73 $\mu g\ m^{-3}$

(2) Figures in **underline** exceed the dust criteria.

3.2.8 Mitigation Measures

As presented above, the construction work is likely to caused unacceptable dust impact on a number of ASRs. The following dust control measures should be incorporated in the Contract Specification and implemented to minimize dust nuisance to within acceptable levels arising from the works:

- dropping heights for excavated materials should be controlled to a practical height to minimize the fugitive dust arising from unloading;
- during transportation by truck, materials should not be loaded to a level higher than the side and tail boards, and should be dampened or covered before transport;
- all stockpiles of aggregate or spoil should be enclosed or covered and water applied in dry or windy condition;
- effective water sprays should be used on the site at potential dust emission sources such as unpaved area, tunnel work areas and active construction areas.
- haul road should be located away from ASRs as far as practicable; watered regularly to maintain a high moisture content of soil;
- the travelling speed should be reduced to 10 kph to reduce the traffic induced dust dispersion and re-suspension from the operating haul trucks;
- wheel washing facilities should also be installed and used by all vehicles leaving the site; and

During blasting, the following measures should be implemented to minimize dust impact:

- wire mesh, gunny sack and sandbag should be used on top of the blast area on each shot for preventing flying rock can also reduce the fugitive dust generation;
- water the surface of the blast area to increase its moisture content;
- dust filters should be placed around the portals; and
- blast door fitted at the portals could further contain dust debris from the tunnelling works.

In order to assess the effectiveness of the mitigation measures, the dust control efficiency adopted in AP-42 was employed. It is assumed that the regular watering on active

construction areas would reduce dust emissions by 50%. If the truck speed could be limited to 10 kph, re-suspension of fine materials could be reduced by 67 %. Regular watering of haul road could further reduce its emission to over 83%. With the above measures, the dust levels at the ASRs will be reduced and modelling results were tabulated in *Table 3.2h & i.*

West Kowloon

Table 3.2h Predicted Mitigated Dust Levels at ASRs (West Kowloon)

ASR	Height (mPD)	Concentration of TSP ($\mu g\ m^{-3}$)[1]	
		Hourly average	Daily average
WK-A1	7	241	124
	15	228	121
	25	182	115
WK-A2	57	258	129
	15	262	127
	25	205	118
WK-A3	7	227	118
	15	199	116
	25	163	112
WK-A4	7	309	138
	15	434	159
	25	237	127
WK-A5	7	251	129
	15	270	127
	25	213	120
WK-A6	7	193	113
	15	172	111
	25	156	108
WK-A7	7	258	128
	15	239	124
	25	204	118
WK-A8	28	150	116
	38	131	108
	48	122	104

(1) Predicted concentration included background TSP level of 99 $\mu g\ m^{-3}$

Shatin

Table 3.2i Predicted Mitigated Dust Levels at ASRs (Shatin)

ASR	Height (mPD)	Concentration of TSP (µg m^{-3})[1]	
		Hourly Average	Daily Averages
ST-A1	51.5	190	89
	60	171	87
	70	151	85
ST-A2	36.5	201	90
	45.4	186	89
	55	169	87
ST-A3	21.5	218	95
	30	204	93
	40	186	91
ST-A4	45	175	96
	53	167	95
	63	162	94
ST-A5	8.7	254	102
	17.2	249	102
	27.2	232	100
ST-A6	8.7	218	98
	17.2	218	99
	27.2	207	98
ST-A7	8.7	207	96
	17.2	208	97
	27.2	199	95
ST-A8	31.5	189	96
	40	183	95
	50	175	94
ST-A9	8.7	167	91
	40	170	92
	50	166	91
ST-A10	12.8	196	91
ST-A11	9.5	270	118
ST-A12	8.5	166	89
ST-A13	8.5	155	82
	17	157	82
	27	151	81
ST-A14	91.5	120	81

ASR	Height (mPD)	Concentration of TSP (μg m^{-3})(1)	
		Hourly Average	Daily Averages
	100	110	80
	110	106	79
ST-A15	139.5	122	80
	148	118	79
	158	114	78
ST-A16	1.5	146	129
ST-A17	1.5	107	101

(1) Predicted concentration included background TSP level of 73 μg m^{-3}

It can be seen that the mitigated dust levels at the ASRs will be considerably reduced and both the hourly and daily dust criteria will be satisfied. The recommended mitigation measures can suppress the dust emissions effectively.

Environmental monitoring and audit (EM&A) for dust generated during the construction phase should also be undertaken at appropriate ASRs to ensure that the dust criteria will not be exceeded. The EM&A requirements are presented in *Section 5.*

3.2.9 Conclusions

TSP is the major pollutant during construction of Route 16. Dust dispersion model was employed to predict the impact upon ASRs.

Dust impacts in some construction periods will be high due to the high dust emissions from the site and proximity of ASRs. Major dust generating activities will be unpaved haul roads, infrastructure construction, bulldozing, stockpiling excavation and material handling. Dust suppression measures such as watering, speed control on vehicles, routing haul road away from ASRs, have been recommended to reduce the dust impacts on ASRs to comply with the dust criteria.

3.3 Water Quality

3.3.1 Introduction

This section presents the water quality impacts associated with the construction of Route 16. As indicated in the Initial Assessment Report, the extent of construction water quality impact of Route 16 Dual-3 scheme will be similar to that of the Dual-2 scheme assessed in the previous endorsed Feasibility Study. This final water quality assessment summarises the findings in the Initial Assessment Report, and incorporates updated preliminary engineering design information that is available to determine the extent of potential water quality impact upon the sensitive receivers along the road alignment.

3.3.2 Baseline Conditions

In order to evaluate the water quality impacts resulting from Route 16, the water sensitive receivers (WSRs) have been identified in accordance with the *Hong Kong Planning Standards and Guidelines* (HKPSG), which provide criteria for identifying environmental

factors influencing proposed developments. The major water bodies along the alignment of Route 16 include:

- Victoria Harbour in the West Kowloon section;
- Tolo Harbour, Shing Mun River and a number of small streams at the Pak Shek village in the Shatin section; and
- a small stream near the ventilation building besides Tai Po Road near So Uk.

Only the small streams at the Pak Shek village and Toll Plaza, and the small stream near the ventilation building will be directly affected by the Route 16 construction activities. Victoria Harbour, Tolo Harbour and Shing Mun River are the downstream receiving water bodies and located outside the construction area; these are located 1.5 km, 6.5 km and 1 km from the nearest works, respectively.

3.3.2.1 West Kowloon Section

Major biological sensitive receivers such as mariculture zones, or commercial fisheries, are not found in the Victoria Harbour. Owing to the highly urbanized nature of the Kowloon peninsula there are no natural streams located within the West Kowloon construction area.

3.3.2.2 Shatin Section

Tolo Harbour is a partially enclosed water body which has used for commercial fisheries and includes three designated mariculture zones (about 9 km away from the nearest works), a sea bird roosting area (about 9 km away from the nearest works) and non-gazetted beaches along the coasts of Ma On Shan and Tai Po area (about 12 km from the nearest works). The water quality of Tolo Harbour has been improved in recent years as reported in the *EPD (1996), Marine Water Quality in Hong Kong for 1995*, but still show signs of pollution.

Shing Mun River is the main river channel of the south New Territories, which intercepts the flows from the upland and lowland areas adjacent to Tai Wai and Shatin, and drains into inner Tolo Harbour. The Shing Mun River has been used for secondary contact recreation such as boating. The water quality of Shing Mun River has been reported to show a gradual improvement. The *EPD (1996), River Water Quality in Hong Kong for 1995* has reported that the water quality of various Shing Mun River tributaries in 1995 ranging from fair to excellent in EPD's Water Quality Index for Inland Waters of Hong Kong.

There are also a number of local small streams that run through the agricultural area at the Pak Shek village in Shatin, where an embankment will be constructed to connect the northern portal of the Shatin Heights tunnel. These local streams could be modified or diverted to facilitate the construction of the proposed alignment.

3.3.3 Government Legislation and Standards

Under the Technical Memorandum on Environmental Impact Assessment Process (Revised Draft, April 1997) and the Water Pollution Control Ordinance (WPCO), Hong Kong waters are subdivided into 10 Water Control Zones (WCZs). Each WCZ has a designated set of statutory Water Quality Objectives (WQOs). For this study, the marine water of Victoria Harbour and Tolo Harbour could be affected by construction discharges from the alignment of Route 16.

The WQOs for the Victoria Harbour Phase II and Tolo Harbour and Channel WCZs (as shown in *Annex C*) will be applicable as evaluation criteria for assessing compliance of the Project. The parameters of most concern during the construction phase will be suspended solids (SS) and dissolved oxygen (DO) levels. The associated WQOs against which impacts will be assessed are as follows:

SS levels: For construction near Victoria Harbour Phase II WCZ, human activity should not cause the natural ambient SS level to be raised by more than 30% nor give rise to accumulation of SS in Victoria Harbour which may adversely affect aquatic communities.

For construction near Tolo Harbour and Channel WCZ, human activity should not cause the annual median SS levels to exceed 20 mg l^{-1}.

D O levels: DO levels in Victoria Harbour Phase II WCZ should not be less than 2 mg l^{-1} within 2 m of the seabed and above 4 mg l^{-1} at an average of three water depths (1 m below the water surface; mid-depth; and 1 m above sea bed).

DO levels should remain above 4 mg l^{-1} in Tolo Harbour WCZ at all times.

All discharges during the construction phase of the Route 16 alignment are required to comply with the *Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* (TM) issued under Section 21 of the WPCO, which defines acceptable discharge limits to different types of receiving waters. Under the TM, effluents discharged into the drainage and sewerage systems, inshore and coastal waters of the WCZs are subject to pollutant concentration standards for particular volumes of discharge. These are defined by the EPD and specified in licence conditions for any new discharge within a WCZ. The pertinent discharge limits for Victoria Harbour and Tolo Harbour and Channel WCZs are shown in *Annex C* of this report.

3.3.4 Potential Sources of Impacts

Potential sources of water quality impacts associated with the construction of Route 16 comprise:

- construction runoff and drainage;
- runoff from the tunnelling activities;
- runoff from general construction activities;
- domestic sewage effluent produced by the on-site construction workers; and
- diversion of existing streams or watercourses, and local water quality impact due to construction works.

3.3.5 Evaluation of Impacts

3.3.5.1 Construction Runoff and Drainage

Runoff and drainage from construction sites may contain considerable loads of suspended solids (SS) and contaminants during cut and fill construction activities. Potential sources of water pollution from site runoff include:

- runoff and erosion of exposed bare soil and earth, drainage channels and eroded gullies, earth working area and stockpiles;
- release of grouting and cement materials with rain wash;
- wastewater from any concrete batching plant;
- wash water from dust suppression sprays and vehicle wheel washing troughs; and
- fuel, oil, and lubricants from maintenance of construction vehicles and mechanical equipment.

Local and coastal water pollution will be substantial if the construction site runoff at the urban or countryside areas is allowed to drain into the storm sewer or natural drainage without mitigation.

3.3.5.2 Runoff from the Tunnelling Work

As evaluated in the IAR, it is considered that the potential water quality impact during tunnel construction will be limited to:

- seepage of ground water into tunnel area if uncontrolled or improper blasting or drilling operations are used;
- inflows of rain water from tunnel portals; and
- release of grouting materials used for construction of diaphragm walls.

Local watercourses, and perhaps coastal water bodies if public sewers are available during construction, could be adversely impacted by contaminated tunnel runoff without mitigation. In addition, there is a potential for contamination of the water table depending on the vertical tunnel profile and its relationship with the water table height, and the geological features along the route. Although Highways Department have set up more than 30 piezometers near the proposed route alignment, only three piezometers that are located above the proposed tunnel alignment have regular ground water level monitoring. The monitoring have been undertaken since August 1995 and the readings are summarized in *Table 3.3a*. The road elevation of the proposed tunnel alignment at these three piezometers are also included in *Table 3.3a*.

Table 3.3a Ground Water Level at Three Piezometers along the Route (Tunnel) Alignment

	DT1 (833016.13E, 822375.73N)	DT17 (834655.71E, 824100.47N)	DKH2 (834918.48E, 824732.08N)
Average Ground Water Level (mPD)	30.35	97.25	57.00
Maximum Ground Water Level (mPD)	35.04	114.33	58.97
Minimum Ground Water Level (mPD)	25.96	84.42	55.63
Proposed Alignment Road Elevation (mPD)	24.5	67	61

As shown in *Table 3.3a*, road elevations below DT1 (at Chainage 820) and DT17 (at Chainage 3220) are below the ground water levels. This is vice versa at DKH2 (at Chainage 3900). It is considered that construction (tunnelling) activities at DT1 and DT17 may require drainage channels and water pumps to discharge ground water runoff. The tunnelling activities may also result in contamination of ground water and draw down of ground water table. Conversely, as the ground water level is lower than the road elevation at DKH2, direct ground water contamination at this location is not expected. As geological information of Eagle's Nest Tunnel and Shatin Heights Tunnel and more number of appropriate piezometer records are not available, no further assessment can be proceeded.

3.3.5.3 Runoff from General Construction Activities

Potential water pollution associated with general site construction activities will be confined to:

- discharge of debris, rubbish, floating refuse and construction waste that are uncontrolled; and
- spillages of oil, diesel and solvent that drains into sewers or adjacent watercourses without control.

It is considered that the impact of these construction activities upon water quality will be minimal provided that site boundaries are well maintained and good construction practice and site management are observed. On-site litter should be disposed properly, and any oil, fuels and solvents stored on-site should be safely handled. The Contractors should prepare guidelines and procedures for immediate clean-up actions following spillages of oil, fuels and solvents.

3.3.5.4 Sewage Effluent from Construction Workers

Sewage effluents will arise from temporary fixed sanitary facilities for on-site workers. Sewage is characterized by high levels of bio-chemical oxygen demand (BOD), ammonia and *E. coli* counts.

It is considered that the construction workers will disperse along the route alignment and public foul sewers may not be available at certain areas. Owing to the lack of established guidelines for sewage generation rates for construction sites, the recommended design rate for offices, specified in the *Guidelines for the Design of Small Sewage Treatment Plants, EPD Solids Waste Control Group, March 1990* has been used for this assessment. A maximum of about 350 workers will be working simultaneously along the alignment and about 19.25 m^3 per day of sewage effluent could be generated. (The estimate does not include sewage effluent generated from any temporary canteen facilities for workers, of which about 0.5 m^3 per m^2 kitchen area per day of sewage effluent could be generated from the facilities.) Significant water quality impact could arise only if the sewage effluent is allowed to discharge directly into the receiving water bodies such as natural streams, drainage channels and catchwaters adjacent to the construction site.

3.3.5.5 Local Impact upon Existing Streams and Watercourses

The construction of Route 16 will impinges freshwater streams and watercourses in the areas between Eagle's Nest Tunnel Portal and Shatin Heights Tunnel Portal (*Figure 3.4a*), and streams and a pond between Chainages 4900 and 5000. In addition, the design of the tunnel ventilation building besides Tai Po Road near So Uk has been revised and enlarged; the construction is likely to impinge an adjacent watercourse.

Where temporary or permanent stream diversions and installation of culverts are necessary, an acceptable hydraulic performance should be maintained to avoid channel overflow during heavy rainfall. Drainage channels and channels near the construction site should be covered to block the entrance of large debris, rubbish and refuse. Where watercourses are not impacted upon directly, indirect impacts due to inflows of site runoff will be associated with elevated levels of suspended solids that may block drainage channels, hinder normal channel flow, and raise the threat of local flooding during heavy rainfall. Increased suspended solid loadings could also cause locally reduced levels of dissolved oxygen in the watercourses. It is considered that the pond between Chainages 4900 and 5000 will be filled during construction and permanently lost.

3.3.6 Mitigation Measures

It is important that appropriate measures are implemented to control runoff and drainage and, thereby, prevent high loadings of SS from entering the Victoria Harbour and Tolo Harbour and Channel WCZs causing impacts on the identified WSRs. Proper site management is essential to minimise surface water runoff, soil erosion and sewage effluents.

The control of construction site runoff and drainage should be prevented or minimized in accordance with the guidelines stipulated in the EPD's *Practice Note for Professional Persons, Construction Site Drainage* (ProPECC PN 1/94). Good housekeeping and stormwater best management practices (BMPs), detailed as follows, should be implemented to ensure that runoff from construction areas and any stored excavated material comply with the WPCO and no unacceptable impact on the WSRs arises due to the construction of the proposed Route 16 alignment. All discharges from the construction site should be controlled in order to comply with the standards for effluents discharged into the Victoria Harbour and Tolo Harbour and Channel WCZs under the TM.

3.3.6.1 Construction Runoff and Drainage

Exposed soil areas should be minimized to reduce the potential for increased siltation, contamination of runoff, and erosion. Construction runoff related impacts associated with tunnelling work and above ground construction activities can be readily controlled through the use of appropriate mitigation measures which include:

- the use of sediment traps; and
- the adequate maintenance of drainage systems to prevent flooding and overflow.

The boundaries of critical areas of earthworks should be marked and surrounded by dykes or embankments for flood protection. Temporary ditches should be provided to facilitate runoff discharge into the appropriate watercourses, via a silt retention pond. Permanent drainage channels should incorporate sediment basins or traps and baffles to enhance deposition rates.

All temporary and permanent drainage pipes and culverts provided to facilitate runoff discharge should be adequately designed for the controlled release of storm flows. All sediment traps should be regularly cleaned and maintained. The temporarily diverted drainage should be reinstated to its original condition when the construction work has finished or the temporary diversion is no longer required.

Sand and silt in the wash water from the wheel washing facilities, which ensure no earth, mud and debris is deposited on roads, should be settled out and removed before discharging into storm drains. A section of the road between the wheel washing bay and the public road should be paved with backfall to prevent wash water or other site runoff from entering public road drains.

Oil interceptors should be provided in the drainage system and regularly emptied to prevent the release of oils and grease into the storm water drainage system after accidental spillages. The interceptor should have a bypass to prevent flushing during periods of heavy rain.

Works within the water gathering grounds, such as the construction of Toll Plaza should be closely monitored to ensure effective implementation of the mitigation measures throughout the construction period. The Site Engineer should be in close liaison with the Water Supplies Department (WSD) to keep them informed of construction activities and the mitigation measures implemented.

In addition, to minimise the impact of flooding during heavy rainfall events at Wai Man Tsuen, the following mitigation measures are recommended.

- the volume and extent of earth filling and stockpiling in the valley at Wai Man Tsuen should be minimized without affecting the progress of construction;
- earth filling and stockpiling activities in the valley at Wai Man Tsuen should be avoided in wet seasons when rainfall is high, wherever practicable;
- regular cleaning and maintenance of local drainage system at Wai Man Tsuen area should be undertaken;
- the period for Route 16 construction near Wai Man Tsuen should be minimized, wherever possible.

3.3.6.2 Tunnelling Work

Temporary open storage of excavated materials should be covered with tarpaulin or similar fabric during rainstorms. Any washout of construction or excavated materials from the drill-and-blast tunnelling work should be diverted to the drainage system via appropriate sediment traps.

Ground water pumped out of tunnels should be discharged into the drainage channels which incorporate sediment traps to enhance deposition rates and to remove silt.

Spent grouts used in diaphragm wall construction should be collected in a separate slurry collection system, reconditioned and reused wherever practicable. The disposal of used grouting materials will only be permitted if it is treated to the TM standards before discharge to the storm drains or disposal to landfill.

3.3.6.3 General Construction Activities

Debris and rubbish on site should be collected, handled and disposed of properly to avoid entering the water column and cause water quality impacts. The solid waste management requirement on site to prevent such impacts is detailed in the *Waste* section of this report.

All fuel tanks and storage areas will be provided with locks and be sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled fuel oils from reaching coastal waters of the Victoria Harbour and Tolo Harbour and Channel WCZs.

3.3.6.4 Sewage Effluent

Construction workforce sewage discharges from fixed toilet facilities on-site should be connected to the nearby existing trunk sewer wherever feasible. However, for areas where existing trunk sewer is not available, it is recommended that appropriate and adequate on-site portable chemical toilets should be provided by licensed contractor who will be responsible for appropriate disposal and maintenance of these facilities.

3.3.7 Conclusions

This water quality assessment has determined that no insurmountable water quality impact should result from the construction of the proposed Route 16 alignment provided that:

- all the recommended mitigation measures including appropriate drainage and silty runoff collection facilities are incorporated into the construction area;

- any modification or diversion of local streams and drainage pipes or channels will be constructed to allow the water flow to the discharge point or outfall without overflow or washout; and
- all temporary drainage diversions will be reinstated, wherever possible, to the original condition after the construction works are completed and implemented properly with regular routine monitoring and audit.

All construction site / works area discharges must comply with the TM standards of the WPCO. Any practical options for the diversion and re-alignment of drainage should comply with both engineering and environmental requirements. It is considered that controls on discharges from land based construction activities and proper site management procedures, as referenced above, will minimise residual water quality impacts to the acceptable levels stipulated in the in the WPCO criteria.

3.4 Ecological Impacts

3.4.1 Introduction

This section presents an assessment of ecological impacts from the proposed Dual 3 Scheme for Route 16, based on the ecological impact assessment undertaken for the Dual 2 Scheme in 1996. Field visits were undertaken in June and September, 1997 to field check and update any change in the ecological conditions of the Study Area and previous findings, based on the current preliminary design as presented in *Section 2*.

As indicated in *Section 1.1*, this assessment is based on the conforming alignment given in the Brief, which was recommended and endorsed as the preferred alignment after detailed investigation of a number of alternative alignment options (see *Section 2.1)*. The Route 16 alignment has been committed in the Shatin Outline Zoning Plan (S/ST/6).

3.4.2 Government Legislation and Regulations

There are a number of international and local regulations, legislation and guidelines which provide the framework for the protection of species and habitats of ecological importance, those related to the current project are:

- Country Park Ordinance (Cap 208) of the Revised Edition 1996;
- Forests and Countryside Ordinance (Cap 96) of the Revised Edition 1994;
- Wild Animals Protection Ordinance (Cap 170) of the Revised Edition 1994;
- Technical Memorandum for the Environmental Impact Assessment (EIA) Ordinance (Cap 499);
- Town Planning Ordinance (Cap 131);
- Hong Kong Planning Standards and Guidelines (HKPSG); and
- United Nations Convention on Biological Diversity.

Under the *Country Park Ordinance (Cap 208)*, Country Parks are designated for the purposes of nature conservation, countryside recreation and education, while Special Areas are areas of government land with special interest and importance by reason of their flora, fauna, geological, cultural or archaeological features. Criteria taking into consideration of determining whether or not a suitable location for designation as a Country Park or Special

Area include landscape quality, recreation potential, conservation value, size, land status and the practicality of management.

The *Forests and Countryside Ordinance (Cap 96)* prohibits felling, cutting, burning or destroying of trees and growing plants in forests and plantations on government land. Its subsidiary Regulations prohibit the picking, felling or possession of listed rare and protected plant species. The list of protected species in Hong Kong which comes under the Forestry Regulations was last amended in 1994 under the *Forestry (Amendment) Regulation 1994* made under *Section 3* of the *Forests and Countryside Ordinance (Cap 96)*.

Under the *Wild Animals Protection Ordinance (Cap 170)*, designated wild animals are protected from hunting, whilst their nests and eggs are protected from injury, destruction and removal. All birds and most mammals are protected under this Ordinance. Prior approval from the Director of Agriculture and Fisheries is required for permission to destroy any of the protected wild animals listed in the Ordinance. The Second Schedule of the Ordinance which lists all the animals protected was last revised in June 1994.

Annex 16 of the *Technical Memorandum of the EIA Ordinance* sets out the general approach and methodology for assessment of ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts. *Annex 8* recommends a list of criteria that can be used for evaluating ecological impact.

The amended *Town Planning Ordinance* (TPO) provides for the designation of coastal protection areas, Sites of Special Scientific Interest (SSSIs), Green Belt or other specified uses that promote conservation or protection of the environment, e.g. conservation areas. Where SSSIs are covered by statutory town plans, the land uses therein are controlled by the provision of the Town Planning Ordinance. The authority responsible for administering the TPO is the Town Planning Board (Planning Department).

The new revised *Chapter 10* of the *Hong Kong Planning Standards and Guidelines* (HKPSG) covers "Conservation". This chapter details the principles of conservation, the conservation of natural landscape and habitats, historic buildings, archaeological sites and other antiquities. It also addresses the issue of enforcement. The appendices list the legislation and administrative controls for conservation, other conservation related measures in Hong Kong and government departments involved in conservation.

The People's Republic of China (PRC) are Contracting Parties to the *United Nations Convention on Biological Diversity* of 1992. The Convention requires signatories to make active efforts to protect and manage their biodiversity resources. Hong Kong Government has stated that it will be "committed to meeting the environmental objectives" of the Convention in 1996.

3.4.3 Baseline Conditions and Ecological Importance

There are mainly three habitat types identified along the proposed Route 16 alignment: urbanized area, secondary woodland and stream habitat. Maps showing the distribution of habitat types are shown in *Figure 3.4a* and *Figure 3.4b*. The ecological importance of each habitat types identified along the alignment was evaluated against the criteria recommended in the *Annex 8* of the Technical Memorandum (TM) where appropriate.

There are no existing or proposed Sites of Special Scientific Interest or Special Areas within the study area. The proposed route passes under the Lion Rock Country Park in tunnel.

3.4.3.1 Shatin Section

The Shatin section of the proposed Route 16 alignment and the associated slip road are in areas of actively cultivated land with urban fringe developments nearby such as the Caltex garage and Sha Tin Heights. There are scattered abandoned agricultural areas which are open and contain some planted exotic trees including *Tristania conferta, Eucalyptus citriodora* and *Acacia confusa*. The exotic shrub *Lantana camara* is also dominant in these areas. These areas are considered to be of extremely limited ecological value with respect to the existing conditions of the area, as well as the evaluation criteria such as naturalness, diversity, rarity, ecological linkage, recreatability, and potential value to support important wildlife.

3.4.3.2 Toll Plaza Section & Ventilation Building

According to the Vegetation Map prepared by World-Wide Fund for Nature (HK) in 1993, the proposed Toll Plaza to the south of Tai Po Road and west of Keng Hau Road, is located on a plantation woodland on the east of Kam Shan Country Park, north-west of Lion Rock Country Park, and north of Beacon Hill SSSI, which is covered by mainly native board-leaved species with vigorous under-storey growth (see *Figure 3.4c*).

The area is close to the Kam Shan Country Park where extensive plantation program have been commenced mostly since the mid-1950s (Hong Kong Country Parks (1984), p.56). The woodland is now evolved into a well-developed secondary woodland sharing similar ecological functions as those woodlands in the Kam Shan Country Park and Lion Rock Country Park.

The proposed route at the Toll Plaza section passes through an area which were identified in the Territorial Development Strategy Review Foundation Report (July 1993) as a potential Country Park (see *Figure 3.4c*). The areas were large tracts of natural landscape territory-wide. However the Country Park extensions will have to take into consideration the Route 16 development which has been committed in the Sha Tin Outline Zoning Plan (S/ST/6). A large area adjacent to the Sha Tin Water Treatment Works was omitted from the Country Park Proposal presumably for a future possible extension. The area that was omitted is very similar in ecological terms to that which is included, consisting of dense secondary woodland with scattered streams.

The Ventilation Building is located behind a petrol station at Tai Po Road as shown in *Figures 2.1a-b*. The main areas of ecological interest affected by the proposal are the woodlands at the Toll Plaza area and Ventilation Building area. As the physical environment of the woodland areas is similar, the baseline condition is described together below.

Woodland

Since the woodland areas are in contiguity with the adjacent woodland within the Country Park areas, the ecological conditions, including both fauna and flora species composition are considered to be similar. The areas are mainly secondary forest with community structure and complexity typical to such undisturbed secondary woodland in Hong Kong, which is species diverse, with a closed canopy of 4m to 15m tall in the upper-storey, and a well-vegetated under-storey. Much of the woodland was fairly impenetrable with dense thickets of woody climbers including Gnetum montanum. Tree species recorded in this woodland were typical of secondary forest and included Alangium chinense, Litsea spp., Machilus thunbergii, Lithocarpus spp., Rhus hypoleuca, Cleistocalyx operculata, Diospyros spp., Mallotus paniculatus, Aleurites montana, Castanopsis fissa, Cinamomum camphora, Ficus hispida, Ficus variegata var. chlorocarpa, Glochidion wrightii and Schefflera otophylla. The shrub and ground flora layers were quite well developed with some areas dominated by dwarf bamboo, and the ground is observed to be covered by thick leaf litter blanket and a good soil cover. Plant species encountered in this portion of the study area are listed by

growth form in Table 3.4a. No rare or protected species were recorded. The tree and understorey flora was typical of secondary woodlands of similar age elsewhere in Hong Kong, and the high structural complexity and species diversity of the woodland, as well as the extensive coverage as a whole joining up with the woodlands in the Country Park, may provide good refuge for a wide variety of wildlife.

Table 3.4a Plant Species at the Toll Plaza and Ventilation Building Secondary Woodland

Tree	Shrubs and Climbers	Herbs and Ground Flora
Acacia confusa	*Brucea javanica*	*Asparagus cochinchinensis*
Acronychia pedunculata	*Dalberhia spp.*	*Christella parasitica*
Alangium chinensis	*Gardenia jasminoides*	*Dicranopteris linearis*
Aleurites montana	*Gnetum montanum*	*Ipomea spp.*
Bamboo	*Illex pubescens*	*Liriope spicata*
Bridelia monoica	*Lantana camara*	*Lygodium japonicum*
Castanopsis fissa	*Melastoma sanginium*	*Pteris semipinnata*
Celtis sinensis	*Ligustrum sinense*	*Rubus spp.*
Cinnamomum camphora	*Mucuna spp.*	*Sida acuta*
Cleistocalyx operculata	*Psychotria rubra*	*Smilax china*
Cratoxylum ligustrum	*Raphiolepis indica*	
Diospyros spp.	*Rhodomyrtus tomentosa*	
Eucalyptus citriodora	*Vitex negundo*	
Ficus hispida		
Ficus microcarpa		
Ficus variegata var. cholorcarpa		
Glochidion wrightii		
Gordonia axillaris		
Illex rotunda		
Lithocarpus spp.		
Litsea glutinosa		
Machilus thunbergii		
Mallotus paniculatus		
Melia azedarach		
Rhus hypoleuca		
Sapium discolor		
Sapium sebiferum		
Schefflera octophylla		
Sterculia lanceolata		
Tristania conferta		

For the woodland areas as a whole, it is ecologically important because of their extensive coverage, naturalness, floral diversity, structural complexity, potential wildlife use as well as fragility.

Avifauna

The bird species recorded in the Previous EIA and the recent site visit in September are listed in *Table 3.4b*. The results suggest that the woodland possesses a potentially high species diversity of birds. Among the 12 species recorded, nine were resident species and three were long-distance migrants (all *Phylloscopus* species). During the survey, breeding behaviour of four species (see *Table 3.4b*) were noted. The record of four resident species (Crested Serpent Eagle, Chestnut Bulbul, Great Tit and Scarlet-backed Flowerpecker), which breed only in established secondary woodland, were in the list, indicating the good habitat quality of the woodland. The difference in species recorded also illustrates seasonal variation in avian community. All bird species are protected under the Wild Animals Protection Ordinance.

Table 3.4b Bird species recorded in the Secondary Woodland

Common name	Scientific name	Number present
March 1995 Survey		*(not reported)*
Black Kite	*Milvus migrans*	
Spotted Dove	*Streptopelia chinensis*	
Koel	*Eudynamis scolopacea*	
Greater Coucal	*Centropus sinensis*	
Large Hawk Cuckoo	*Cuculus sparverioides*	
Hair Crested Drongo	*Dicrurus hottentottus*	
Black-necked Starling	*Sturnus nigricollis*	
Crested Mynah	*Acridotheres cristatellus*	
Magpie	*Pica pica*	
Crested Bulbul	*Pycnonotus jocosus*	
Chinese Bulbul	*Pyconotus sinensis*	
Magpie Robin	*Copsychus saularis*	
Japanese White-eye	*Zosterops japonicus*	
Black-faced Laughing Thrush	*Garrulax perspicillatus*	
September 1997 Survey		
Black Kite	*Milvus migrans*	1
Crested Serpent Eagle	*Spilornis cheela*	2
Red-whiskered Bulbul	*Pyconotus jocosus*	5
Chinese Bulbul	*Pyconotus sinensis*	11*
Chestnut Bulbul	*Hypsipetes castanotus*	1
Arctic Warbler	*Phylloscopus borealis*	4
Eastern Crowned Warbler	*Phylloscopus coronotus*	1
Pale-legged Leaf Warbler	*Phylloscopus tenellipes*	5
Japanese White-eye	*Zosterops japonicus*	25*
Long-tailed Tailorbird	*Orthotomus sutorius*	15*
Great Tit	*Parus major*	6*
Scarlet-backed Flowerpecker	*Dicaeum cruentatum*	3

* *evidence of breeding noted.*

Mammals and Other Wildlife

The Kowloon Hill area is well known of the stronghold of the Long-tailed Macaque *Maraca facilcularis,* and numerous monkeys could been seen along the Kowloon Hills Fitness Trail and some ventured into the extensive woodland below the water catchment near to the proposed route. A single scat of civet was found in the previous study and suggested that the habitat range of this species may cover this woodland area.

During the recent site visit, neither mammal nor reptile was observed. Several dig holes believed to be created by wild boar around root base of woody vegetation was found; and a hole believed to be pangolin refuge was observed during the recent bird survey at the Toll Plaza area. Given the close vegetation coverage and hence provision of good habitats and rich food sources, the area has a potential to support mammals of small to medium size and probably a range of wildlife as well.

Stream Community

Investigation of stream courses at the Shatin end on and near to the proposed tunnel portal was attempted during the site visits. Subject to the accessibility of the area, the ecological condition of the streams was inspected at different sampling locations (see *Figure 3.4a)*.

There are several streams in the vicinity of the woodland area around the proposed toll plaza location, some of which are seasonal and others permanent. The streambed was mainly lined with granitic bedrock and boulders of small to medium-size. The seasonal streams S1 & S2 observed were generally small, approximately 0.3 - 0.5 m in width with a moderate flow rate, and mostly shaded by mainly small trees and shrubs. The upper course was either dry or receiving input from seepage, indicating the seasonal nature of the stream. Sediment load was considered to be significant and mayfly *Baetis* spp. was the only benthic invertebrate species found. The record of freshwater crab, *Potamon hongkongensis* implied that the stream was clean and a common dragonfly species *Orthetrum triangulare melania* was spotted nearby, implying the potential use of this water body by invertebrates inhabiting around.

Streams S3 & S4 located north of the orchard and squatter in Pak Shek area were considered permanent as the width of the streams was wide, with widths range from 0.5 - 1m and a consistent flow of water. Stream S3 was exposed, with mainly grasses as the bank vegetation. The flow was relatively slow, with algae-covered stagnant pools. Plastic bags, rust steel sheets and glass bottles were found accumulated in the stream. In addition to the heavy sedimentation load, it is unlikely that the stream could support important wildlife. Mayfly *Baetis* spp. was the sole species recorded. In addition, *Brachydiplax chalybea flavovittata*, a widespread and common pond dragonfly species was spotted around the stream channel which implies the use of such habitat by terrestrial invertebrates. Beyond the orchard was an exposed concrete-lined pool with a depth approximately 0.8 - 1 m. The water appeared to be green, indicating the flourishing of algae.

Stream S4 was a larger stream which was approximately 1.5 m wide. The stream was shaded with dense riparian vegetation, comprised mainly woodland tree species. The flow was rapid which may be due to the altitude gradient and probably the input from torrential rain period in previous summer months. No benthos were found during the survey.

On the slope opposite to the petrol station was a channeled stream course. It appeared that water collected in this channel was mostly diverted to Kowloon Reservoir and hence the lower stream course is expected to be dry or seasonal. Regarding the nature of this water channel, it is unlikely that the lower stream will support diverse stream invertebrates.

The current stream survey indicates that the streams have been subjected to disturbance of various extent already. The stream water is considered to be clean in general but the suspended particles and high sediment load suggest that the uppermost reaches of the streams have been affected by erosion in the hillsides above and developments along the Tai Po Road. Vegetation clearance on the slope south of a nearby look out was noted during current site visit.

At the Ventilation Building area, there is a channeled stream with the streambed stacked up with boulders in the valley behind a Shell petrol station (see *Figure 2.1b*). The stream channel is approximately 2m wide with a moderate flow of water. Water quality is considered poor as oil was observed in a recent field visit on water surface and rubbish such as plastic bags and glass bottles were found in the channel. The stream was shaded with riparian vegetations comprised mainly trees. Sediment load was observed to be high and no benthic invertebrates were found. It is believed that the construction of this channeled stream was intended to create habitats for stream fauna by using boulders as substrate instead of concrete lining. However, since the stream channel is located near the road-side,

the ease to access may lead to disturbance and water pollution and hence deter the colonization of stream fauna.

There are three possible causes for the scarce occurrence of stream invertebrates. Firstly, the high sediment load, as observed when turning over the boulders, fills the interstitial spaces among boulders and substrate particles, leading to suffocation of benthic invertebrates and hence deterring invertebrate colonization. Secondly, passive drift of benthic invertebrates due to floods during heavy rain period also lead to decrease in invertebrate found. Thirdly, the invertebrate may already emerge during time of the survey because of the seasonality of stream community in Hong Kong. It was noted that there was accumulation of rubbish in some stream sections, thus the utilization of such habitats by wildlife is not expected to be extensive.

With respect to the current findings and the evaluation criteria as recommended in the TM, namely naturalness, diversity, rarity, potential wildlife use, size, as well as ecological linkage, the ecological value of the streams within the study area is considered to be limited.

3.4.3.3 West Kowloon Section

The route at the West Kowloon end is extremely "urban" and principally no natural habitat will be affected. The only vegetated area is under the newly proposed Ching Cheung Road connection where a young secondary woodland is located (*Figure 3.4b*). According to observation in recent field visits, part of the woodland was recently stabilized by concrete lining. Dominant species were mostly pioneer tree species such as *Pinus massoniana, Sapium discolor, Mallotus paniculatus* in the upper-storey; *Ficus hirta, Psychotria rubra and Litsea rotundifolia* in the under-storey, with patchy of the fire-indicator species *Dicranopteris linearis* scattered around. A species list is shown in *Table 3.4c*. All species observed are common to such habitat type in urban fringe.

Table 3.4c Plant Species Identified in the Ching Cheung Road Young Secondary Woodland

Trees	Shrubs	Herbs and Climbers
Acacia confusa	*Alocasia macrorrhiza*	*Asparagus cochinchinensis*
Aporusa dioica	*Ilex asprella*	*Dicranopteris linearis*
Bridelia monoica	*Melastoma candidum*	*Elephantopus tomentosa*
Casuarina equisetifolia	*Melastoma sanguineum*	*Gymnema sylvestre*
Celtis sinensis	*Phyllanthus cochinchinensis*	*Hyserpa nitida*
Cratoxylum cochinchinense	*Phyllanthus emblica*	*Innula cappa*
Dalbergia balansae	*Psychotria rubra*	*Ischaemum spp.*
Desmos cochinchinensis	*Rhodomyrtus tomentosa*	*Liriope spicata*
Dimocarpus longan	*Sageretia theezans*	*Millettia nitida*
Ficus hispida	*Tarenna attenuata*	*Miscanthus floridulus*
Ficus microcarpa	*Wikstromeia indica*	*Morinda umbellata*
Ficus superba	*Ardisia crenata*	*Mussendanea pubescens*
Leucanea leucocephala	*Dianella ensifolia*	*Strophanthus divariculatus*
Litsea glutinosa		*Tetracera asiatica*
Macaranga tanarius		*Tinospora sinensis*
Mallotus paniculatus		*Uvaria microcarpa*
Microcos paniculata		
Pinus massoniana		
Phyllanthus reticulatus		

Trees	Shrubs	Herbs and Climbers
Rhus succedanea		
Rhus chinesis		
Sapium discolor		
Schefflera octophylla		
Sterculia lanceolata		
Zanthoxylum avicennia		
Alchornea trewioides		

Wildlife use of the woodland is anticipated to be limited because of its small size, as well as highly fragmented and developed surrounding which make the presence/movement of any wildlife of conservation interest unlikely. Except several common bird species including the Magpie, Spotted Dove, as well as the Chinese Bulbul, no other animal of ecological importance were observed in the woodland during the site visits.

Generally speaking, no important ecological resources has been identified in the Kowloon Section of the alignment, and regarding the naturalness, size, diversity, rarity, re-creatability, ecological linkage, as well as potential value to support important wildlife, the ecological value of the young secondary woodland under the proposed Ching Cheung Road connection Road is considered to be low.

3.4.4 Impact Assessment and Mitigation Measures

3.4.4.1 Potential Impact

The proposed project calls for the construction of a highway mainly in tunnel and on cut with a limited section mainly on fill; in west Kowloon area it is on structure. It is assumed as the worst case scenario that the area within the construction including all cut and fill slopes will be completely disturbed during construction.

The resulted primary ecological impact relates to the habitat loss of secondary woodlands and natural stream courses, as a result of the landtaking for the construction work, particularly at the Toll Plaza and Ventilation Building. Any wildlife inhabiting the project area would also be affected directly and indirectly through the loss of roosting, breeding, nesting, feeding, or hibernating habitat, as well as the resultant habitat fragmentation.

Potential impacts on the stream habitats include the requirement for water during construction and any potential associated impacts on local streams, as well as run off of construction wastes into stream courses, leading to sedimentation. Furthermore, any work that involves channeling, culverting or diverting the stream will result in direct habitat loss.

There will also be indirect impact to the surrounding woodland/stream habitat and the associated wildlife because of disturbance due to increased human activities and uncontrolled construction practice, such as storage or dumping of construction material, disposal of the surplus fill, and improper use of fire.

3.4.4.2 Impact Assessment

Habitats present in the urban Kowloon and Sha Tin road sections are of low ecological value only, and the potential ecological impact arising from the current project should be limited. The new Ching Cheung Road connection on viaducts in the Dual 3 Scheme may lead to habitat loss of a young secondary woodland of low ecological value. Therefore provided that strict construction practice is implemented, the habitat loss would be restricted to structural

supports and therefore impact minimized. No country park or other designated areas for conservation will be affected by the current project.

To minimise potential ecological impacts on the secondary woodlands, it is understood that alternative alignment options were explored and examined in the Previous Feasibility Study, and the current alignment layout given in the Brief is the preferred option with the least environmental impacts, particularly on ecology with the secondary woodland encroachment minimised by constructing the road sections in tunnels as far as possible except the toll plaza area which has been designed to a practical minimum size.

The resulting ecological impact is that approximately 5.6 ha of native, closed-canopy woodland and 350 m of perennial stream courses at the Toll Plaza and Ventilation Building sites will be affected. *Annex 8* of the TM states that "mature native woodland larger than one hectare", as well as "natural stream course longer than 500 metres", are regarded as important habitat in Hong Kong. Based on the ecological field surveys undertaken, the woodlands are of ecological significance because they resulted from years of protection from fire and timber harvest and may provide habitats for a range of animal wildlife. Nearly all of the existing woodland cover within the work areas of the alignment would be affected during construction period, hence the ecological impact arising from the woodland affected is considerable.

Given that the stream habitats within the Study Area is considered to have limited ecological value owing to its disturbed nature and poor species diversity, and similar habitat types could be found abundantly in the surrounding woodland area, the impact to this habitat type resulted from the proposed project should not be substantial.

Impact on wildlife depends on the ecology of the animal being considered, such as sensitivity to human disturbance, such as noise during the construction and operation phase of the proposed development; presence of any territorial behaviors and territorial size requirement; as well as the carrying capacity of the surrounding woodland habitats. For the wildlife identified and believed to be present within the study area during the current and previous studies, they are all considered to have a wide distribution range in the New Territories. Given the mobility of most animals, as well as the small size of the affected woodland relative to the surrounding woodland area (under 5%), the ecological impact to wildlife is not expected to be signiificant.

3.4.4.3 Mitigation Measures and Recommendations

The mitigation measures recommended below focus on impact minimisation and woodland planting to mitigate the woodlands affected.

Impact Minimisation

Impacts on terrestrial ecology can be minimised to the extent that the construction process does not destroy all the habitats along the alignment, and the following mitigation measures are recommended:

- Government should consider investigation at the detailed design stage possible design measures to further reduce landtake for the toll plaza area, such as reducing the total number of toll lanes by increasing the proportion of auto-toll lanes so that the width of the toll plaza site could be reduced, arranging the car park and ancillary facilities underground, and integration of the portal building with the administration building. This could result in a reduction of landtake in the order of 0.5 ha or more.

- The exact location of haul routes, storage and works areas etc. should be selected to minimize disturbance on/or avoid ecological sensitive area as far as possible.

- Woodland trees and streams outside the work area should be protected by using temporary barricades during construction to reduce unnecessary human disturbance.
- Damage that occurs to trees to be retained should be treated with surgery.
- Wild and uncontrolled open fires should be strictly prohibited within the work site boundary, and fire fighting equipment should also be installed in the work area.
- Work area for the viaduct construction at the woodland under the Ching Cheung Road connection should be well-defined and minimized.
- The mitigation measures recommended should be checked by regular site-audit to ensure they are properly implemented.

Woodland Planting

On-site opportunity for woodland planting should be explored whenever possible during the detailed design stage. Suitable planting area such as the cut-slope of the toll plaza, and any temporary working area for the toll plaza and ventilation building should be re-instated back to the original conditions as far as possible. Species planted should be compatible to the surrounding woodland (see *Table 3.4a*), or provide ecological resources for wildlife such as food and shelter as far as possible to enhance the potential value of the woodland replanting (see *Table 3.4d*).

Table 3.4d Native Tree Species Recommended for Tree Planting

Major Species *	
Aporusa chinensis	*Sapium discolor*
Elaeocarpus sylvestris	*Schefflera octophylla*
Machilus breviflora	*Schima wallichii*
Machilus thunbergii	
Minor Species	
Acronychia pedunculata	*Ixonanthes chinensis*
Alangium chinense	*Lithocarpus glaber*
Artocarpus hypargyrea	*L. spp.*
Bischofia trifoliata	*Litsea cubeba*
Canthium dicoccum	*L. monopetala*
Carallia brachiata	*L. verticillata*
Castanopsis fissa	*Machilus chinensis*
C concinna	*M. oreophila*
C. spp.	*M. velutina*
Celtis sinensis	*Meliosma rigida*
Celtis philippensis	*Ormosia emarginata*
Choerospondias axillaris	*Ormosia semicastrata*
Cinnamomum parthenoxylum	*Osmanthus spp.*
Cratoxylum ligustrinum	*Pithecellobium clypearia*
Cryptocarya spp.	*Prunus phaeosticta*
Diospyros morrisiana	*Pygeum topengii*
Disopyros eriantha	*Quercus myrsinaefolia*
Endospermum chinense	*Q. spp.*
Engelhardtia chrysolepis	*Rapanea neriifloia*
Evodia lepta	*Reevesia thyrsoidea*
Evodia meliaefolia	*Sapium sebiferum*
Ficus variegata	*Sarcosperma laurinum*

*Minor Species **	
Garcinia oblongifolia	*Scolopia seava*
Garcinia multiflora	*Sterculia lanceolata*
Gironniera nitida	*Styrax suberifolius*
Gmelina chinensis	*Symplocos lancifolia*
Gordonia axillaris	*Syzygium hancei*
Ilex cinerea	*Syzygium levinei*
Ilex rotunda	*Viburnum odoratissimum*

** Major species are selected for their high frequency in natural secondary woodlands, attractiveness to native wildlife, and tolerance of exposed, open sites.*

Based on the preliminary design, available land is a limiting factor to mitigate the secondary woodlands affected. Three major sites were identifed to be available, at Pak Shek Village, Wai Man Tsuen, and an area to the west of the Butterfly Valley Interchange, which would provide within the project boundary the land for woodland planting.(see *Figure 3.4d, 3.4e,* and *3.7b*).

The Pak Shek Village Area lies between Tai Po Road and the KCRC railway just outside the north portal of Shatin Height Tunnel, which is currently covered by orchard, agricultural land (either active or abandoned) and landscaping plantation with low ecological value. The site area is approximately 2.5 ha currently zoned as Green Belt (Sha Tin OZP S/ST/7). Wai Man Tsuen is located in a valley bottom bounded by Butterfly Valley Road to the West, King Lam Street to the south and Yee Kuk West Street to the east. This area is currently covered by cottages and disturbed wasteland, with some landscaping trees along the road-side. The zoning intention of this area is for industrial use but approximately 1 ha of the area is intended for Green Belt. All of the Pak Shek Village Area, as well as the Green Belt area in Wai Man Tsuen, provide an opportunity for woodland planting after completion of work.

The area to the west of the Butterfly Valley Interchange considered suitable for woodland planting is approximately 1 ha alongside the Ching Cheung Road sliproad, in between the Castle Peak Road and Ching Cheung Road. Currently this area is zoned as Open Space on the draft Kwai Chung OZP (No. S/KC/12) and Green Belt on the draft Kwai Chung ODP (No. D/KC/A), covered mainly by grassy habitat that has little ecological value. Planting native tree species on this site to enhance the ecological value of the existing habitat could be a form of mitigation for the woodland affected. Should open space needs to be provisioned on that area, they should be restricted to low intensity passive uses.

The Project Proponent will be responsible for the funding and establishing the woodlands, using species that are compatible with the surrounding woodland as shown in *Table 3.4d* with wildlife use potential, with an objective to create self-sustainable woodlands.

3.4.4.4 Residual Impact

It is considered that with the implementation of the above recommended mitigation measures, no significant residual impact on terrestrial ecology is anticipated due to the construction of the Toll Plaza and Ventilation Building.

3.4.5 Conclusions

The ecological conditions of the key were field-checked and updated for the current study. The loss of secondary woodlands due to the landtaking for the construction of Toll Plaza and Ventilation Building would result in considerable ecological impacts.

Considering the contiguity with the woodland areas of the adjacent Kam Shan Country Park and Lion Rock Country Park, and provided that the recommended woodland plantings will be undertaken on-site, as well as design measures to minmise landtake such as the use of

autotoll, residual impact from the project is not considered detrimental. Indirect impact to wildlife would be limited as they could find refuge in the adjacent woodlands within the Country Park areas.

3.5 Construction Waste

3.5.1 Introduction

The route alignment, and the types and nature of the construction activities of Route 16 Dual-3 Scheme have been described in *Section 2*. As the main alignment of the Dual-3 Scheme will be the same as the Dual-2, the key issues related to solid waste handling and disposal identified for the Dual-2 Scheme will also be applicable to the Dual-3 Scheme. However the Dual-3 carriageways and additional connections have the following waste implications.

- Eagle's Nest Tunnel: It is expected that about 50% more excavated material will be generated from tunnelling works. Fill requirements for the two schemes are not expected to be significantly difference. More surplus excavated material will require off-site disposal.
- Shatin Heights Tunnel: More excavated material will be generated.
- The rest of the Shatin Section: Additional general construction waste will be generated from the construction of embankments to T3. The additional amount of excavated material and demolition waste are expected to be small.

The findings and recommendations of the Previous EIA for the Dual-2 Scheme has been reviewed and updated with respect to latest information of the project, where appropriate.

3.5.2 Legislation

The following legislation covers or has some bearing upon the handling, treatment and disposal of wastes in Hong Kong:

- Waste Disposal Ordinance (Cap 354);
- Waste Disposal (Chemical Waste) (General) Regulation (Cap 354);
- Crown Land Ordinance; and
- Public Cleansing and Prevention of Nuisances (Urban Council) and (Regional Council) By-laws (Cap 132).

3.5.3 Waste Arisings and Impacts

Sources

Activities during the construction phase will result in the generation of a variety of wastes which can be divided into distinct categories based on their nature and the options for their disposal. These include:

- surplus excavated and inert material suitable for reclamation and fill;
- general construction waste;
- demolition waste;

- chemical waste; and
- general refuse.

The definitions for each of these categories and the nature of their arisings and potential impacts are discussed in the following sections.

Surplus Excavated Material

Major earthwork excavations will be undertaken at the Toll Plaza and at the portals, and filling operations for the Lai Wan approach viaduct embankment and at the Wai Man Tsuen cottage area.

Excavated material will comprise rock, of which 90% is expected to be of a good usable quality. The majority of the excavated material will be used as fill on site. It is estimated that about 1,129,000 m^3 of excavated material will be generated, of which 250,000 m^3 and 350,000 m^3 will be used as filling material at the Shatin and West Kowloon Sections respectively. A surplus of approximately 529,000 m^3 of excavated material will require off-site disposal. The optimisation of the cut and fill balance for the Dual-3 scheme has resulted in the generation of lesser surplus excavated material than the Dual-2 scheme (approximately 800,000 m^3).

The storage and stockpiling of excavated material prior to utilisation on site or disposal at fill sites could also lead to the generation of dust as assessed in *Section 3.2.*

The disposal of excavated materials may also result in additional noise impacts, possible congestion due to increased traffic loadings, and dust and exhaust emissions from the haul vehicles. Potential noise and air quality impacts associated with the disposal of surplus excavated materials are discussed in *Sections 3.1* and *3.2* respectively.

General Construction Waste

Waste will arise from a number of different activities carried out during construction which may include:

- wood from formwork;
- equipment and vehicle maintenance parts;
- materials and equipment wrappings;
- unusable cement/grouting mixes; and
- damaged or contaminated construction materials.

The volume of construction waste generated will be dependant on the operating procedures and site practices, and hence cannot be quantified at this preliminary design stage. As the majority of the viaducts will be precasted at the precasting yards (at the Kowloon end and toll plaza), most of the general construction waste will be generated from these yards.

Due to the inert nature of most of the general construction waste, disposal is not likely to raise long term environmental concerns. In order to conserve void space at the strategic landfills, construction waste with more than 20% (by volume) of inert material should not be disposed of at landfill. The Government, therefore, encourages segregation of mixed construction waste on site in order to facilitate reuse and recycle of useful materials on-site, delivery of inert material to public dumps and minimise disposal of waste to landfills. Inert materials may be disposed of at a public dump, while putrescible waste (eg wood, packaging, paper) should be disposed of at a landfill.

If general construction waste is generated in a large quantity it may hinder building operations and present a safety hazard if not removed frequently, in addition to causing potential water quality impacts, as discussed in *Section 3.3.*

The storage and disposal of general construction waste have the potential to create similar visual, dust and associated traffic impacts as the storage and disposal of excavated materials.

Demolition Waste

Demolition waste will arise from:

- clearance of Wai Man Tsuen cottage area;
- clearance of plant nurseries in Shatin, and
- clearance of temporary structures/buildings in Pak Shek Village in Shatin.

The volume of demolition wastes arising from clearance of Wai Man Tsuen is estimated to be 16,000 m^3. However it is difficult to estimate the volume of waste for demolition of the squattered huts in Shatin, but the quantity is not expected to be significant. It is expected that contamination of inert materials will occur during the demolition of the village and squatter areas by wood wastes, general refuse and possibly other wastes associated with the trading activities of the villagers/ squatters. The construction contractor is encouraged to sort demolition waste into inert (concrete, brick, etc) and non-inert (wood, paper, plastic etc) material at the Wai Man Tsuen Cottage where a number of concrete and brick structures can be found. The demolition waste of the squatter areas will be taken to landfill.

The storage and disposal of demolition waste may present greater visual, litter and odour impacts than the excavated material and general construction waste. Demolition waste should therefore be removed from site as soon as practical and should not be allowed to stockpile on site for more than a week. Provided that the demolition waste is handled and disposed of in accordance with *Section 3.5.4 and 3.5.5,* it is anticipated that the potential environmental impacts associated with the handling and disposal of demolition waste will be minimal.

Chemical Waste

Chemical Waste as defined under the *Waste Disposal (Chemical Waste)(General) Regulation* includes any substance being scrap material, or unwanted substances specified under *Schedule 1* of the Regulations. A complete list of such substances is provided under the Regulations. Chemical wastes likely to be generated during the construction will for the most part arise from the maintenance of plant and equipment. These may include, but need not be limited to the following:

- spent filter cartridges containing heavy metals;
- scrap batteries or spent acid/alkali from their maintenance;
- brake clutch linings containing asbestos materials;
- used hydraulic and lubricating oil;
- spent mineral oils/cleaning fluids from mechanical machinery; and
- spent solvents/solutions, which may be halogenated, from equipment cleaning activities.

Chemical wastes pose serious environmental and health and safety hazards if not stored and disposed of in an appropriate manner. It is difficult to quantify the amount of chemical waste which will airse from the construction activities as it will be dependent on the Contractor's on-site maintenance intentions and the numbers of plant and vehicle used. However, It is not anticipated that significant quantities of chemical wastes will be generated during the construction of Route 16. Provided that any chemical wastes generated from the construction activities are stored, transported and disposed of in accordance with the guidelines detailed in *Section 3.5.4*, the environmental impacts due to chemical waste handling and disposal will be minimal.

General Refuse

The construction workforce will generate a variety of general refuse requiring disposal. General refuse will arise mainly at the proposed major work sites at Wai Man Tsuen, the toll plaza site and Pak Shek Village. General refuse may include newspapers, food wastes and packaging, and waste paper and will generally be disposed of to landfill.

The storage of general refuse has the potential to give rise to a variety of adverse environmental impacts. These include odour if waste is not collected frequently (eg. daily), windblown litter, water quality impacts if waste enters water bodies, and visual impact. The site may also attract pests and vermin if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of wastes, at sites other than approved landfills, can also lead to similar adverse impacts at those sites.

The construction sites of the Route 16 will employ a maximum of approximately 350 workers per day. Estimates of waste arisings based on these numbers of workers suggest that the amount of general refuse produced from the worksites will be in the range of 210 kg per day. Provided that the mitigation measures recommended in *Section 3.5.5* are adopted, the environmental impact caused by storage, handling, transport and disposal of general refuse are expected to be minimal.

3.5.4 Recycling, Treatment, Storage, Collection, Transport and Disposal Options

This section discusses the options for waste management and highlights the methodologies available for waste minimisation.

Excavated Material

It is anticipated that most of the excavation works will be carried out during the first 1.5 years of construction. As discussed in *Section 3.5.3*, about 529,000 m^3 of excavated material will require off-site disposal. It is expected that 90% of the material are rock. The materials could be exported at an average rate of the order of 1000m^3/day.

There is a good market in Hong Kong for good quality rock which may be used for the construction of seawalls and fill material. The construction contractor should consult with Fill Management Committee (FMC) for the potential users of the material. It is anticipated that the surplus rock could be absorbed by local construction industry.

During the excavation works temporary stockpiles will be required for the storage of surplus materials and the materials that will eventually be used as on site fill. It is proposed that the stockpiles are located at the toll plaza, Pak Shek Village and Wai Man Tsuen cottage area.

General Construction Waste

A number of measures can be introduced during the construction period relating to a high standard of design and management which will minimise the generation of general construction wastes.

The design could maximise the use of standard wooden panels in formwork so that the maximum reuse of panels can be achieved. The need to cut panels could also be minimised. Alternatives such as the use of steel formwork or plastic facing could be considered to increase the potential for reuse. It is important that wood wastes are stored separately from other general construction wastes to minimise any contamination which would render the wastes unsuitable for disposal at public dumps.

Careful planning and good site management could be employed to minimise the over ordering or mixing of concrete, mortars and cement grouts.

In addition proper storage and site practices will minimise the damage or contamination of construction materials. The requirements for the handling and disposal of bentonite slurries should follow the Practice Note For Professional Persons ProPECC PN 1/94 - Construction Site Drainage.

Construction waste can either be disposed of at landfill, or at a public dump. Depending on the nature of the construction waste generated, surplus construction material or waste which is not suitable for re-use on-site will be collected by a waste collector under arrangement with the contractor and deposited of at a public dump (for inert materials) or landfill (for degradable materials). The Contractor should ensure that the necessary waste disposal permits or licences have been obtained prior to the collection of the waste.

Many development and reclamation projects (such as West Rail, Tseung Kwan O reclamation) have a requirement to import fill material from elsewhere. In addition, due to the limited void space at landfills for disposal of domestic and industrial waste in Hong Kong, delivery of inert material at these reclamation sites or public dumps would be the preferred method.

It would be advantageous for the Contractor to recycle as much as possible of the construction waste on-site, in order to reduce the requirement to import additional materials. Recycling would also reduce the collection, transportation and disposal of construction waste and any associated charges by the waste haulier. In accordance to Polluters Pay Principle, the Government intends to implement a charging policy for disposal of waste, including construction waste, to landfill soon.

On site measures may be implemented which promote the proper disposal of wastes once off site. For example having separate skips for inert material (rubble, sand, stone, etc) and non-inert (wood, organics, etc) waste would help ensure that the former are taken to public dumps, while the latter are properly disposed of at controlled landfills. Since waste brought to public dumps will not be charged, while those brought to landfill would be charged, separating waste may also help to reduce waste management costs.

If waste materials have to be collected for disposal then maximising loads will keep the number of trips to a minimum. Materials complying with the conditions set out in public dumping licence should be disposed of at public dumps. Details of the nearest public dumps which will be receiving suitable inert materials prior to the construction could be obtained from the FMC's Surplus and Fill Requirement Database (periodic report published by FMC) or in consultation with FMC. Construction waste with not more than 20% by volume (30% by weight) inert materials can be disposed of at landfills. As discussed above, the contractor is encouraged to sort mixed construction material into inert material and construction waste material in order to facilitate the reuse of the material and further minimise the amount of inert waste to be disposed of at landfills. The South East New Territories Landfill (SENT), North East New Territories (NENT) and Western New Territories Landfill (WENT) are available for the disposal of construction wastes with less than 20% (by volume) inert waste. The Contractor should consult the Waste Disposal Authority on the final disposal of this waste at landfills.

Demolition Waste

It is likely that the majority of demolition waste arising from the site clearance work will have to be disposed of at landfill sites because of the nature of the structures (wooden hut and tin sheds) and degree of contamination of the wastes that will occur during clearance work. On-site sorting of demolition and other construction waste should be addressed in the Waste Management Plan and be carried out by the contractor as far as practicable so as to facilitate subsequent reuse or recycling and final disposal to appropriate disposal facilities according to their acceptance criteria and availability.

In order to minimise the impacts of the demolition works these wastes must be cleared as quickly as possible after demolition. The demolition and clearance works should therefore be undertaken simultaneously.

Chemical Waste

If chemical wastes do arise from the construction works then appropriate methods should be employed for their storage collection and disposal. The contractor should contact a licensed chemical waste collector or Enviropace, the Chemical Waste Treatment Facility operator, who offer both a chemical waste collection service and supply the necessary storage containers for these wastes. The contractor should register with EPD as a chemical waste producer. In addition, the contractor should consult EPD to ensure that the handling and disposal methods for the wastes in question are appropriate.

The Chemical Waste Regulations governing the storage and disposal of chemical wastes must be followed, in order to ensure that there are no unacceptable impacts. The volumes of chemical waste should be kept to a minimum by good management. Different types of chemical waste should be stored seperately in order to reduce the potential for contaminations and chemical reactions of wastes due to chemical impactibility.

Containers used for the storage of chemical wastes should be suitable for the substance they are holding, resistant to corrosion and maintained in a good condition. The containers should be stored safely and securely closed.

Chemical wastes should not be stored in any container with a capacity exceeding 450 litres unless the specifications have been approved by the EPD. Every container of chemical waste should display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.

The storage area for any containers should not be used for any purpose except for the storage of chemical wastes and should be fully labelled in accordance with the Regulations. Chemicals which are incompatible and could cause fire or explosion if they are mixed should be segregated in separate areas. The storage area should be enclosed on at least three sides by a wall, partition or fence which is at least 2m in height or the height of the tallest container, whichever is the greater. Adequate ventilation and space for the handling of containers should be provided, with the area being kept clean and dry.

Liquid chemical wastes should be stored in an area which has an impermeable floor and retention structure with the capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest. When calculating the available retaining capacity, the volume occupied by the containers being stored should be taken into consideration. Bunded areas should be kept clean and dry, possibly by covering. If water does collect within the bund it must be tested before being disposed. This requirement does not apply to large, approved below ground containers.

General Refuse

General refuse generated on-site should be stored and collected separately from other construction and chemical wastes. The Contractor may arrange for the collection and disposal of the refuse by a reputable waste haulier. The removal of waste from the site should be arranged on a daily or at least on every second day by the Contractor to minimise any potential odour impacts, minimise the presence of pests, vermin and other scavengers and prevent unsightly accumulation of waste.

General refuse should be stored in enclosed bins or compaction units. Compaction units assist in reducing the volumes of waste to be transported for disposal. The relatively small volumes of wastes generated during the construction may be insufficient to justify the use of compaction units.

3.5.5 Mitigation Measures

This section sets out the recommended storage, transportation and disposal measures to avoid potentially significant environmental impacts associated with waste arisings from the construction of the facility or to reduce these to acceptable levels. The Route 16 contractor should incorporate these recommendations into a comprehensive on-site waste management plan.

Segregation of Waste

In order to ensure that all waste is disposed of in an appropriate manner, waste should be separated by category on-site by the contractor. The waste should be segregated into the following previously defined categories:

- excavated material (inert) suitable for reclamation or fill;
- construction and demolition material (inert) for beneficially reuse on site or at public dump;
- construction and demolition waste (non -inert) for landfill;
- chemical waste; and
- general refuse.

It is recommended that the segregated wastes should then be disposed of as follows:

- inert construction and demolition material when deemed suitable for reclamation or land formation should be reused on site or delivered to public dumps;
- inert material deemed unsuitable for reclamation or land formation and non-inert construction waste material should be disposed of at landfill;
- mixed construction and demolition waste should be sorted on-site as far as practicable to facilitate subsequent reuse or recycling and final disposal to landfills.
- chemical waste as defined by *Schedule 1* of the *Waste Regulations (Chemical) 1992*, should be stored in accordance with approved methods defined in the Regulations and the chemical waste disposed of at the Chemical Waste Treatment Centre located at Tsing Yi; and
- general refuse should be disposed of at landfill.

The Waste Disposal Authority should be consulted by the Route 16 contractor on the final disposal of these wastes.

Waste Minimisation

Construction materials should be recycled or reused wherever possible. The waste management strategy to be employed should be waste minimisation at source. Where waste generation is unavoidable then the potential for recycling or reuse should explored and opportunities taken. If wastes cannot be recycled then the recommended disposal routes should be followed.

Waste reduction measures should be introduced at the design stage and carried through the construction activities, wherever possible, by careful purchasing control, reuse of formwork and good site management.

Training and instruction of construction staff should be given at the site to increase awareness and draw attention to waste management issues and the need to minimise waste generation. The training requirements should be included in the site waste management plan.

Recycling of construction and demolition wastes should be addressed in the Waste Management Plan.

Waste Treatment

It is not anticipated that there will be any waste treatment, except sewage, undertaken at the site during the construction.

Storage, Collection and Transport of Waste

Reputable waste hauliers should be used to collect and transport the wastes to the appropriate disposal points. The necessary measures to minimise adverse impacts including windblown litter and dust from the transportation of these wastes should also be instigated.

It is recommended that:

- wastes should be handled and stored in a manner which ensures that they are held securely without loss or leakage thereby minimising the potential for pollution;
- only reputable waste hauliers authorised to collect the specific category of waste concerned should be employed;
- removal of demolition wastes should coincide with the demolition work;
- appropriate measures should be employed to minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers;
- the necessary waste disposal permits should be obtained from the appropriate authorities, if they are required, in accordance with the Waste Disposal Ordinance (Cap 354), Waste Disposal (Chemical Waste) (General) Regulation (Cap 354) and the Crown Land Ordinance;
- collection of general refuse should be carried out frequently, preferably daily;
- waste should only be disposed of at licensed sites and site staff and the contractor should develop procedures to ensure that illegal disposal of wastes does not occur;
- waste storage areas should be well maintained and cleaned regularly; and
- records should be maintained of the quantities of wastes generated, recycled and disposed, determined by number of truck loads for each types of waste and average weight for each truck load of waste or other method.

Environmental Monitoring and Audit

It is recommended that auditing of each waste stream should be carried out periodically by the Site Engineers to determine if wastes are being managed in accordance with the Contractor's procedures and the site waste management plan and if waste reduction targets are being achieved and could be improved. The audits should look at all aspects of waste management including waste generation, storage, recycling, treatment, transport, and disposal. An appropriate audit programme would be to undertake a first audit at the commencement of the construction works, and then to audit quarterly thereafter.

3.5.6 Conclusion

No unacceptable impacts upon the environment, in terms of specified government regulations and guidelines, have been identified arising from the storage, handling, collection, transport and disposal of wastes from the construction of the Route 16 Dual 3 scheme. The reuse of excavated material on-site is recommended. In most cases the inert construction and demolition material can be easily re-used on other fill sites or delivered to public dumps.

However, the mitigation measures recommended in this section should be incorporated into Contract Specifications and applied to ensure that environmental nuisance does not arise from the storage, transport and disposal of the various types of waste arising from the construction of Route 16. These recommendations will form the basis of the waste management plan for the construction of Route 16 to be developed by the Route 16 contractor prior to construction.

3.6 Landscape and Visual Impact

3.6.1 Introduction

The assessment, reviews the Kowloon and Shatin sections of Route 16 separately. Each section is considered in terms of its existing landscape, landscape impacts, visual impacts and proposed landscape mitigation, whilst the conclusions of the assessment process are also summarised in table form.

3.6.2 Environmental Legislation and Guidelines

In February 1997, the Environmental Impact Assessment Ordnance confirmed the requirement for landscape and visual issues to be considered as an integral part of the EIA process, whilst a Technical Memorandum (Annex 18) established guidelines for the assessment. A degree of control is also currently achieved through the requirement to address visual issues as part of the environmental review and assessment process. The Environmental Protection Department's Advice Note (2/90), relating to the *Application of the Environmental Impact Assessment Process to Major Private Sector Projects*, identifies visual impacts as being an issue of concern to be addressed. Landscape impact, however, is not specifically identified.

The White Paper *Pollution in Hong Kong - A Time to Act* states that the Governments' overall policy objectives for environmental planning are:

"to avoid creating new environmental problems by ensuring the consequence for the environment is properly taken into account in site selection, planning and design of all new development".

Whilst these policy objectives were originally related to the specific environmental issues of noise, air, water and waste disposal, they may now be regarded as applying to the landscape and visual impacts of development.

In addition, the Hong Kong Planning Standards and Guidelines Chapter 10 - Landscape and Conservation - outlines those design criteria which should be considered when planning within the rural environment.

3.6.3 Approach

In order to ensure a continuity of approach, the evaluation of landscape and the visual impacts for Route 16 is based upon the method adopted for the Feasibility Study EIA Report of 1996. The conclusions of this study have been reviewed and updated as a precursor to the current Investigation Assignment.

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

- landscape impacts relate to the effects of development upon the physical characteristics or components, which together form that landscape, eg landform, vegetation, buildings, streams, boulders etc and the consequential impact upon landscape character.
- visual impacts relate to the changes arising from development to individual "receptor groups" views of that landscape, eg residents of the Lai Chi Kok Reception Centre or users of the Che Kung Miu Road Playground.

The form of landscape and visual impact assessment adopted for the proposed Route 16 has been formulated in order to address the specific issues typically raised by a development of this scale and complexity. The following section outlines the main components of this methodology.

3.6.4 Methodology

The assessment process commences with a description of the project including the alignment and features associated with both the construction and operational phase. (See Section 2 of this report).

In order for the subsequent assessment to be seen against the context of the existing landscape and individuals views of that landscape, the second stage of the assessment process is to establish the baseline conditions.

The baseline landscape and visual conditions in the case of Route 16 are assessed through an appraisal of the proposed roads existing landscape context. This appraisal is followed by a description of the roads proposed alignment.

The key potential impacts of the roads construction and operation upon the baseline landscape and identified receptor groups views of that landscape are then identified and assessed for the Kowloon and Shatin areas respectively.

Potential landscape and visual impacts (both positive and negative) are considered at three points in time: during construction, on day of opening andin year 10 of operation.

Through the assessment of impacts at these three points in time, distinctions may be drawn between temporary, permanent, cumulative, long term and short term effects.

Landscape and visual impacts identified may be further categorised as being either *direct* impacts i.e. within the study area as defined by the visual envelop or *indirect* impacts, eg off

site visual impact of construction traffic movements or the disposal of surplus tunnel excavation material.

3.6.4.1 Landscape Impacts

Landscape impacts are assessed at two levels:

- firstly in terms of the systematic consideration of impact upon individual landscape features;
- secondly in terms of the aggregate impact upon the sites landscape character

Areas of discrete landscape character (Landscape Character Areas) are defined within the roads visual corridor as a means of structuring the assessment of landscape impacts.

Landscape impacts are predicted primarily on the basis of the order of change to baseline conditions prevalent in 1997. No attempt is made to 'quantify' what is essentially a subjective but systematic and structured assessment process.

The criteria utilised in order to define potential impacts upon landscape resources into the three generic categories of *Severe, Moderate* and *Low* are given below.

- character and quality of existing landscape
- key features of the existing landscape
- the nature of predicted impacts
- degree of change to key features
- the ability of the landscape to accommodate change (ie sensitivity)
- the significance of change within a local, regional and national context

3.6.4.2 Visual Impacts

The assessment of visual impacts is structured by individual receptor groups. Receptors are identified through the definition of a *visual corridor*, or zone of visual influence for the route, within which views of the road and its associated works, *are possible* and the subsequent categorisation of individuals into 'user groups' within that envelope area. The sensitivity of receptors is categorised as being *High, Moderate* or *Low*.

Potentially highly sensitive receptors include existing residents, eg residents of Holford Gardens, Shatin or visitors to the Chik Wan Street Rest Garden. Moderately sensitive receivers may include residents of the Mei Foo Sun Chuen Estate. Low sensitivity receivers may, for example, include workers in the Wai Man Tsuen industrial area.

The criteria used to assess the degree of visual impact (*severe, moderate and low*) are as follows:

- value of existing views
- degree of change to existing views
- proximity of receptor
- sensitivity of receptor
- number of receptors in group

- availability and amenity value of alternative views

The visual sensitivity of receptors is regarded as relating principally to four factors;

- social, cultural, and educational background
- receptors function whilst exposed to view
- degree of exposure to view
- period of exposure to view

It should be noted that the effects of development which are considered low or negligible in their impact are termed *insignificant* whereas moderate and severe impacts are termed *significant*. Impacts which are beneficial in terms of *enhancing* the quality of receptors views are termed *positive*.

3.6.5 Kowloon Section

3.6.5.1 Existing Landscape\Townscape

The study area covers the existing urban area of Lai Chi Kok, bordered to the south by the new West Kowloon Reclamation and to the north by the natural hill slopes to the south west of the Eagles Nest ridge. This dense urban area includes a variety of land uses of contrasting urban character. Landscape Character Areas (LCAs) within the visual corridor of the road are shown on Figure 3.6a.

The area of Lai Chi Kok to the east of the proposed alignment is characterised by numerous industrial, factory and warehousing buildings, some 8 to 10 floors high, set in a regular grid along Cheung Sha Wan Road and parallel side roads.

In the vicinity of the existing Lai Chi Kok Interchange on Kwai Chung Road, there are a variety of land uses. To the north east, Wai Man Tsuen Village is located on the floor of the Butterfly Valley encircled by Butterfly Valley Road and the recently widened Ching Cheung Road. To the north west the Lai Chi Kok Reception Centre and the Lai Chi Kok Hospital comprise an institutional enclave characterised by a number of blocks clustered to the west and south of a wooded conical hill at the entrance to Butterfly Valley.

A bus depot and a covered area of food stalls are shaded and screened by a belt of mature trees immediately adjoining the junction of Butterfly Valley Road and Castle Peak Road.. To the south of this junction, the telephone exchange building is surrounded by a number of small scale sites including the site of a former incinerator, many of which are currently either being used for scrap metal trading, as works areas for other construction sites, or have been left vacant. The outline development plans indicate that these sites may be developed in the future as a sports stadium.

To the west of the alignment the densely spaced high rise residential towers of the Mei Foo Sun Chuen public housing estate provide a continuous backdrop to the road corridor.

Although some individual buildings are of modest interest, the urban fabric of Lai Chi Kok is generally of little or no architectural character or visual interest. The overall townscape character is confused with little apparent structure and, in consequence, is of relatively low quality.

The new reclamation area has yet to be developed, and is currently dominated by the construction of the elevated West Kowloon Expressway. The Mei Foo Sun Chuen Buffer Open Space, a 10.5 Ha park lying to the south of the housing estates has recently been completed. Whilst the area to the north of the Ching Cheung Road is predominantly natural

hill slope covered with dense secondary woodland vegetation. This provides a green, natural backdrop to the urban area when viewed from the Harbour or reclamation to the south.

3.6.5.2 Description of the Proposed Route

At its southern end, Route 16 will have north and south bound connections into the West Kowloon Expressway at the Lai Wan Interchange. From this junction, the proposed route would head northwards rising from an approximate level of +12m (AOD) to some +19m as it crosses over the Lai Chi Kok Interchange.

The road will remain at this level on elevated structure as it heads north between the existing buildings which adjoin Kom Tsun Street at the bottom of Butterfly Valley Road. The route will remain at an approximate level of +18m AOD as it turns to the north east, crossing over the lower end of the Wai Man Tsuen Village and entering into a pair of portals set into the lower slopes of Eagles Nest Hill beneath the recently widened Ching Cheung Road.

A pair of slip roads pass to the north of the Lai Chi Kok Hospital hill before diverging and linking into a widened 4-lane section of the Ching Cheung Road to the north of Lai Chi Kok Park.

3.6.5.3 Landscape Impact Assessment

Primarily as a consequence of the indifferent quality of the existing urban fabric, the new road will result in a low landscape impact in the vicinity of the Lai Wan and Lai Chi Kok Interchanges. Here the existing urban form is already dominated by highway structures and is able to accommodate the introduction of the new route. (Table 3.6a summarises the predicted landscape impacts of the roads construction and operation).

However, the loss of mature trees at the Li Chi Kok interchange (KL8) and the bus depot (KL2) will result in a severe construction impact, which will reduce to a low level by Year 10 of operation as replacement planting matures.

Route 16 will, however, result in moderate landscape impact on the existing townscape at the lower end of Butterfly Valley Road (KL1), where the elevated road structure passes through an urban "pinch point" between a Sub-Station building and the Reception Centre to form a feature totally dominating the cross-sectional profile of the road and adjoining buildings. Similarly, where the road traverses the Wai Man Tsuen Village area , its scale and height will be in sharp contrast to that of the surrounding topography. Whilst the tunnel portal construction may also result in the loss of large areas of natural, wooded hillslope, resulting in the severe construction and operational impacts (KL4).

With the clearance of Wai Man Tsuen Village and the culverting of the Butterfly Valley nullah, it is intended to utilise the valley floor for the disposal of spoil arising from the tunnel excavation. This will result in a severe constructional landscape impact. However, with the construction of new public park in the area this impact will be mitigated to a low level by Year 10 of operation (KL3).

The alignment of two slip roads across the upper slopes of Lai Chi Kok Hospital Hill will result in a severe construction impact as a consequence of the loss of natural hill form and the loss of its partial secondary woodland cover (KL5). The steepness of the cut slope will preclude revegetation of the hillside, although the construction of raised planters on the benches would partially mitigate impact to a moderate level by Year 10.

To the west of Lai Chi Kok Hospital Hill, the construction of the Route 16 slip roads over the Castle Peak Road Rest Garden will result in a moderate landscape impact (KL6).

The need to widen Ching Cheung Road to a dual 4-lane configuration will involve the loss of existing natural hillslopes and established vegetation on either side of the highway, resulting in a severe construction impact. Replanting will, however, only reduce this impact to a moderate level by Year 10 of operation (KL7).

Table 3.6a Summary of Significant Landscape Impacts - Kowloon

Location	Construction	Opening	Year 10	Mitigation
Lower Butterfly Valley Road	Moderate	Moderate	Moderate	Screen barriers, architectural finish to elevated structure
Bus Depot	Severe	Moderate	Low	Tree planting
Wai Man Tsuen Valley	Severe	Moderate	Low	Butterfly Valley Park Design
Eagles Nest Hill Slopes	Severe	Severe	Moderate	Re-vegetation
Lai Chi Kok Hospital Hill (facing Butterfly Valley Road)	Severe	Severe	Moderate	Raised planters on berms with granite block facing
Castle Peak Road Rest Garden	Moderate	Moderate	Moderate	Screen barriers, architectural finish to elevated structure and planting
Ching Cheung Road margins	Severe	Severe	Moderate	Re-planting-raised planters on berms with granite block facing
Li Chi Kok Interchange Existing Trees	Severe	Severe	Low	Replacement Street Tree planting

Note: For mitigation details refer to Section 3.6.5.6.

3.6.5.4 The Visual Corridor and Sensitive Receptors

The visual corridor for Route 16 as it passes through Lai Chi Kok is indicated on Figures 3.6c and 3.6d. As a consequence of the density of urban form, the extent of the visual envelope is relatively limited. Whilst the proposed route adopts an alignment through an area dominated by industrial and commercial land uses which are generally less sensitive to visual intrusion.

However, the road also passes extremely close to the new staff quarters of the Lai Chi Kok Reception Centre and the Lai Chi Kok Hospital at an elevated level. There is also a cooked food stall area adjoining the route at the Lai Chi Kok Interchange that will be adversely affected.

There will be more distant views down onto the proposed road as it passed over the existing Lai Chi Kok Interchange from the upper floor of the high rise residential blocks at the eastern end of the Mei Foo Sun Chuen Estate, and from the high rise staff quarters block at the Reception Centre. Similar elevated views would be possible from the Police Headquarters. There will be distant views from the Mei Foo Sun Chuen Buffer Open Space. The slip roads and widening of the Ching Cheung Road will also be visible from the northern edge of the Mei Foo Sun Chuen estate.

There will also be a visual impact upon motorists on the surrounding road network, most notably Butterfly Valley Road mainly during the construction phase.

Many of the land uses shown as falling within the visual envelope of the Route (Figures 3.6c and 3.6d) are not visually sensitive receivers as a consequence of having limited external views (eg the industrial and warehousing blocks along Cheung Sha Wan Road), or because of the nature of the present land use activity, such as the bus station, or the open storage areas and works yards on the edge of the reclamation. The visual impact upon receptors at these sites is considered largely insignificant.

There would be no visual impact on the users of the Roman Catholic Cemetery, the Caritas Hospital on Wing Hong Street, the Tin Hau Temple, nor on the properties on Tai Po Road and Caldecott Road.

There are a number of development proposals that would affect the visual impact assessment, most notably the stadium development on Yuet Tung Street. However, it is not possible to accurately assess the impact of the proposed route on the stadium site and other developments as this will be determined to a large extent by the future design and orientation of the buildings.

The extent of the visual corridor is shown on the visual impact assessment drawing, in Figure 3.6c and 3.6d. Visually sensitive receiver groups are located on these plans by reference numbers (KV1 - KV15).

3.6.5.5 Visual Impact Assessment

The following receptors have been assessed as incurring visual impact during the course of the construction of the route. A summary of visual impacts during construction and operation is given in Table 3.6b.

- Users of Mei Foo Sun Chuen Buffer Open Space (KV1)
- Residents of Mei Foo Sun Chuen Estate (South) (KV2)
- Residents of Mei Foo Sun Chuen Estate (East) (KV3)
- Residents of Mei Foo Sun Chuen Estate (North) (KV4)
- Residents of Reception Centre Staff Quarters (High Rise) (KV8)

There will be partial views from the eastern end of the recently constructed Mei Foo Sun Chuen Buffer open space of the elevated slip roads adjoining the Lai Wan Interchange. These would be seen in the context of the West Kowloon Expressway, currently under construction, but would significantly increase the level of built structure in this area, resulting in additional visual impact. This would be reduced to a low level, however, as the planting matures within the park by Year 10.

There would be long distance views of the elevated structures over the Lai Wan Interchange from the high rise residential blocks at the southern and eastern end of the Mei Foo Sun Chuen Estate and also from the Lai Chi Kok Reception Centre. Currently, upper floor

apartments in these blocks have views of the existing Interchange and the Kwai Chung Road, although some of these (particularly lower floor views) are partially obscured by the existing HK Telecom building, office buildings and existing trees around the bus station and interchange.

There will be close over views of the Ching Cheung Road slip roads from the north facing Mei Foo Sun Chuen blocks. The loss of large areas of natural vegetated hillslope will constitute a severe construction visual impact upon residents. The provision of planters on the cut slope benches will only mitigate this impact to a moderate level by Year 10. Illustration of the road scheme are provided in Annex F.

Motorists on Kwai Chung Road (KV10)

Motorists on Ching Cheung Road (KV5)

There will be direct close and long distance views of the Lai Chi Kok Viaduct from both carriageways of the Kwai Chung Road, albeit within the context of the existing road network. Motorists on the Ching Cheung Road will experience direct views from both east and west bound carriageways of the new viaduct and slip roads as they traverse Butterfly Valley at a high level. This, combined with the infilling of the valley floor and the re-contouring of Lai Chi Kok Hospital Hill, will result in a moderate visual impact to passing motorists, reducing to a low level by Year 10 of operation as the re-vegetation progressively matures.

Motorists on Butterfly Valley Road (KV6)

Motorists travelling south, down Butterfly Valley Road, will encounter massive earthworks, the loss of natural wooded hillslopes and intensive construction activity resulting in a moderate construction impact, reducing to a low operational impact.

Users of Offices, Lai Chi Kok Road (KV7)

There will be low visual impact upon office workers in Lai Chi Kok Road and Yuet Lun Street. The new Lai Chi Kok viaduct will constitute a substantial new element in the view. However, the road will be seen against the backdrop of the high rise industrial area to the east of Kan Tsun Street.

Residents of the LCK Reception Centre Staff Quarters

(Low Rise) (KV9)

Construction of the tunnel approach viaduct will result in a severe visual impact upon residents of the new apartments (approximately 50 no.) within the Lai Chi Kok Reception Centre, who currently have views out onto Butterfly Valley Road/Kom Tsun Street. These views will be obscured and dominated by the new elevated road structure, and from upper floors, obstructed by the road and its traffic.

Cheung Shun Street - Cooked Food Stalls (KV12)

Cheung Sha Wan Police Station (KV13)

There would be direct west facing views over a length of some 400 metres of the new viaduct as it crosses the Lai Chi Kok Interchange, from the cooked food stalls and the Cheung Wan Police Headquarters. The new route would be seen within the context of the existing elevated roads and the Kwai Chung Road corridor, but would result in a severe visual impact upon diners. There will, however, be a low visual impact upon workers in the Police HQ, where there will be more elevated views down onto the Kwai Chung Road flyover.

Patients and Staff of LCK Hospital (KV15)

The removal of the upper, eastern face of LCK Hospital Hill, with its associated secondary woodland cover will expose views from the hospitals hill top garden over the Butterfly Valley interchange, resulting in a severe construction impact.

Table 3.6b Summary of Visual Impact - Kowloon

Receptor	Construction	Opening	Year 10	Mitigation*
Users of Mei Foo Sun Chuen Park	Moderate	Moderate	Low	Planting in park
Residents of Mei Foo Sun Chuen Estate (South)	Low	Low	Low	
Residents of Mei Foo Sun Chuen Estate (East)	Low	Low	Low	
Residents of Mei Foo Sun Chuen Estate (North)	Severe	Severe	Moderate	Planters on benches
Motorists on Ching Cheung Road	Moderate	Moderate	Low	Re-vegetation
Motorists on Butterfly Valley Road	Moderate	Moderate	Low	Re-vegetation
Office Workers in Lai Chi Kok Road	Low	Low	Low	Structure design Re-planting
Residents of LCK High Rise Staff Quarters	Low	Low	Low	Re-planting
Residents of the Lai Chi Kok Reception Centre Staff Quarters	Severe	Severe	Severe	Structure design
Motorists on Kwai Chung Road	Low	Low	Low	Structure design Re-planting
Workers at Wai Man Tsuen Industrial Area	Low	Low	Low	
Diners at Cheung Shun Street Cooked Food Stall	Severe	Moderate	Moderate	
Workers in Police HQ	Low	Low	Low	
Residents of Wai Man Tsuen Village	Insignificant			Residents to be relocated
Patients and Staff of LCK Hospital	Severe	Severe	Moderate	Planters on benches

* During construction stage, normal provision of site screen hoarding is recommended as the mitigation measures

3.6.5.6 Mitigation

A number of proposed mitigation measures are identified in the preceding assessment of impacts, however, the following specific mitigation measures are proposed to assist ameliorate those significant landscape and visual impacts identified. Hard landscape treatment such as screen mounding or barriers, and architectural detailing of structures will have immediate effect on completion of the construction of the road. Soft landscape measures will, however, require time for planting to become established and mature before they become fully effective as visual screens, filters or softening elements.

Due to the tightly constrained configuration of the proposed route alignment within Lai Chi Kok, there is little space available for landscape or visual impact mitigation through screen planting or earthworks. Mitigation of the moderate landscape impacts incurred at the lower end of Butterfly Valley Road will, in particular, be constrained by the construction of the road corridor (KL1/KV9).

Those measures which should be considered in order to protect residents of the LCK Reception Centre, however, include: the architectural treatment of the elevated structure, particularly of the exposed undersides of the road deck and the support columns; and the provision of combined noise baffles/visual screens above the viaduct parapet. The noise barriers will have visual impacts to the surrounding environment, therefore careful architectural design of the barriers should be carried out at the detailed design stage to ensure that the barriers could blend in with the surrounding.

The regrading of Lai Chi Kok Hospital Hill will result in severe visual and landscape impacts (KL5/KV15). Mitigation through the provision of planters on each bench will reduce these severe impacts to a moderate level by Year 10. The provision of direct planting was not considered practicable as the slope would be on rockcut.

Motorists on Butterfly Valley Road (KV6) will incur a moderate visual impact during construction. By Year 10 of operation, however, the maturation of woodland and bench planter planting will mitigate impact to a low level.

Diners at the Cheung Shun Street Cooked Food Stall (KV12) will suffer severe visual impact during construction of the LCK viaduct. This may be mitigated, however, by the provision of a suitably designed feature screen trellis, incorporating tree and climber planting.

The severe construction landscape impact upon the lower Butterfly Valley (Wai Man Tsuen) (KL3) will mitigate to a low level by Year 10 of operation by virtue of the creation of a new public park (Butterfly Valley Park) over the tunnel spoil deposited on the valley floor.

3.6.6 Shatin Section

3.6.6.1 Existing Landscape Context

The study area covers the lower slopes of the west side of the upper Shatin Valley, south of Hin Tin. Landscape Character Areas within the visual corridor are shown on the Landscape Assessment Plans, (Figures 3.6f and 3.6g). The following description summarises the routes landscape context from its links into Route T3 in the north, to the Eagles Nest Tunnel portal in the south.

A number of village settlements exist on the lower east facing slopes below Tai Po Road, and much of the land is under horticultural production. There are low rise residential areas on Shatin Heights Road, at Woodcrest Hill, Shatin Gardens and Keng Hau Road, all set within the well vegetated slopes along Tai Po Road.

The flat area of the valley bottom is characterised by recreational land uses lying between the KCR line and the Che Kung Mui Road. The current Hong Kong School of Motoring (HKSM), football pitch and adjacent Bicycle Park sites are subject to future redevelopment as a KCR depot.

To the south, Hin Tin is heavily developed with high rise residential estates, including Grandway Gardens, Holford Gardens, Hin Keng Estate, Carado Gardens and Lung Hang Estate, forming the south western edge to the Shatin urban area.

The upper part of the Shatin Valley above the water treatment works consists of undeveloped natural hill slopes, covered with well vegetated dense scrub and secondary woodland. Access is limited to hiking trails along the major ridge lines, and the only obvious man made elements are the Tai Po Road connection to Lai Chi Kok and two overhead power lines.

3.6.6.2 Description of the Proposed Route

The following description traces the alignment of the route from north to south. The proposed route broadly follows a line parallel to the old Tai Po Road from the north western urban edge of Shatin to the lower slopes of Beacon Hill.

From its northern connection into Route T3, the proposed road will run parallel with the Kowloon-Canton railway to a point beneath the Shatin Heights condominiums from where it turns uphill and westwards to pass into a short tunnel beneath Keng Hau Road (Shatin Heights Tunnel).

Two slip roads diverge from the route at a point opposite the Hin Tin Swimming Pool, pass over the railway and Driving School on structure and link into Che Kung Miu Road opposite the Che Kung Miu Road Playground.

The Shatin Heights Tunnel is broadly aligned beneath the Tai Po Road and emerges on the hillside above the Shatin Water Treatment Works. The area between the Shatin Heights Tunnel and the Eagles Nest Tunnel accommodates the 18-lane Toll Plaza within a low lying, undulating area of woodland.

The proposed tunnel ventilation building is located on the lower slopes of Beacon Hill, 300 metres south east of the tunnel portal and accessed off the old Tai Po Road.

3.6.6.3 Landscape Impact Assessment

Figures 3.6f and 3.6g identify those Landscape Character Areas which fall within the roads visual corridor.

Route 16 will result in significant impacts upon the character and quality of existing landscape of the Upper Shatin Valley. These impacts relate to three distinct areas: the lower slopes of the Shatin Valley between Shatin Heights and the Kowloon Canton Railway, the Che Kung Miu Road Area in Shatin; the mid-level slopes between the Tai Po Road and the Shatin Water Treatment Works.

South of the interface with Trunk Road T3, (Chainage 500,000) the construction of Route 16 across the steeply sloping, well vegetated area of small holdings and nurseries will cause severe loss of natural landform and vegetation (SL4). This impact will extend south as far as the Sha Tin Heights Tunnel portals.

The slip roads which link Route 16 with the Che Kung Miu Road will result in severe landscape impact upon the mature frontage of the Che Kung Miu Road Playground (SL7 - Figure 3.6g) involving the loss of the mature tree belt which currently screens the open space from passing traffic.

The Route will also result in a severe landscape impact through extensive clearance of natural secondary woodland and substantial cutting and filling of existing natural slope profiles in the vicinity of the proposed toll plaza and the Eagles Nest tunnel portal. (*Figure 3.6f*).

The proposed tunnel ventilation building is set against the hillslopes of Beacon Hill and is situated within a Landscape Protection Area, as designated in the Metroplan Landscape Strategy for the Urban Fringe and Coastal Areas. Construction of the ventilation structure will result in a severe landscape impact through the loss of existing vegetation and landform (SL2). This impact will reduce to a moderate level by Year 10 of operation as new planting progressively matures.

Table 3.6c Summary of Landscape impacts - Shatin

Ref no	Location	Construction	Opening	Year 10	Mitigation
Figure 3.6f SL1	Toll Plaza	Severe	Severe	Moderate	Regrading/Re-vegetation
Figure 3.6g SL7	Che Kung Miu Playground	Severe	Severe	Moderate	Screen barriers, architectural finish to elevated structure/ Re-planting
SL4	Nurseries on hillslopes	Severe	Severe	Moderate	Regrading/Re-vegetation
SL2	Beacon Hill Ventilation Building	Severe	Severe	Moderate	Replanting

Note: For mitigation details refer to Section 3.6.6.6.

3.6.6.4 The Visual Corridor and Sensitive Receptors

The proposed route follows a visually prominent alignment across the lower slopes of the Shatin Valley, climbing south across the western valley side, where it is visible to residents of the many high rise blocks at Pak Shek and Tai Wai, and the low rise residential blocks at Shatin Heights. The open nature of the valley floor will also permit views from those recreational and commercial uses that line the Che Kung Miu Road. The Che Kung Miu Road slip roads will be clearly visible from the adjacent Hin Tin Public Swimming Pool, the Bicycle Park, the Driving School Centre, the high rise blocks at Carado Gardens the adjacent open space, and low rise village houses on the south and west sides of the Tin Sam Village.

The proposed alignment runs parallel to, and will be visible from, other major transport corridors and will be visible to passengers on the Kowloon Canton Railway in the vicinity of the Che Kung Mui Road through Hin Tin.

To the south of Keng Hau Road, the urban fringe character of the landscape changes to a more rural nature. The Toll Plaza area will be seen in distant views from the high rise residential blocks at Pak Shek, and from elevated viewpoints in the country park to the south and west.

The extent of visual influence of the proposed route and visually sensitive receptors within the Shatin Valley are shown on visual impact assessment *Figures 3.6f-h*, whilst a summary of visual impacts is given in *Table 3.6d.*

3.6.6.5 Visual Impact Assessment

The following receptors have been assessed as suffering significant visual impact during the course of the construction (and on occasion the operation) of the route. However, a number of potential receptors identified within the visual corridor are not considered visually sensitive since they have limited external views (eg the Hin Keng Commercial Centre and Indoor Sports Centre), or as a consequence of the nature of the present land use activity, (eg the petrol filling station on the Tai Po Road). Illustrations of the road scheme are provided in *Annex F.*

Residents of Halford Gardens (SV1)

Residents of Grandway Gardens (Chick Fai Street) (SV2)

Residents of Grandway Gardens (SV3)

Residents of Sun Chui Estate (SV4)

High level apartments (above 6/F) of south facing blocks at Grandway Gardens and Halford Gardens will have views over Cheng Wing Chi College and Tun Kwin Lau Pak Lok School along the line of the proposed Route 16 and Route 3 for a distance from 500 to 1,200 metres, where the road would replace the existing vegetated hill slopes below Tai Po Road. However, the road would be seen within the context of the adjacent KCR line and Che Kung Mui Road, and the intervening HKSM and Bicycle Park sites. The visual impact of Route 16 (as distinct from Route T3) construction upon residents will be moderate reducing to a low level by Year 10. There would be a similar low operational impact on the upper floors of the western corner block of the Sun Chui Estate (SV4).

Residents of Tai Wai Sun Tsuen (SV5)

Users of Chik Wan Street Rest Garden (SV6)

Pupils of Cheng Wing Chi College (SV7)

At the connection into the proposed Route T3, there will be a severe visual impact upon school and college pupils of Cheng Wing Chi College and Lau Pak Lok School, where the elevated road will replace the existing views to the west, of the wooded slopes which surround Chik Wan Street Rest Gardens. If retained, (dependent upon alignment of Route T3) there will also be severe visual impacts upon users of the Rest Garden itself.

Existing views of residents from a small number of south west facing houses at Tai Wai Sun Tsuen would be affected by the loss of the woodland belt along the side of Tai Po Road, resulting from construction of Route T3, which will open up views of Route 16 and the urban edge of Shatin.

Users of Kowloon Canton Railway (KCR) (SV8)

Route 16 will be visible to passengers on the KCR looking west. The new road will run parallel to the railway for a distance of some 750 metres, and will detract from passengers' views of the Shatin the valley side which currently comprise wooded hill slopes.

Due to the transitory nature of the views and visual environment within the carriage, however, passengers are considered generally to have a low visual sensitivity. Although the proposed Route would only be visible for a brief time, many people will be affected, often on a twice daily basis, resulting in a moderate construction impact. Screen planting between the road and railway will reduce the operational impact to a low level, assisted by the use of climbers to cloth the two retaining walls which support the split level carriageway of Route 16. These walls to be faced in granite blocks.

Users of Che Kung Miu Road Playground (SV10)

Users of Hin Tin Public Swimming Pool (SV13)

Users of Hin Tin Recreation Area (SV16)

Views of the main Route alignment from the Hin Tin Public Swimming Pool, football pitch and Hin Tin Recreation Area are screened by the embankments to the KCR. However, users of the swimming pool will be in close proximity to the elevated slip roads to Che King Miu Road and will incur a moderate impact.

Users of the HKSM would also have direct views of the elevated slip roads as they pass over the site, resulting in a low visual impact. (This site is zoned for redevelopment as a depot site for the KCR).

The slip roads would also be prominent in views from the Che Kung Miu Road Playground, which will suffer a loss of existing mature trees on the frontage with Che Kung Miu Road, resulting in a severe construction impact.

Carado Gardens (SV9)- Lung Hang Estate (SV11) - Ling Hang Centre (SV23) - Carmel Alison Lam Primary School (SV17) - Hin Keng Estate (North)(SV18) - Hin Keng Commercial Centre Open Space (Roof) (SV20) - Hin Keng Estate (South) and Ka Tin Court (SV21) - Sui Fung Garden (SV22) - Lung Hang Estate (SV23) - Tin Sam Estate (SV24) - Hung Mui Kuk Playground (SV25)

The section of road between Chik Wan Street and Keng Hau Road will be clearly visible from a number of residential tower blocks which form the south western urban edge of Shatin. The route will, however, be seen within the context of the existing KCR line, Che Kung Miu Road and the amusement park, motoring school and football pitches which lie between.

Route 16 and its slip roads will have a severe construction impact upon many residents, particularly from the higher floors. Impact will be a product of the route effectively extending the existing transport corridor into the hill slope, and a loss of visual amenity through the loss of natural landform and the extensive clearance of existing vegetation. There will, however, be a low impact on non-residential uses at the Carmel Alison Primary School (SV17), Hin Keng Commercial Centre and on the more distant residential blocks (eg Sui Fung Gardens SV22).

The elevated slip roads onto Che Kung Mui Road would be prominent in views from the apartments at Carado Gardens (SV9), the houses on the west side the Tin Sam Estate (SV24), and the Hung Mui Kok playground (SV25), replacing the existing low level views of the HKSM and the vegetated embankment slopes of the KCR beyond and the Che Kung Miu Road.

Residents of Shatin Gardens (SV12)

Residents of Shatin Heights Road (SV14)

Residents of Woodcrest Hill (SV15)

There will be a severe construction and operational visual impact upon the residents of Shatin Gardens (SV12) on the Tai Po Road with close, elevated views down onto the new road. The properties at Woodcrest Hill and Shatin Heights Road are set back and screened from the Route by a belt of mature vegetation, and would experience a low visual impact (SV14/15).

The toll plaza will be visible from middle to upper west facing apartments at Hin Keng Estate (South)(SV21) and Ka Tin Court. The new road will result in moderate impact, as a

consequence of the deep cutting and filling of hill slopes, loss of vegetation and night time lighting.

Residents of Keng Hau Road (SV19)

Severely affected residents on Keng Hau Road have existing views of the land currently under horticultural use on the west side of the KCR, and the well vegetated slopes below Tai Po Road. The Route and the new cutting into the slopes below Tai Po Road and around the tunnel portal will become the dominant feature in these views, with properties looking directly along the road for up to 750 metres to the north, resulting in a severe visual impact.

Users of Country Park Extension Area (SV26)

Users of Country Park Hiking Trails (SV27)

The area of the toll plaza to the south of Keng Hau Road will be visually less intrusive and seen only in distant views from the topmost floors of the residential towers on the Hin Keng Estate. The plaza will be set well down within the surrounding topography, limiting views from viewpoints on the valley floor and from the Tai Po Road. It is anticipated, however, that there will be partial views from the MacLehose Trail between Eagle's Nest and Beacon Hill, but that generally hiking trails within the Country Park would be largely unaffected.

Beacon Hill, Tai Po Road - Tunnel Ventilation Building

The proposed tunnel ventilation building is a massive structure some 40 metres in height set into a prominent hillside. It would be clearly visible from locations in close proximity to the site and also partially in views from the urban fringe of Lai Chi Kok to the south. The ventilation building would result in a severe visual impact on the low rise residential blocks to the south of Tai Po Road. Motorists on the Tai Po Road and users of the adjacent petrol station would experience low visual impact.

Motorists on Route 16

As a consequence of the roads elevated alignment, motorists travelling in either direction will encounter a sequence of visually stimulating experiences, particularly as the road emerges from Eagles Nest Tunnel into the Shatin Valley.

3.6.6.6 Mitigation

The section of road through the Shatin Valley is confined in its alignment to the east by the KCR line and to the west by the steeply sloping hill slopes below Tai Po Road, leaving little room for large scale mitigation. The alignment and configuration of the carriageways have, where possible, been refined to minimise land take, with the road becoming grade separated to reduce widths in the pinch point between Shatin Gardens (SV12) and the KCR line. Reinforced earth retaining walls with granite block facing and tree and shrub planting at their bases and top are proposed to assist blend the new road into the hill side.

Careful regrading of slopes to profiles of 1:1.5 or less will facilitate extensive replanting of woodland, ie planting of the cut and fill slopes below the Tai Po Road. In the vicinity of the tunnel portals, steep cut slopes should be formed in natural rock, or granite faced, to eliminate the use of shot-crete (Figure 3.6f - SL1, Figure 3.6g - SL4). The toll plaza is located such that the slope cutting and landscape impact would be minimised. Any loss of woodland during construction will be compensated by re-planting.

The proposed ventilation building near Tai Po Road will also have severe visual impact to the environment. During the detailed design stage, careful architectural design of the building should be carried out and the size should be minimised as far as practicable.

The most seriously affected visually sensitive receptor, at Sha Tin Gardens (SV12), and Keng Hau Road (SV19) are too close, and at too elevated a level for the carriageways to be screened. The re-contouring and planting proposed on hillslopes and around the portals will assist in mitigating the impact of the road. However, the visual impact for these residents in the long term will remain severe. A 7m reinforced earth retaining wall is proposed below Shatin Gardens, however, this will have limited effect as a visual screen. Careful architectural and landscape design with integration of earth mounding and planting will be required to mitigate the visual impact due to the retaining wall.

The operational visual impact upon KCR passengers (SV8) and users of the recreational facilities on the valley floor (SV10/13/16) sill be partially ameliorated by screen planting to the east of the new road. Extensive re-planting of cut slopes to the west of Route 16 and around the tunnel portals will also progressively reduce both landscape and visual impacts. Where the KCR and Route 16 adjoin, views of the route will be screened by virtue of the roads elevation, the provision of a retaining wall and planting to the base of the wall.

Where the Che Kung Mui slip roads are elevated in order to cross over the KCR, there is less opportunity to mitigate visual impacts (SV10/13/16). Careful architectural treatment of viaduct parapets, columns and the underside of the road deck will help to provide a visually less intrusive structure. A 3m high noise barrier is proposed along the frontage of Che Kung Miu Road Playground (SV10/SL12)and the Tin Sam Estate (SV24/SL25). The design of noise barriers will require careful design and softening through the appropriate use of planting, including climbers. This structure will screen views of existing traffic and partially screen views of the new elevated structures. New planting will replace existing vegetation lost along the boundary to Che Kung Miu Road, mitigating impact to a moderate level by Year 10 of operation.

The Land Use Assessment describes two options for the future use of land beneath the elevated Che Kung Miu Road slip roads currently occupied by the Hong Kong School of Motoring. One option proposes re-zoning the land to "Road and Amenity Area", the alternative option being to incorporate the land as passive open space as part of the Hin Tin Public Swimming Pool. Both options will provide the opportunity to incorporate screen planting beneath and adjacent to the structures.

View points from the high rise residential blocks at Carado Gardens (SV9) and Lung Hang Estate (SV11) are elevated, looking down onto the road pavement. It is not therefore feasible to mitigate fully the visual impact of the new Route or its traffic. Screen planting is proposed along the eastern embankment slopes which will progressively screen parts of the road. There will, however, be a long term moderate visual impact for residents.

The severe landscape impact associated with the construction of the toll plaza (Figure 3.6f - SL1) is capable of partial long term mitigation to a moderate level through an intensive planting on slope profiles capable of re-vegetation to indigenous woodland. The long term operational impact upon receptors in the Hin Keng Estate (SV18/21) may also be mitigated to a moderate level by adopting this approach.

Given the size and visual prominence of the ventilation building and effective mitigation will depend upon the quality of architectural design on this important structure. It will proposed, therefore, that a limited architectural competition be promoted based upon a well defined design brief in order to secure an optimum design solution.

Table 3.6d - Summary of Significant Visual Impacts - Shatin

Receptor	Construction	Opening	Year 10	Mitigation
Residents of Halford Gardens	Moderate	Moderate	Low	Regrading/ Re-vegetation
Residents of Grandway Gardens (Chick Fai Street)	Moderate	Moderate	Low	Regrading/Re-vegetation
Residents of Grandway Gardens	Moderate	Moderate	Low	Regrading/ Re-vegetation
Residents of Sun Chui Estate	Moderate	Moderate	Low	Regrading/Re-vegetation
Residents of Tai Wai Village	Severe	Severe	Moderate	Screen planting
Users of Chik Wan Street Garden	Severe	Severe	Moderate	Screen planting
Students of Cheng Wing Chi College	Severe	Severe	Moderate	Screen planting
Passengers on KCR	Moderate	Moderate	Low	Screen planting/climbers/retaining wall finish
Residents of Carado Gardens	Severe	Moderate	Moderate	Screen planting/ Re-grading hillslopes
Users of Che Kung Miu Playground	Severe	Severe	Moderate	Screen planting/structure design
Residents of Lung Hang Estate	Severe	Moderate	Moderate	Screen planting Regrading hillslopes
Residents of Shatin	Severe	Severe	Severe	-

Receptor	Construction	Opening	Year 10	Mitigation
Gardens				
Users of Hin Tin Pool	Moderate	Moderate	Low	Structure design/ Screen planting
Shatin Heights Road	Low	Low	Low	-
Users of Hin Tin Playground	Moderate	Moderate	Low	Structure design/ Screen planting
Carmel Alison School	Low	Low	Low	-
Residents of Hing Keng Estate (North)	Severe	Moderate	Moderate	Screen planting
Residents of Keng Hau Road	Severe	Severe	Severe	Regrading and re-vegetation of hillslopes
Hing Keng Commercial Centre	Low	Low	Low	-
Residents of Hin Keng Estate (South)	Moderate	Moderate	Moderate	Regrading and re-vegetation of hillslopes
Sui Fung Garden	Low	Low	Insignificant	-
Lung Hang Estate	Low	Low	Insignificant	-
Residents of Tin Sam Estate	Severe	Severe	Moderate	Screen planting
Hung Mui Kuk Playground	Low	Low	Low	-
Country Park Extension	Low	Low	Low	-
Country Park Hiking Trails	Low	Low	Low	-

Receptor	Construction	Opening	Year 10	Mitigation
Residents south of Ventilation Building	Severe	Severe	Moderate	Screen planting

3.6.7 Conclusion

Landscape Impact

Key landscape impacts within Kowloon will focus upon the infilling of the lower Butterfly Valley, the loss of wooded natural hillslopes in the vicinity of the tunnel portals and ventilation building, to the east of LCK Hospital Hill and to the north of Ching Cheung Road. Mitigation of these engineered cut slopes will be limited to the provision of planters on benches, unless a significantly increased area of hillside is regraded to slopes of less than 1:1.5 capable of sustaining vegetation.

At Shatin, key impacts will include the clearance of vegetation and extensive cutting of natural slope profiles around the toll plaza, tunnel portals and below Tai Po Road; the high impact on the local landscape setting around the Holford Gardens area where Route 16 connects with Route T3, the loss of mature trees on the Che Kung Miu Playground frontage.

Within the Shatin Valley there is little space available for large scale landscape mitigation. Landscape impacts will be reduced by woodland planting and the sensitive regrading of cut and fill slopes to accommodate planting at the tunnel portals, toll plaza and below Tai Po Road.

It is recommended that a detailed Tree Survey be carried out at the detailed design stage.

Visual Impact

Route 16 will result in key visual impacts in Kowloon where the road passes on elevated road structure in front of the Lai Chi Kok Reception Centre Staff Quarters.

In the Shatin Valley, Route 16 will result in severe visual impact upon residents of Shatin Gardens; houses on Keng Hau Road; tower blocks at Carado Gardens, Hin Keng Estate, Holford Gardens and Grandway Gardens, and a number of low rise residential blocks at Tai Wai Sun Tsuen to the south of Chik Wan Street, users of Hin Tin Swimming Pool, the Chik Wan Street Rest Garden and Che Kung Miu Road Playground.

Mitigation measures are limited for elevated view points from high rise blocks, receptors at Holford Gardens, the Cheng Wing Chi School, Shatin Gardens and Keng Hau Road. Re-planting of hillslopes, extensive regrading, careful architectural treatment of highway structures, noise barriers and retaining walls with screen planting in close proximity to residential buildings or sensitive receivers will, however, assist in reducing the visual impacts upon less elevated receptors.

To summarise, therefore, the construction and operation of Route 16 will result in significant, long term landscape and visual impacts, a number of which are incapable of effective mitigation. However, a significant reduction in impact may be achieved through the regrading of landform beyond the immediate highway corridor in order to facilitate the comprehensive re-vegetation of cut and fill slopes to indigenous woodland, within both the Butterfly and Shatin Valleys.

A series of direct noise mitigation measures have been considered for Route 16 to reduce the noise impacts at the Lai Chi Kok Reception Centre Staff Quarters, Hin Keng Estate,

Carado Garden and Shatin Heights. The best practicable mitigation package recommended, comprises a combination of 3 and 5m high roadside noise barriers and low noise road surfaces for the West Kowloon Section and a combination of 2 and 4m noise barriers, low noise road surfaces and 7m high reinforced earth embankment for the Shatin Section. The design of noise barriers will require careful design and softening through appropriate use of planting, including climbers.

The visual impact of 3 and 5m high noise barriers proposed for the Lai Chi Kok viaduct (Figure 4.1e) could exacerbate the severe visual impact of Route 16 upon residents of the LCK Reception Centre Staff Quarters, through the loss of natural light and the further obstruction of views. Careful design of these prominent structures as an integrated component of the viaduct will be required in order to minimise impact.

At Shatin the formation of a 7m high reinforced earth embankment north of Shatin Heights tunnel will require sensitive regrading of the adjoining hillslopes in order to achieve the successful integration of landforms and revegetation.

The provision of 4m high noise barriers to the northern limits of Route 16 and 3m high barriers to the Che Kung Miu Road slip roads will require detail design appropriate to their setting.

3.6.8 Environmental Monitoring and Auditing

The outline landscape mitigation measures identified in the EIA are, where appropriate, embodied within the Investigation Assignment Landscape Works drawings (as attached in *Annex F*).

At the detailed design stage these outline proposals will be developed and refined in order to optimise their effectiveness in terms of mitigation. Whilst contract documentation and specification will seek to ensure the effective and conservation of existing landscape features during construction and the successful establishment of new planting.

Meaningful financial penalties are to be incorporated within the conditions of contract with respect of the protection of existing vegetation and other landscape features.

During Construction Phase

The landscape construction works will be closely monitored to ensure all specified measures to ensure the establishment of planting are fully complied with and any defects or omissions rectified at the earliest opportunity. Monitoring will continue on a regular basis throughout the construction period and the subsequent 24 month establishment/defects liability period.

The protection provided to all trees, woodland and other landscape features identified to be retained will be monitored throughout the construction period to ensure their retention in a good condition. Any damage by the Contractor or by other parties to landscape features will be notified to the project Landscape Architect for appropriate remedial action.

The extent of agreed works areas, storage areas and access roads will be regularly checked during the construction phase. Any trespass by the Contractor outside the limit of the works, including any damage to existing trees and woodland will be reported to the project Landscape Architect.

Prior to the commencement of construction, a reliable source of plant material should be secured and approved. Operations relating to the supply of specialist plant material (including the collecting, germination and growth of plants from seed) will be monitored to ensure that plants will be available during the appropriate planting seasons.

The progress of the engineering works will be regularly reviewed on site to identify the earliest practical opportunities for planting and seeding works to be undertaken.

Planting works, tree preservation and erosion control will be monitored both during and after the construction stages by a qualified Landscape Architect.

Post Construction Phase

All works necessary for the successful establishment of plant material (intended to mitigate visual and landscape impacts) be monitored on a weekly basis during a 24 month (minimum) Establishment Period. During the first year when the construction contract is within its project maintenance period, the monitoring and auditing tasks will be performed by the Project Landscape Architect. Measures to make good defects will be implemented and inspected during the first available growing season.

3.7 Landuse and Cultural Impact

3.7.1 Introduction

Since there are no significant changes to the Route 16 alignment in terms of landuse and cultural impacts, this section presents the assessment reported in the previous Feasibility Study.

The assessment was based on the planning methodology agreed by the relevant district planning offices. The study addressed the land use impacts assessment pertaining to affected areas in Kowloon and Sha Tin, and took into account the broad assumptions of relevant planning studies, current statutory/non-statutory plans and consultations with relevant government departments.

Information from the Antiquities and Monuments Office indicate that the know archaeological/historical important sites in the vicinity of the Route 16 area are all at sufficient distance from the alignment, that it is very unlikely that they would be affected by the project. The nearest sites included:

- Lei Cheng Uk Tomb in Shek Kei Mie - approximately 2 km away;
- Che Kung Miu Temple - over 300m away from the eastern end of the Che Kung Miu Road Connection; and
- Old Shatin Police Station in Tung Lo Wan - over 1 km away.

3.7.2 Landuse Context

West Kowloon

The main area affected by the alignment is bounded by Ching Cheung Road in the north, Butterfly Valley Road in the west, King Lam Street in the south and Yee Kuk West Street in the east. The subject site is located within a valley straddled by steep hill slopes. There is an existing stream which runs through the valley and drains to a nullah adjacent to Kom Tsun Street.

The landuse zonings of the area in the vicinity of the Route 16 is shown in *Figure 3.7a*. A number of cottages and old industries/godowns currently lie within the area affected by Route 16. The Butterfly Valley Cottage Area (Wai Man Tsuen) has approximately 200 cottages owned by government, administered by the Housing Department and Building and Lands Department's Property Management Section. Currently, only pedestrian access to

the cottage area is possible via a pedestrian stairways from Butterfly Valley Road. There is no vehicular access to the cottage area given the existing grade differences which is about 10% or more from the existing Butterfly Valley Road and Ching Cheung Road.

There are a number of existing industries and godowns located on the eastern part of the valley which are generally associated with the manufacturing and storage of dangerous goods including LPG storage and other pollutive industrial uses. The industries and godowns are on short-term tenancies renewable every three months. The industrial area is currently under the administration of Kowloon District Lands Office. Vehicular access to the industrial area is currently taken off King Lam Street.

Major parts of the cottage area and industries/godowns are zoned Industry (I) in the current Cheung Sha Wan OZP S/K5/10. Remaining zonings include Open Space and Government/Institution & Community (G/IC) uses. The Cheung Sha Wan & Sham Shui Po ODP (Northern Part) D/K5A/1A provided for a planning layout which encompassed the cottage and industrial areas and made provision for various land use zonings. The plan provided mainly for I(A) uses, with allocation for an Local Open Space (LO) and a Government Reservation (G) site along King Lam Street. The 'G' site included a public toilet and cooked food centre as general planning requirements for the area. A 9 m drainage reserve was incorporated within the layout for the area, aligned beneath a proposed internal road and the LO site.

An existing knoll, the Lai Chi Kok Hospital and Lai Chi Kok Reception Centre are located west of Butterfly Valley Road. Residential buildings between the hospital and reception centre have been completed recently. The entire area is currently zoned G/IC in the Lai Chi Kok OZP S/K16/4. An existing open space is located at the junction of Castle Peak Road and Ching Cheung Road to the west of the planning area. The park is currently zoned Open Space in Lai Chi Kok OZP and is used mainly as a passive open space.

Sha Tin

The main alignment and connection are depicted in *Figure 2.1a*. The Route 16 alignment emerges from tunnel just after Keng Hau Road and is routed within a valley sandwiched by steep hill slopes and Tai Po Road on the western side and the Kowloon-Canton Railway (KCR) line on the eastern side.

The Pak Shek Village currently has a few squatters and scattered parcels of farmland mostly operating on Crown Land leases. There are a few parcels of land under private ownership. The others are either under Crown Land permits/licences, short term tenancies or government land allocations. In the vicinity, there are some residential developments, mainly R(B), located along Tai Po Road. Besides the R(B) zoning, the rest of the areas are zoned Green Belt (GB) in the current Sha Tin OZP S/ST/9.

To the east of the KCR line are existing development areas. A temporary bicycle park and football pitch, Hin Tin Public Swimming Complex and Playground, and Hong Kong School of Motoring currently occupy the areas adjacent to the KCR line. The Hong Kong School of Motoring is currently operating on short-term tenancy. In the adopted Pak Shek Layout Plan L/ST 17/1C, provisions have been made for the planned Ma On Shan Railway line and depot by reserving the temporary bicycle park and School of Motoring zoning the sites to Other Specified Uses (OU) annotated 'Possible Railway Depot with Commercial/Residential Development above'. The Sha Tin OZP has similarly zoned the area OU annotated 'Railway Depot Comprehensive Development Area'. There is no current plan to reprovision the Hong Kong School of Motoring and Bicycle Park sites. There is also no proposed layout plan for the OU site under the current ODPs.

3.7.3 Planning Context

This section describes the Route 16 alignment and proposed connections in the context of planning intentions and proposals for areas affected by the proposed alignment. The relevant planning studies, statutory and non-statutory plans are outlined below.

Territorial Development Strategy Review (TDSR) & Metroplan

TDSR has defined long term development scenarios for the territory. The strategy currently envisages future development of the territory's port facilities and urban growth into West Kowloon and the north-east region with corresponding increase in transport infrastructure requirements. Development of Route 16 was identified as being essential to all the development options in the TDS as a principal strategic road linking West Kowloon with Sha Tin, Tai Po and future developments in Ma On Shan.

The southern part of the proposed R16 alignment lies within the Metroplan planning area. Metroplan envisages the Butterfly Valley area as providing space for development of medium density industries in Kowloon. The existing industrial estate in Cheung Sha Wan Road/King Lam Street was identified as a high priority action area for redevelopment and upgrading. The Metroplan strategy called for the retention of the Green Belt north of Ching Cheung Road which would be kept as a scenic backdrop to the proposed Butterfly Valley Urban Fringe Park. The green belt would also enhance the visual aspects of the Butterfly Valley area as a major city gateway, to West Kowloon and Hong Kong Island.

West Kowloon Development Statement (WKDS)

The WKDS was prepared in November 1993 as part of the process to translate Metroplan's broad planning intentions into the necessary development controls, standards, guidelines and institutional mechanisms required to achieve the principal objectives of the Selected Strategy.

Under the transport network assessment, Route 16 was envisaged as providing a link with the proposed Route 3/West Kowloon Expressway at Lai Wan Interchange, thereby creating a major road link between the North-east region with Hong Kong Island in the future.

WKDS envisaged that the existing industrial area north of King Lam Street would be upgraded and redeveloped for future industries.. Being within the Metroplan planning area, the permissible range of plot ratio for industrial development is 5 to 12 for Types A and C industries with a maximum average plot ratio of 9.5 within a given industrial zone. WKDS also specified a development height band of 40 m to 65 m for the area between Ching Cheung Road and King Lam Street. These planning parameters are indicative of the scale of development and serve only as a very broad basis for development proposals within the area. More specific and detailed evaluation of the potential land use and transport impacts would need to be carried out at a local level in order to ascertain a suitable scale of development that can be sustained within the area.

2nd Comprehensive Transport Strategy (CTS2) Review

Under the 2nd CTS Review, Route 16 was proposed as a highway which would run roughly parallel to Tai Po Road, connecting Sha Tin with urban Kowloon. It indicated that the amount of relief provided by Route 16 to other tunnels in the corridor would depend very much on the highway connections to the urban areas in Kowloon. The need for this project depends critically on the build-up in traffic moving between Kowloon and the North-east New Territories, and this will be affected by the impact of traffic management policies. According to the study, the project has been tentatively programmed for completion by the late 1990s.

The report stated that apart from timing, the southern end of the route and its connections with Kowloon requires detailed investigation.

Statutory and Non-Statutory Plans and Planning Guidelines

Reference has been made to the relevant Outline Zoning Plans (OZP) and Outline Development Plans (ODP) within the study areas for Kowloon and Sha Tin during the course of the land use impact assessment. These are government plans which are used as a planning framework for future development and development control purposes. Reference has also been made to relevant departmental layout plans to ascertain the planning intentions for the areas affected by Route 16 alignment and road connections. Where possible, the basic assumptions and planning intentions apparent in these plans have been taken into consideration in replanning land uses within the affected areas, especially on the Kowloon side. The Hong Kong Planning Standards and Guidelines (HKPSG) have also been employed in the application of planning standards and requirements for areas which have been replanned for new uses.

3.7.4 West Kowloon

3.7.4.1 Impact on Existing Uses

The selected main alignment extends from Lai Wan Interchange northwards above Butterfly Valley Road and then passes through Butterfly Valley Cottage Area in a north-east direction and enters into two tunnels below Ching Cheung Road. The proposed tunnel portals are within the existing green belt area just under Ching Cheung Road.

The Wai Man Tsuen cottage area will be the main area affected by the alignment The requirement to provide road connections from Route 16 to Ching Cheung Road will also result in the provision of a number of elevated slip-roads traversing the cottage area. Most of the cottages would be physically affected by Route 16 and it's connections, with potential adverse environmental impacts, implying that the clearance of the entire cottage area is likely to be preferable.

The current programme envisages that construction work affecting the cottage area could begin in 2000. A works area has been identified which includes the cottage area and part of the existing industrial site as depicted on *Figure 3.7a*. Existing dangerous goods industries and godowns would also have to be cleared to make way for the works area. Clearance of the cottages and industries in the Butterfly Valley area is congruent with government's intentions to redevelop the Butterfly Valley Cottage Area and existing industries in the future as depicted in the Cheung Sha Wan & Sham Shui Po ODP (Northern Part) D/K5A/1A. Consultations with Housing Department and the Lands and Buildings Department have indicated that it would take about one to two years to clear and rehouse the affected tenants depending on issues such as residents' appeals and other unforeseeable circumstances. Buildings and Lands Department have highlighted that clearance and rehousing are sensitive issues which may sometimes take a longer period to resolve than anticipated.

There would be fewer problems in clearing the dangerous goods industries as they are operating on quarterly short-term tenancies which can be terminated on short notice. Notwithstanding this, Kowloon District Lands Office have indicated that a longer notice period is desirable.

The foothills of the existing knoll west of Butterfly Valley Road will be required for construction of portals for the two road connections to and from Ching Cheung Road/Castle Peak Road-Kwai Chung and Route 16. The Route 16 connections to/from Ching Cheung Road would have to be either tunnelled through the knoll or constructed on viaduct. Not withstanding the G/IC zoning assigned to the knoll, there is no existing building and no

development proposal envisaged for the area except for the tunnel portals. As such, the land use impact on this area is minimal.

The Route 16 project would involve encroachment onto existing facilities managed by Provisional Urban Council (PUC) in the Sham Shui Po area. These facilites include the following:

- Lai Chi Kok Interchange Amenity Plot
- Cheung Sha Wan Road/Lai Chi Kok Flyover Amenity Plot
- Castle Peak Road/Ching Cheung Road Rest Garden
- Lai Chi Kok Park Complex

Most of the proposed encroachment into these PUC facilities would be on a temporary basis. The permanent encroachment would only involve very small area. The area temporarily occupied for construction activities will be reinstated or re-landscaped upon completion of the roadworks. Highways Department will seek UC's approval for the above encroachment.

3.7.4.2 Planning Proposal

The major changes to the existing land uses and road traffic arrangements within the Butterfly Valley Cottage Area would require replanning of the area for possible future development. The land use and layout scenarios for industrial uses were considered for planning of the Butterfly Valley Cottage Area in the Previous EIA as extracted in *Annex E* for reference. *Figure 3.7b* shows the conceptual layout of the preferred scenario 2.

3.7.4.3 VentilationBuilding

Given the Route 16 alignment, the level of existing development within the Kowloon area and the overall objective of improving air quality in this region, there are very few suitable locations for the development of the ventilation shaft. The latest proposal is to locate the ventilation shaft north of Tai Po Road (see *Figure 2.1a*). The site identified is located within a Green Belt zone and is close to future residential development just south of Tai Po Road. Due to the fact that the area is susceptible to visual and environmental impacts, the area immediately south of Tai Po Road was identified as a Special Control Area wherein planning parameters such as land use, building height and other considerations have been assessed and recommended for development of sites located in that vicinity. The old Carlton Hotel site is currently being developed for residential use by a private developer whose location is close to the proposed ventilation shaft. Notwithstanding that the proposal is incompatible with existing and future land use around the proposed site, and in view of the limited choice of a suitable site, possible mitigation measures could be included in the design of the structure to alleviate the potential environmental and visual impacts of the development. Since the ventilation building is located on a site zoned as 'Green Belt' in the draft Lai Chi Kok OZP S/K16/4, a section 16 application to the Town Planning Board for the proposed use in the 'GB' zone is required.

3.7.5 Sha Tin

Impact on Existing and Proposed Uses

The selected main alignment would traverse through the Pak Shek Village area and then merge with Road T3 in the north. Two tunnel portals just north of Keng Hau Road will be constructed within the GB area.

There is a need to improve traffic flow by providing alternative connections to Route 16 from areas south of Che Kung Miu Road and Shing Mun River Channel. The Route 16

connections to/from Che Kung Miu Road are depicted on *Figure 2.1a*. The proposed connections will run over the KCR line, across the Hong Kong School of Motoring site and connect to Che Kung Miu Road. Due consideration has been given to the alignment of the connections. These include satisfying the technical and transport requirements of the Route 16 connections and minimising the land use impacts on existing and proposed developments as much as possible.

The main areas affected by the main alignment and the proposed connections to Che Kung Miu Road are the existing Pak Shek Village and the proposed Ma On Shan Railway Depot site. According to Housing Department, there are approximately 70 families that could be affected by the project. The existing village would have to be cleared to make way for the works area which is required to carry out the necessary earthworks for Route 16. The responsibility of clearing and rehousing the affected residents in Pak Shek Village lies under the jurisdiction of the Housing Department. The target date for implementation is in 2001. Given that it would take about two years, if not longer, to effect clearance and rehousing, the clearance programme for Pak Shek Village would have to be prioritised and expedited in order to meet the implementation date.

Besides the impact on existing village residents, there are also several private land lots currently existing within the village areas. These lands would have to be resumed under the Roads Ordinance to make way for construction of Route 16. Loss of development potential in the areas affected is nominal as the planning intention for the area is to retain the GB zone assigned under the current Sha Tin OZP. District Lands Office's confirmation of the actual land lots affected by Route 16 would have to be obtained once the alignment and connections have been finalised.

The requirements to provide road connections from Route 16 to Che Kung Miu Road will affect a portion of land, approximately 1.5 ha, within the OU site Railway Depot Comprehensive Development Area. The selected connections have minimised the extent of impact on the proposed OU comprehensive development site, taking cognisance of the future development of the railway depot and associated development into account. Provisions have been made for the implementation of the Route 16 connections in the planning and design of the proposed railway depot and associated commercial/residential developments at Tai Wai. The Che Kung Miu Road Connection alignment from the previous Feasibility Study has been incorporated into the current Railway Development Study: Tai Wai to Ma On Shan.

The proposed connections will also affect a small portion of an existing open space and playground, approximately 1,500 m^2, adjacent to Che Kung Miu Road. There is an existing culvert which takes up the full width of Che Kung Miu Road. A means to mitigate the impact on the open space is to provide a linkage onto the middle of Che Kung Miu Road but this would cause serious disruptions to the existing road and culvert and would involve considerable expenditure. The connections would have to be aligned alongside Che Kung Miu Road which would affect the adjacent open space. The affected area would have to be excluded from the playground as active recreation is usually not allowed under major roads. The area affected could be rezoned to 'Amenity area'.

The land affected by the connections to Che Kung Miu Road could be rezoned to 'Roads and Amenity Area'. The affected land has little development potential as much of it will be sterilised by the road connections. Amendments to the Sha Tin OZP would have to be undertaken after the route has been gazetted.

Toll Plaza

Besides the Sha Tin connections, the toll plaza, which is proposed at a location south of the existing Water Treatment Works area, will be required (see *Figure 2.1a*). The selected site is currently zoned GB in the Sha Tin OZP S/ST/9. The site lies outside the current Country

Park boundary. There is no existing structure, nature trail or footpath affected by the toll plaza. Due considerations have been given to minimise the amount of cut and fill.

However, there are current plans to extend the Country Park boundary up to the Water Treatment Works. Besides this potential land use proposal, there are no other land use impacts.

3.7.6 Conclusions

West Kowloon

In the Previous EIA, while recognising the need to maximise development potential for the Butterfly Valley area, there were other planning considerations which had been taken into account in the assessment presented above. One of these major issues was the clearance of the existing Butterfly Valley Cottage Area and industries. It would usually take about one to two years to effect clearance and rehousing. The clearance programme may need to be expedited in view of the 2000 target date for implementation of the Route 16 project.

From these planning considerations, the Previous EIA indicated that the most preferred land use strategy was Scenario 2 as it would provide for both the land uses reserved under the OZP and ODP and possible reprovisioning of existing industries and godowns affected by the project. Scenario 2 (see *Figure 3.7b*) was recommended to be adopted as a conceptual layout plan for the development of the Butterfly Valley area. The suggested planning parameters are subject to a more detailed transport analysis study to determine traffic impacts, the findings of which would serve as refinements to the layout plan. Once finalised, the route alignment and connections, and the new layout plan should be gazetted to replace the corresponding areas on the current Cheung Sha Wan OZP and ODP.

Shatin

The main planning issue related to Sha Tin alignment is the need for land clearance and resumption at Pak Shek Village. The existing Pak Shek Village would have to be cleared in order to make way for works to begin 2001. It may take two years or longer to rehouse the affected residents, the clearance programme should be commenced as soon as possible. The clearance programme would have to be expedited to be in time for the target construction date. In addition to clearance, the timing of the resumption of the affected private lands within Pak Shek Village would also have to be taken into consideration.

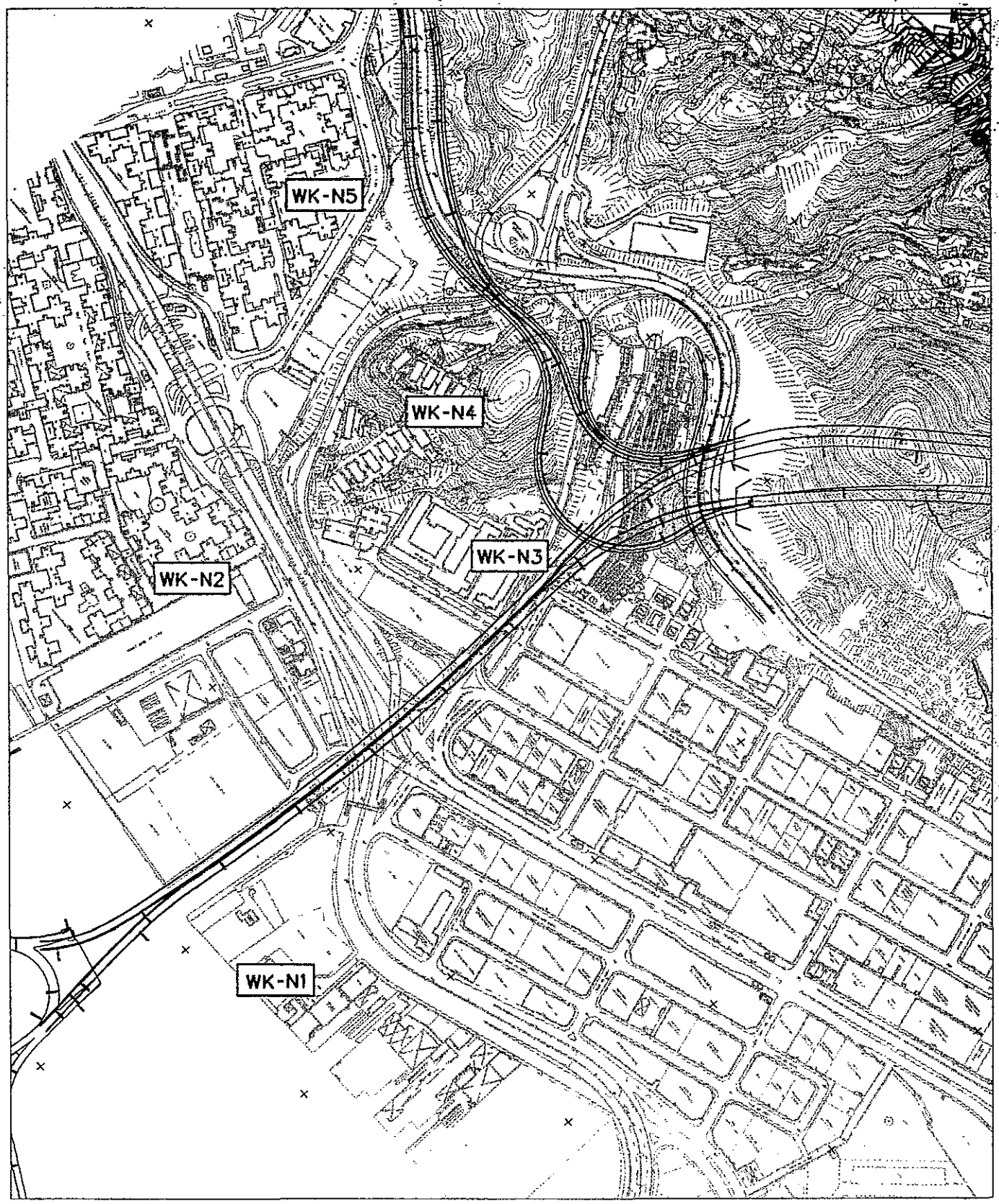

FIGURE 3.1a - LOCATION OF NOISE SENSITIVE RECEIVERS (WEST KOWLOON)

Date : Oct 97	Drawing No. /Contract/C1641/31a

ERM Hong Kong
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

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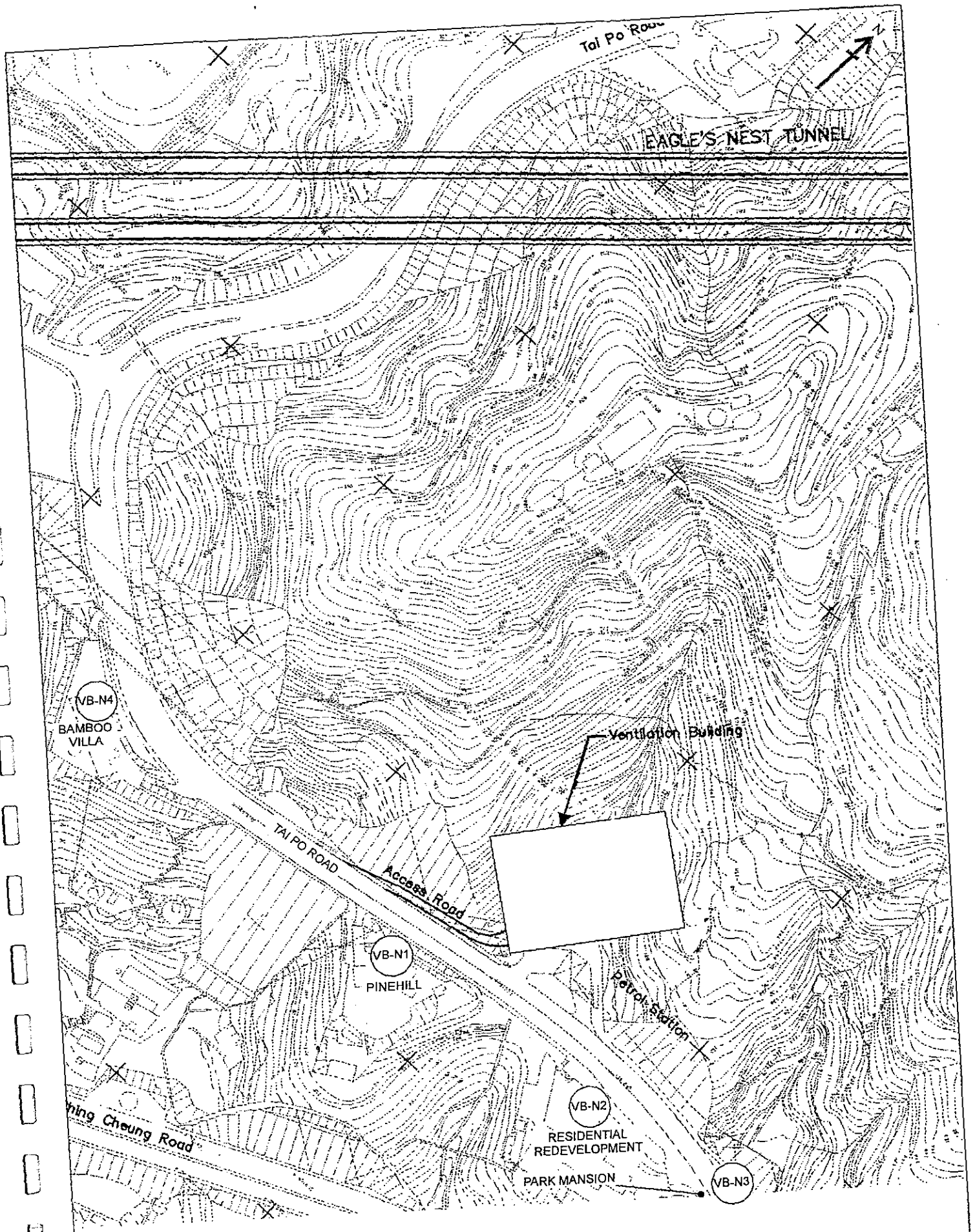

FIGURE 3.1b - LOCATION OF NOISE SENSITIVE RECEIVER (VENTILATION BUILDING)

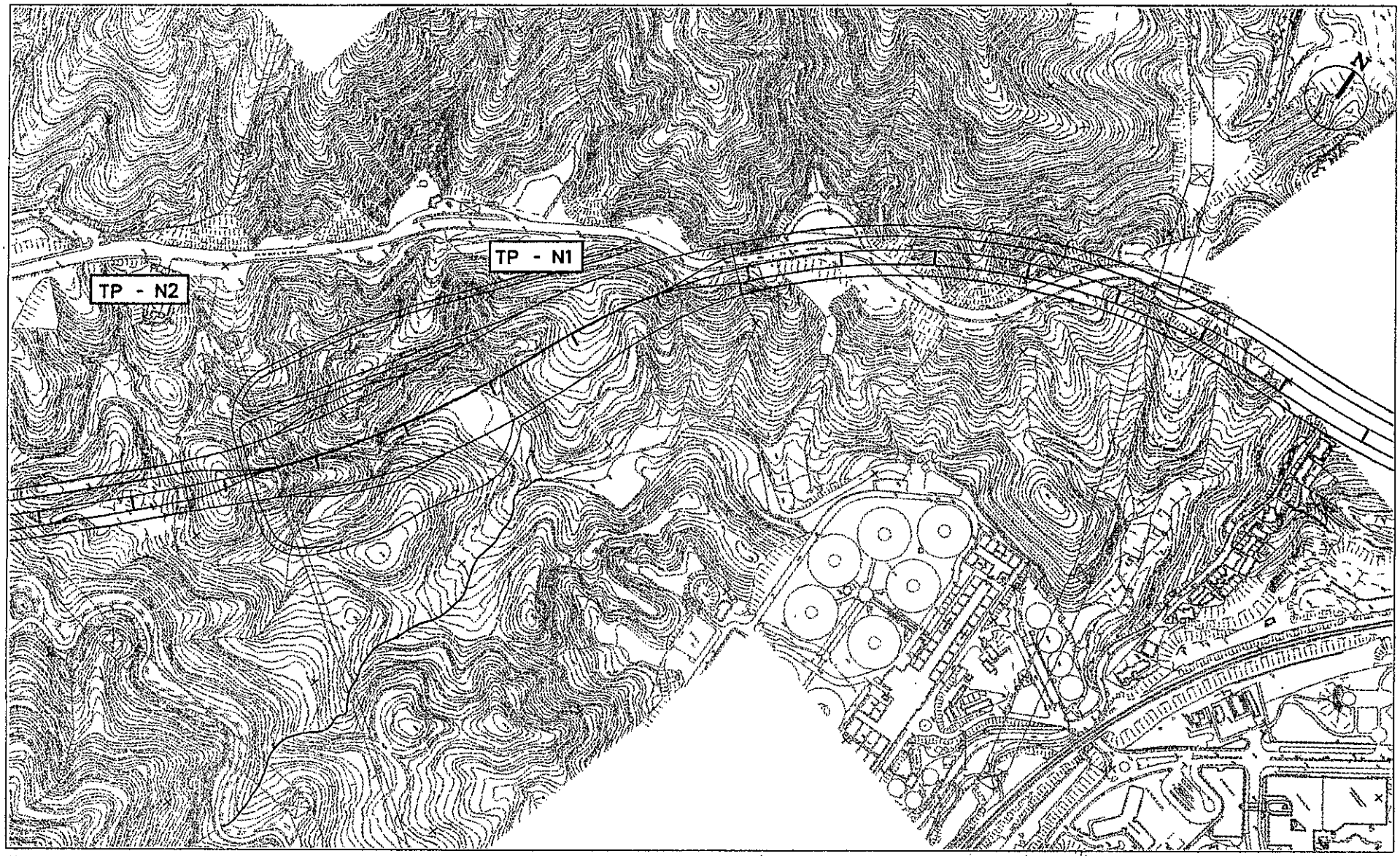

FIGURE 3.1c - LOCATION OF NOISE SENSITIVE RECEIVERS (TOLL PLAZA)

Date : Oct 97	Drawing No. /Contract/C1641/31c

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KEY

TP - N2 NSR

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Hong Kong

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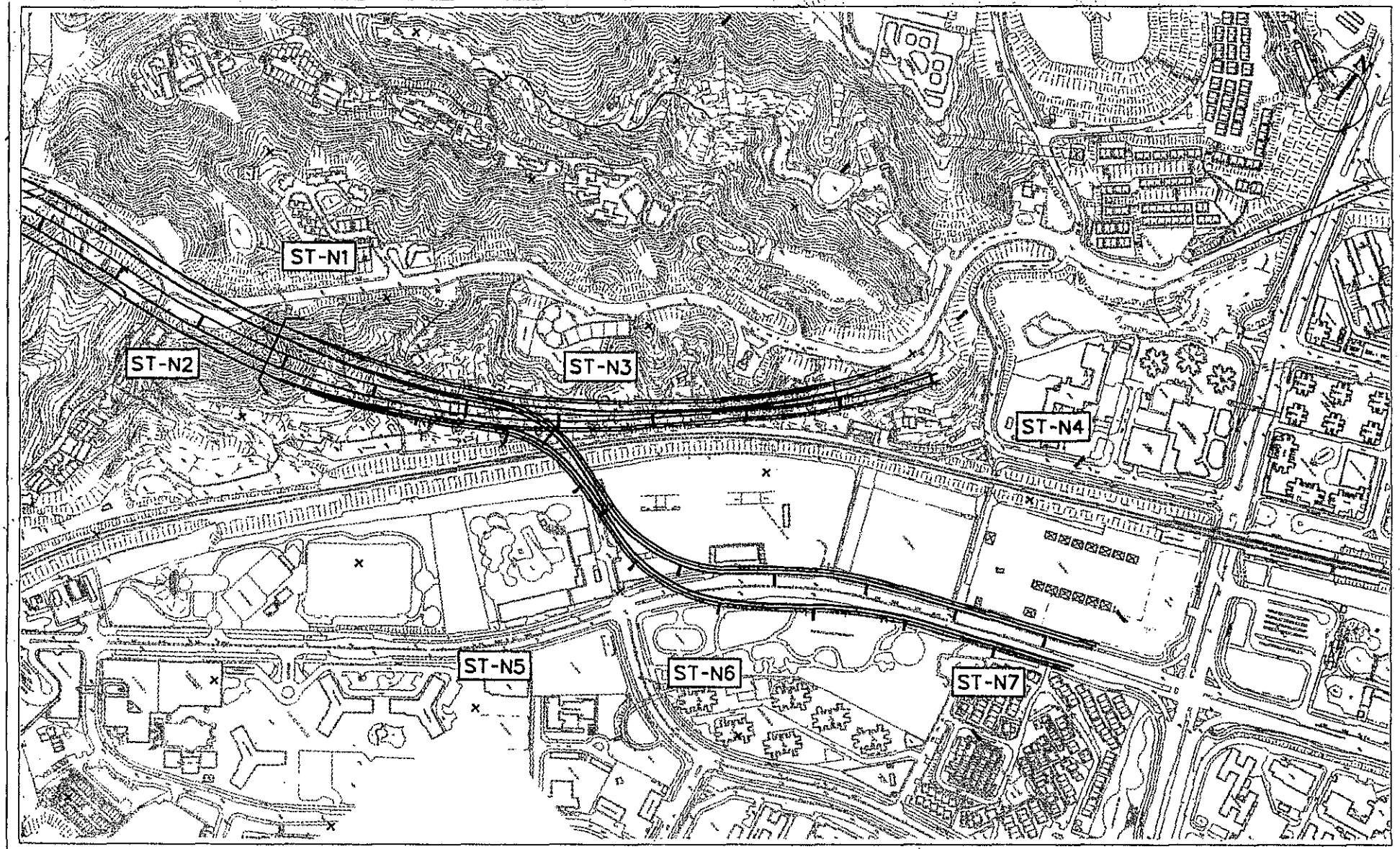

FIGURE 3.1d - LOCATIONS OF NOISE SENSITIVE RECEIVERS (SHATIN)

Date : Oct 97	Drawing No. /Contract/C1641/31d

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KEY

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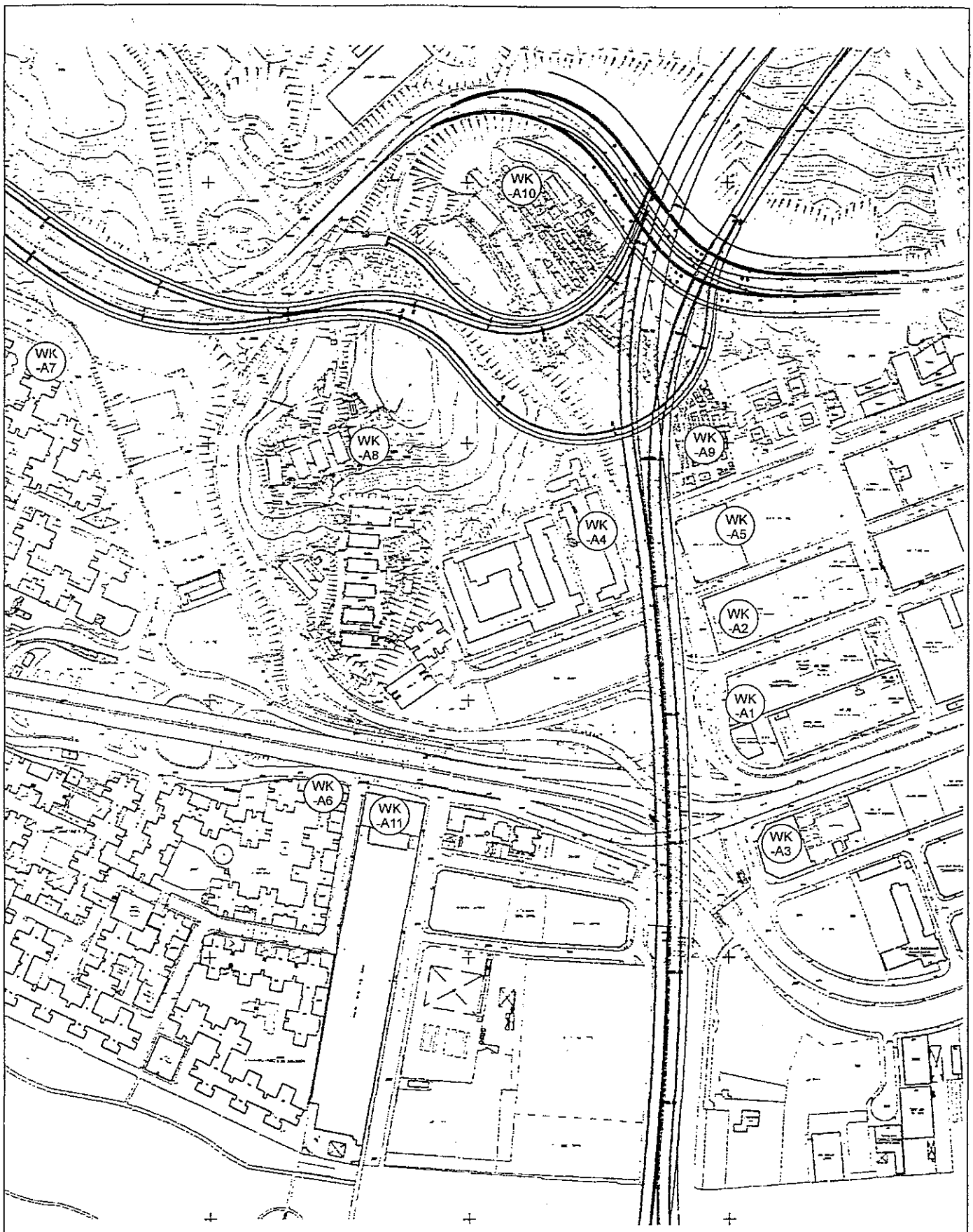

FIGURE 3.2a - LOCATION OF AIR SENSITIVE RECEIVERS
(WEST KOWLOON)

Environmental Resources Management

6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

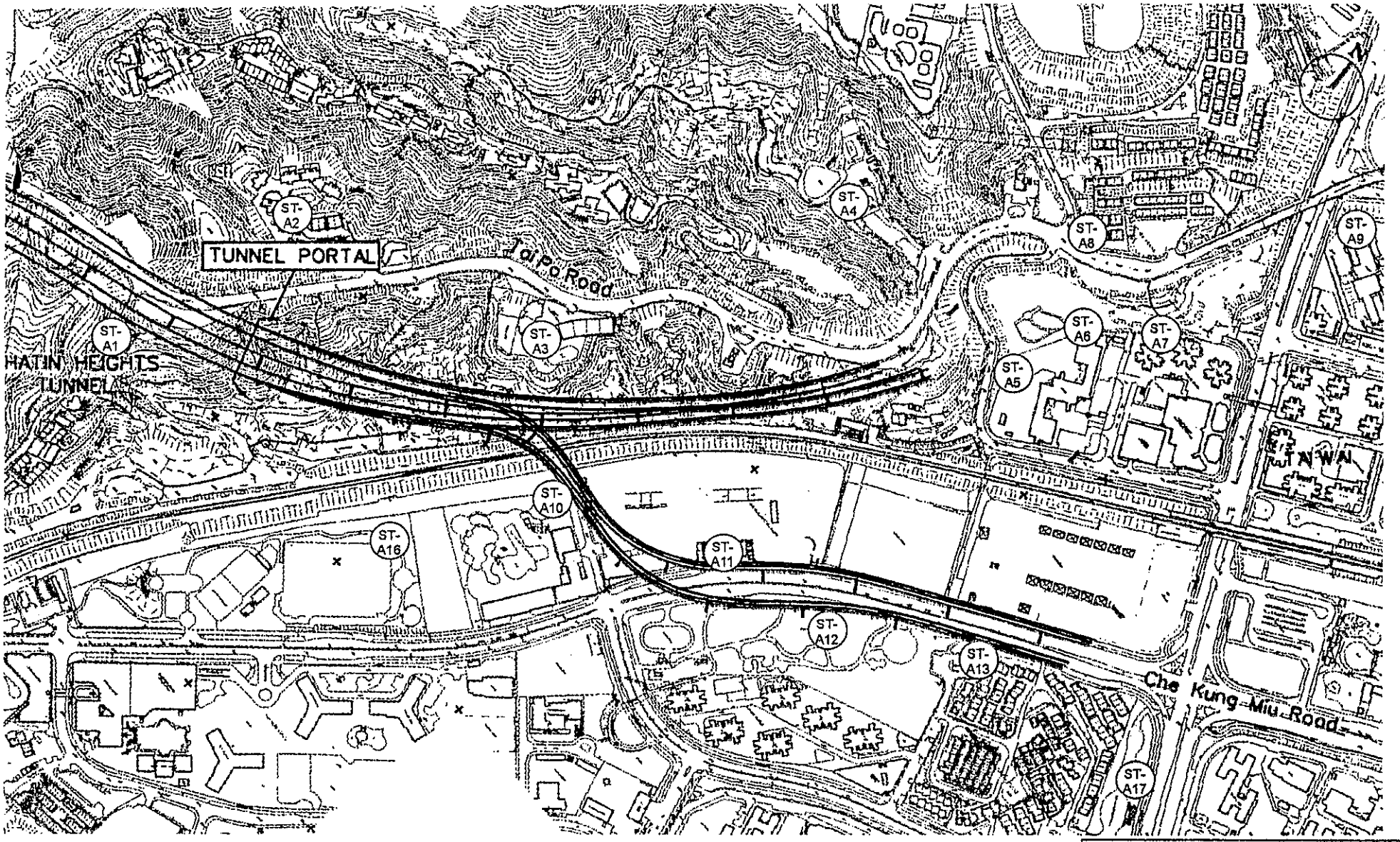

FIGURE 3.2b-1 - LOCATION OF AIR SENSITIVE RECEIVERS (SHATIN)

Environmental Resources Management
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong
ERM

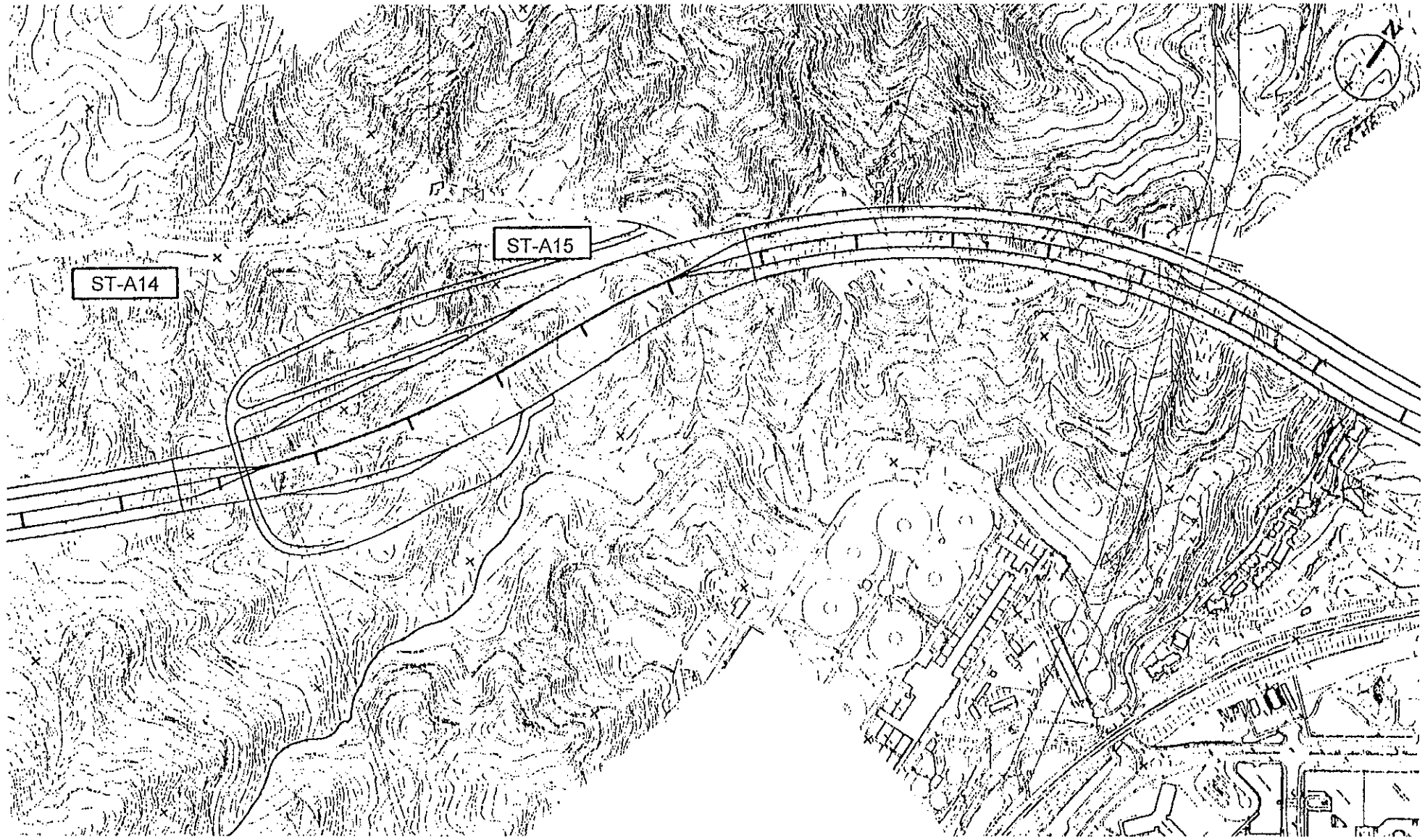

FIGURE 3.2b-2 LOCATION OF AIR SENSITIVE RECEIVERS (SHATIN)

Environmental Resources Management
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong
ERM

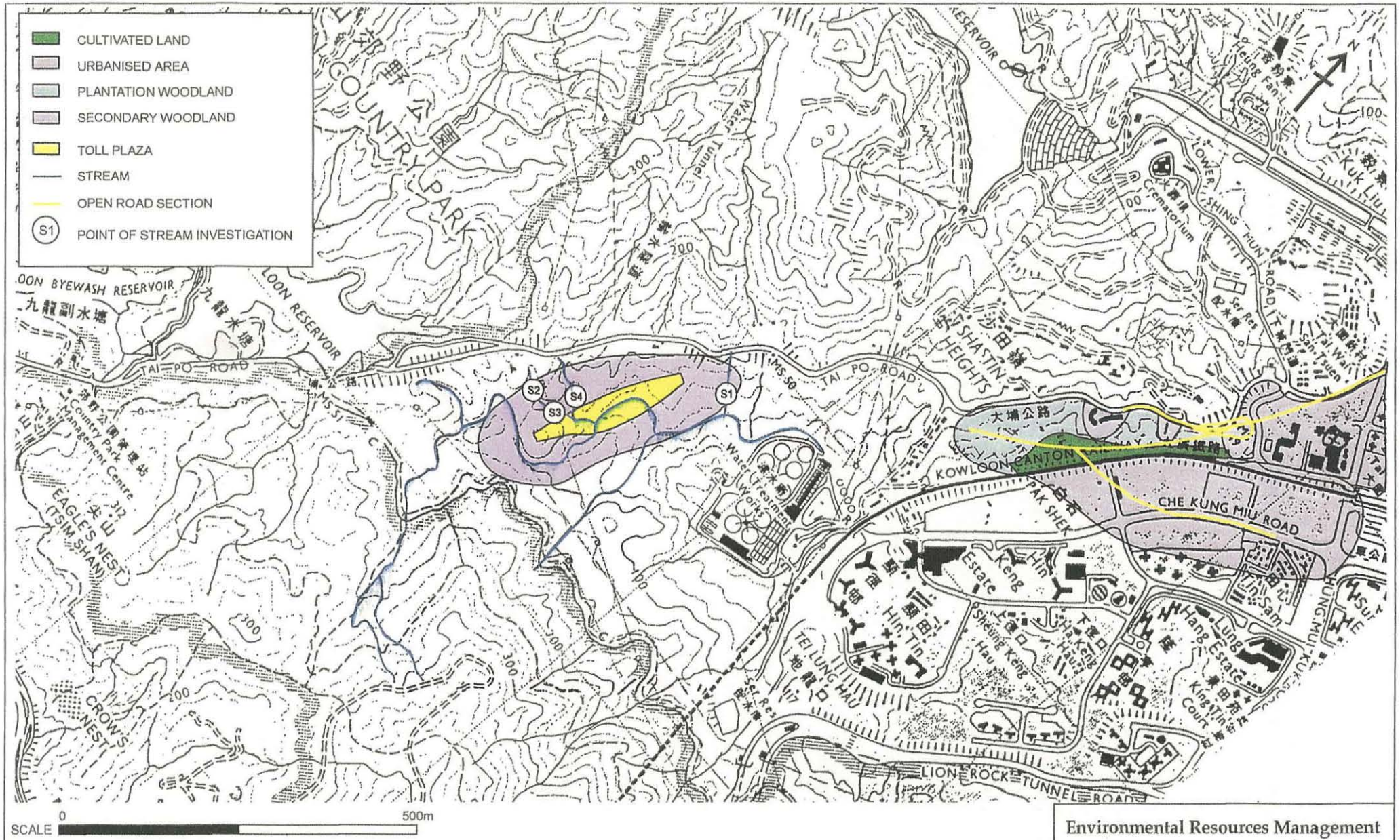

FIGURE 3.4a - HABITAT MAP OF ROUTE 16 - SHATIN AND TOLL PLAZA SECTION

Environmental Resources Management

6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

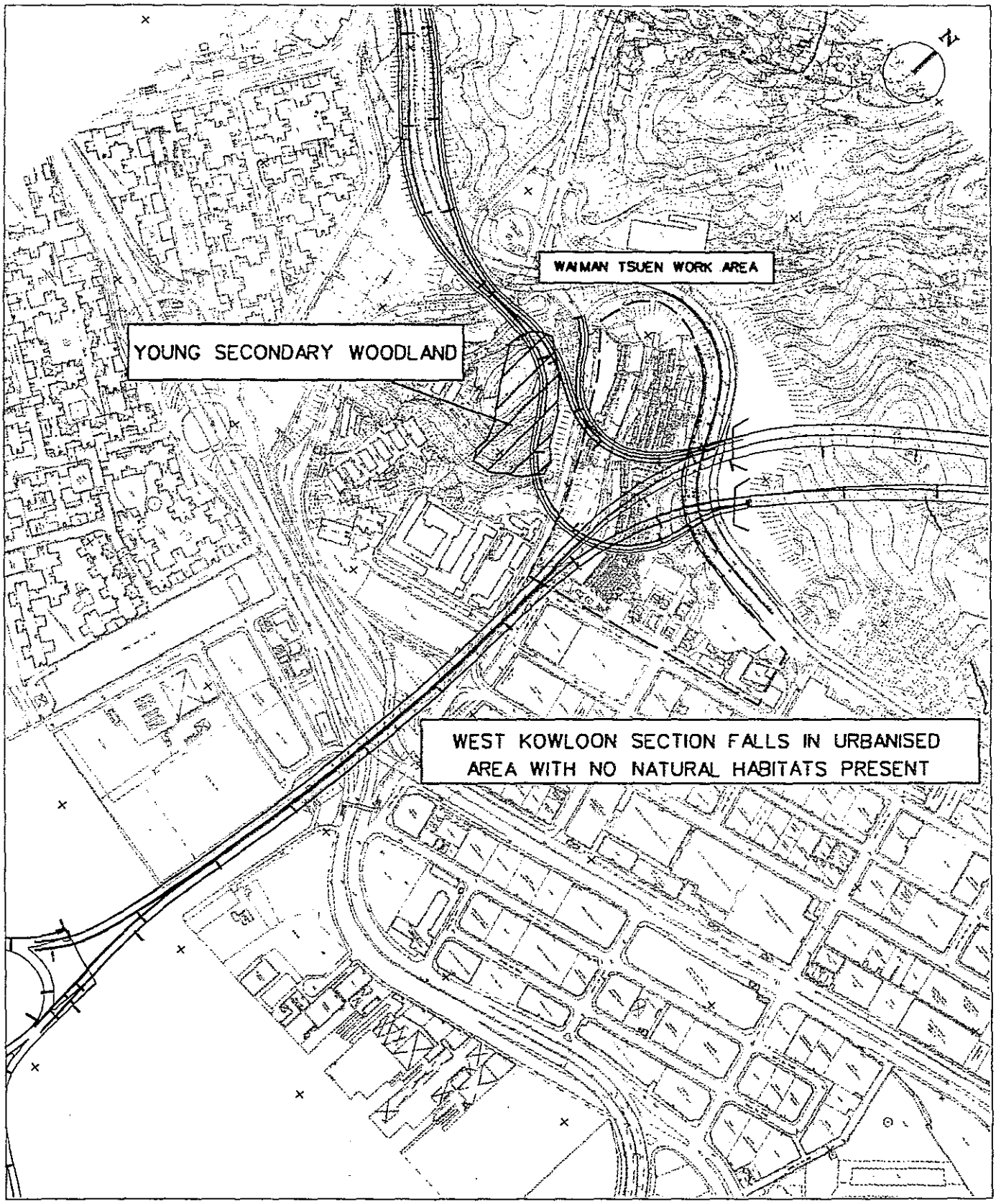

FIGURE 3.4b HABITAT MAP OF ROUTE 16 - WEST KOWLOON SECTION

Date : 29 Sept 97

Drawing No. /Contract/C1641/C1641_2

ERM Hong Kong
6th Floor
Hecny Tower
9 Chatham Road
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Hong Kong

ERM

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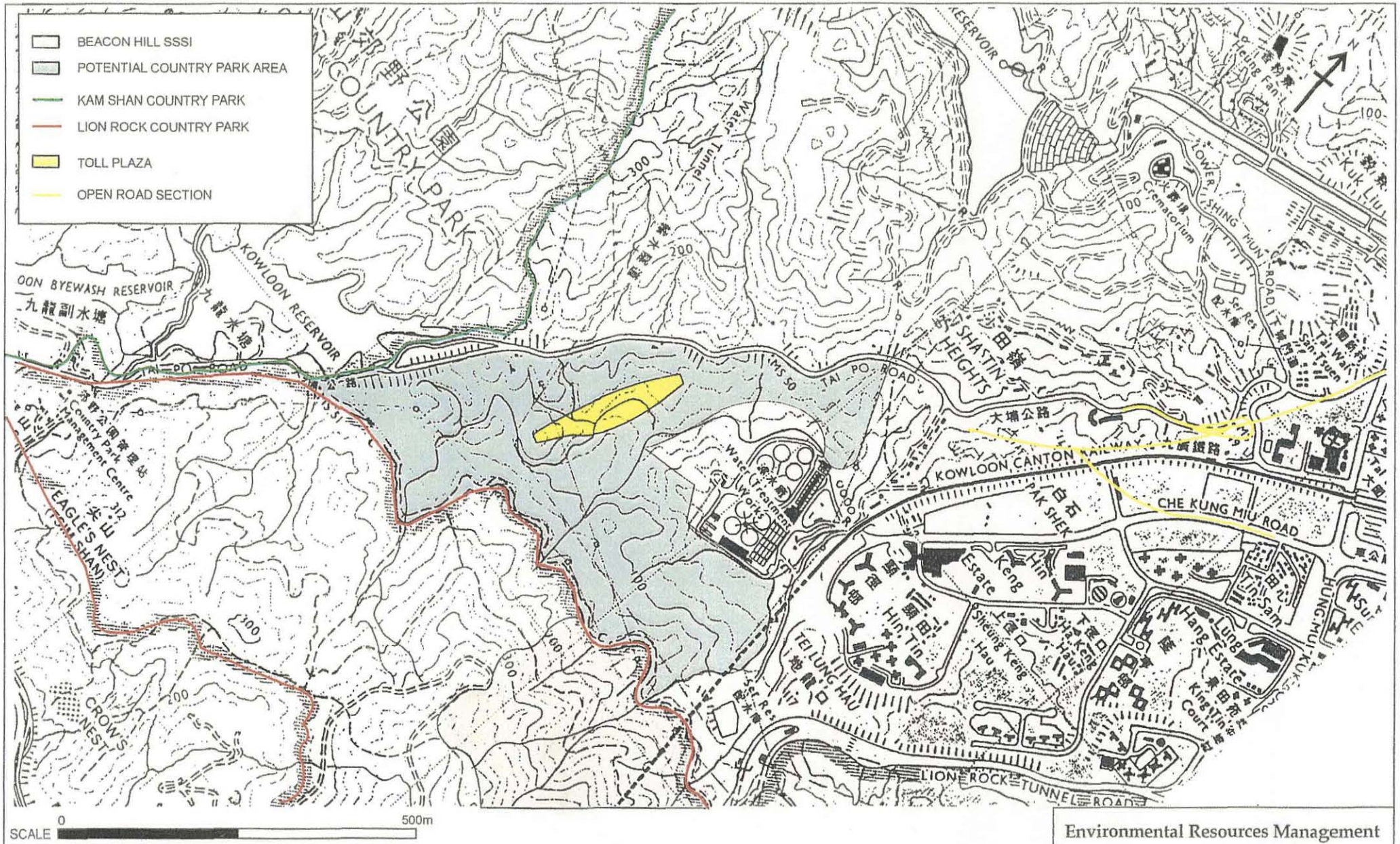

FIGURE 3.4c - AREA OF CONSERVATION ALONG ROUTE 16

Environmental Resources Management
6th Floor
Hecny Tower
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Tsimshatsui, Kowloon
Hong Kong
ERM

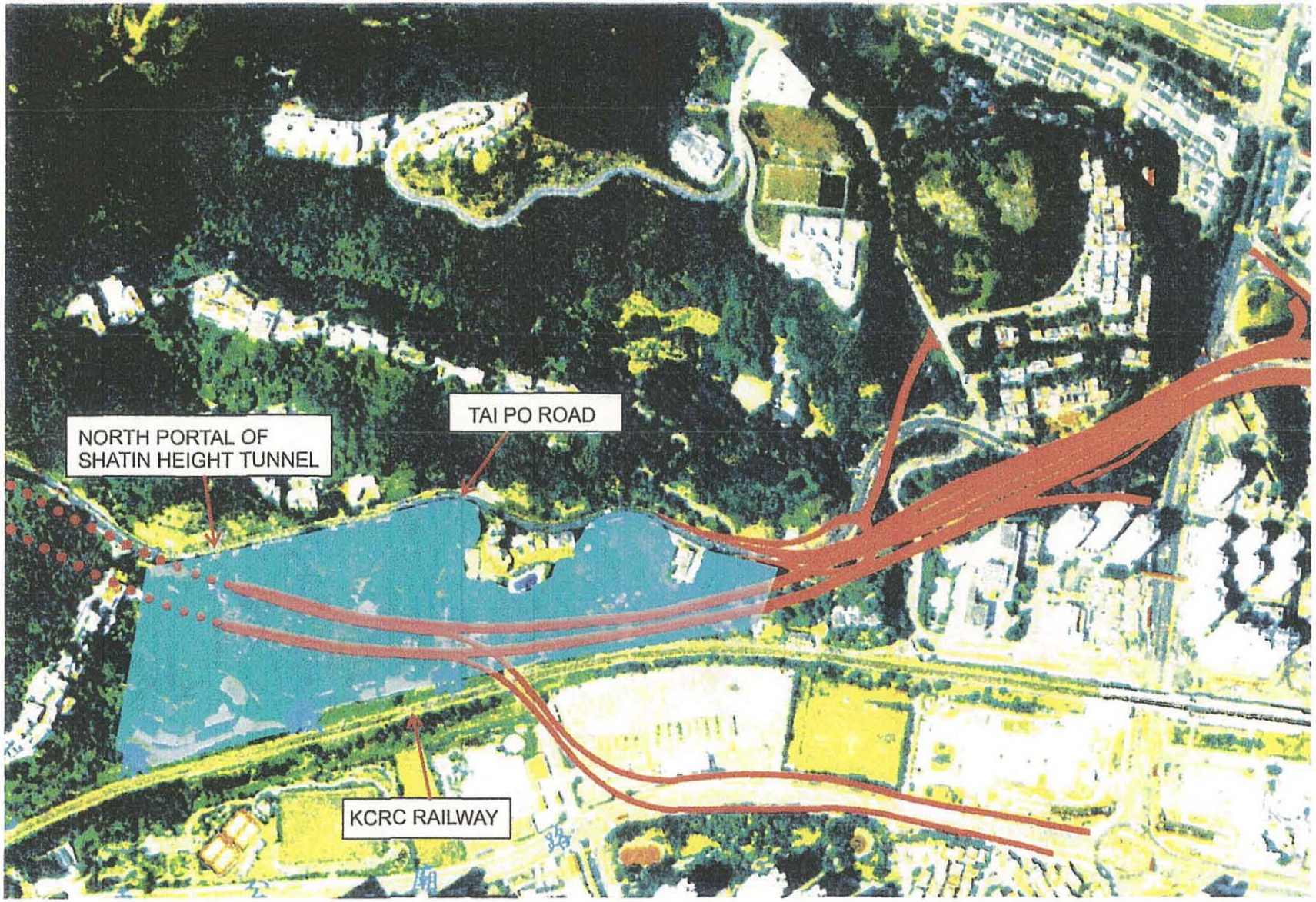


FIGURE 3.4d - LOCATION FOR WOODLAND PLANTING - PAK SHEK VILLAGE AREA

Environmental Resources Management
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong
ERM

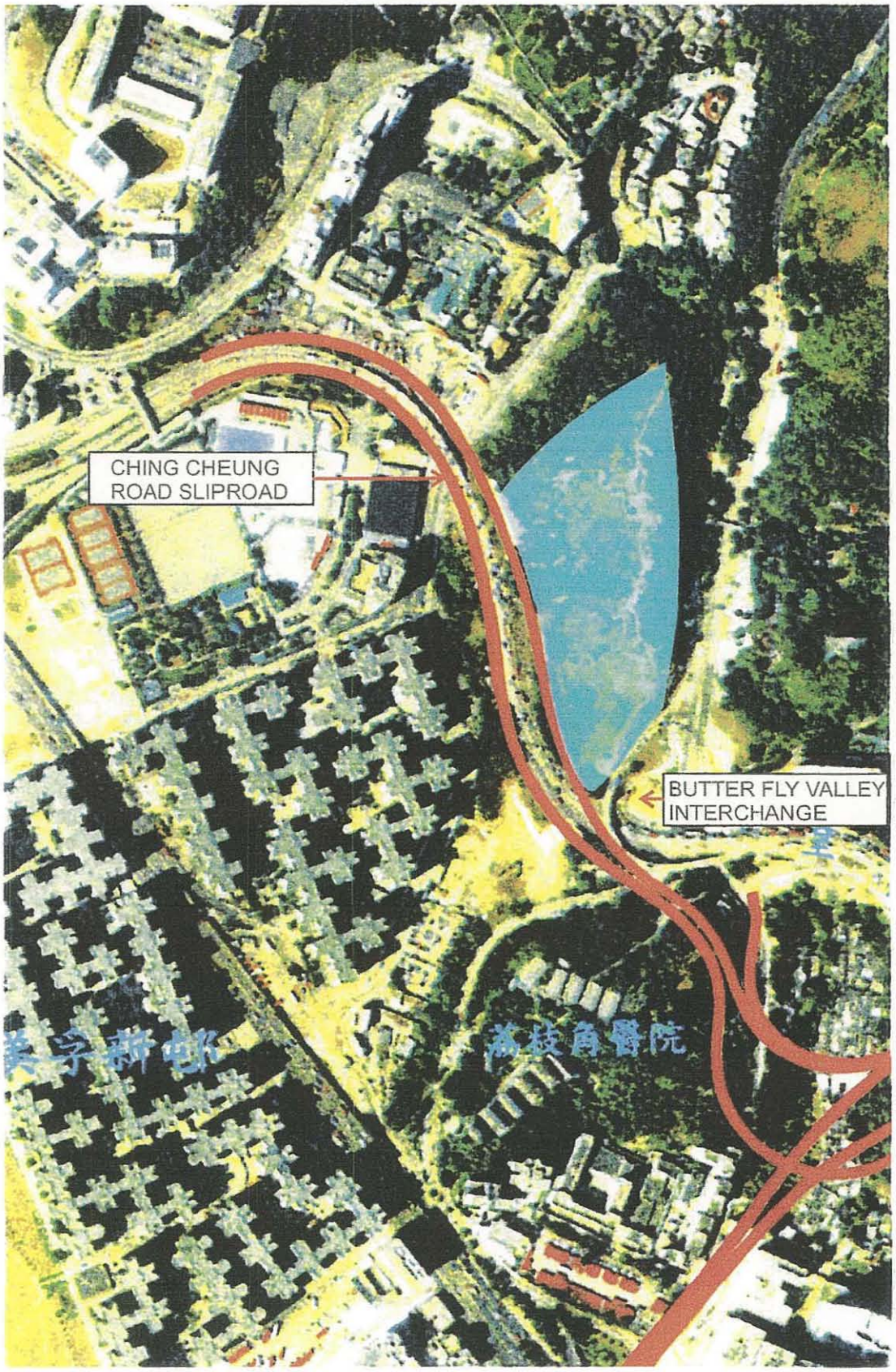
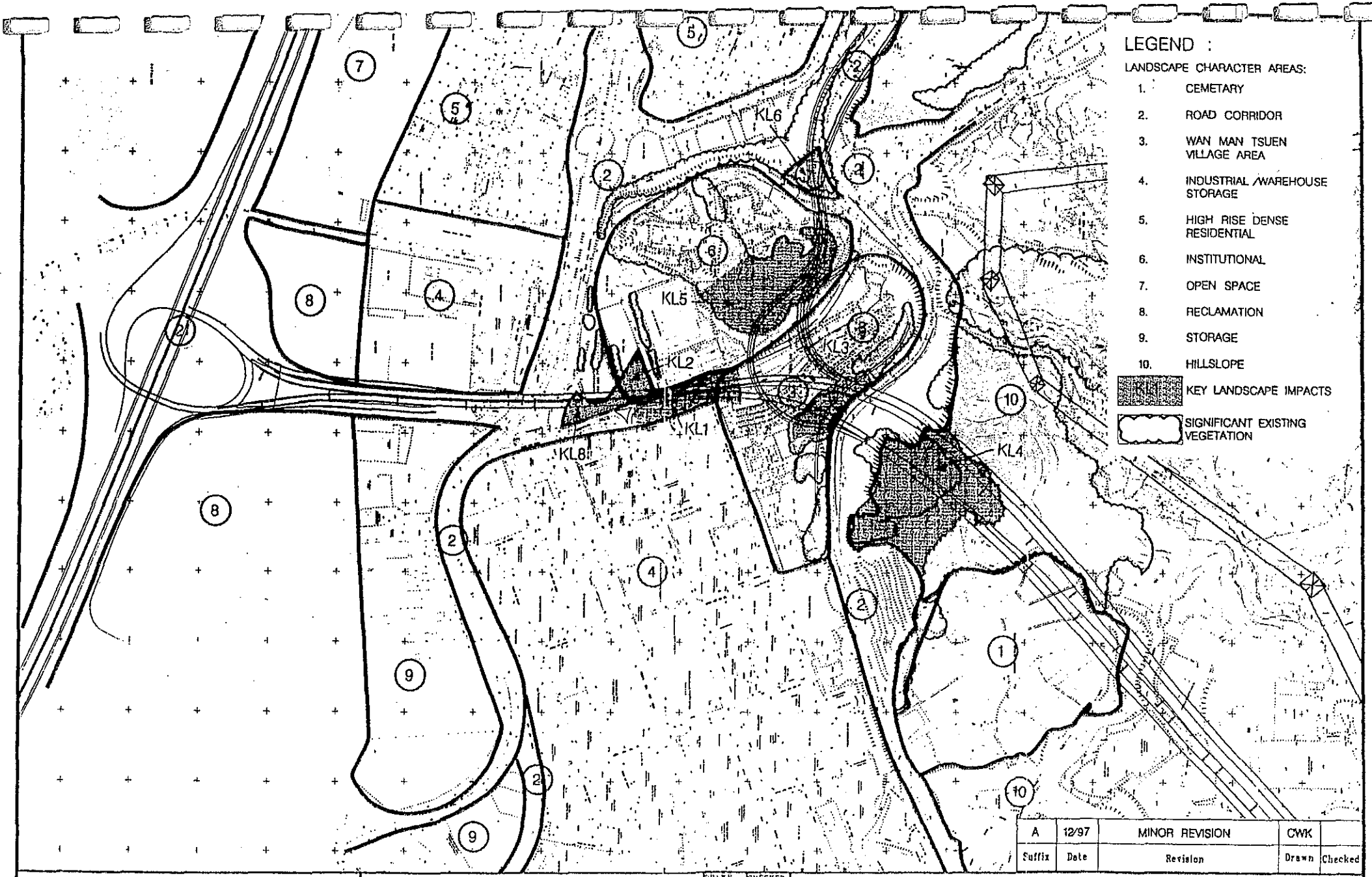


FIGURE 3.4e - LOCATION FOR WOODLAND - PLANTING-BUTTERFLY VALLEY INTERCHANGE

Environmental Resources Management
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong
ERM



Suffix	Date	Revision	Drawn	Checked
A	12/97	MINOR REVISION	CWK	

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Route 16

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WEST KOWLOON TO SHATIN
INVESTIGATION ASSIGNMENT

DRAWN	CHECKED
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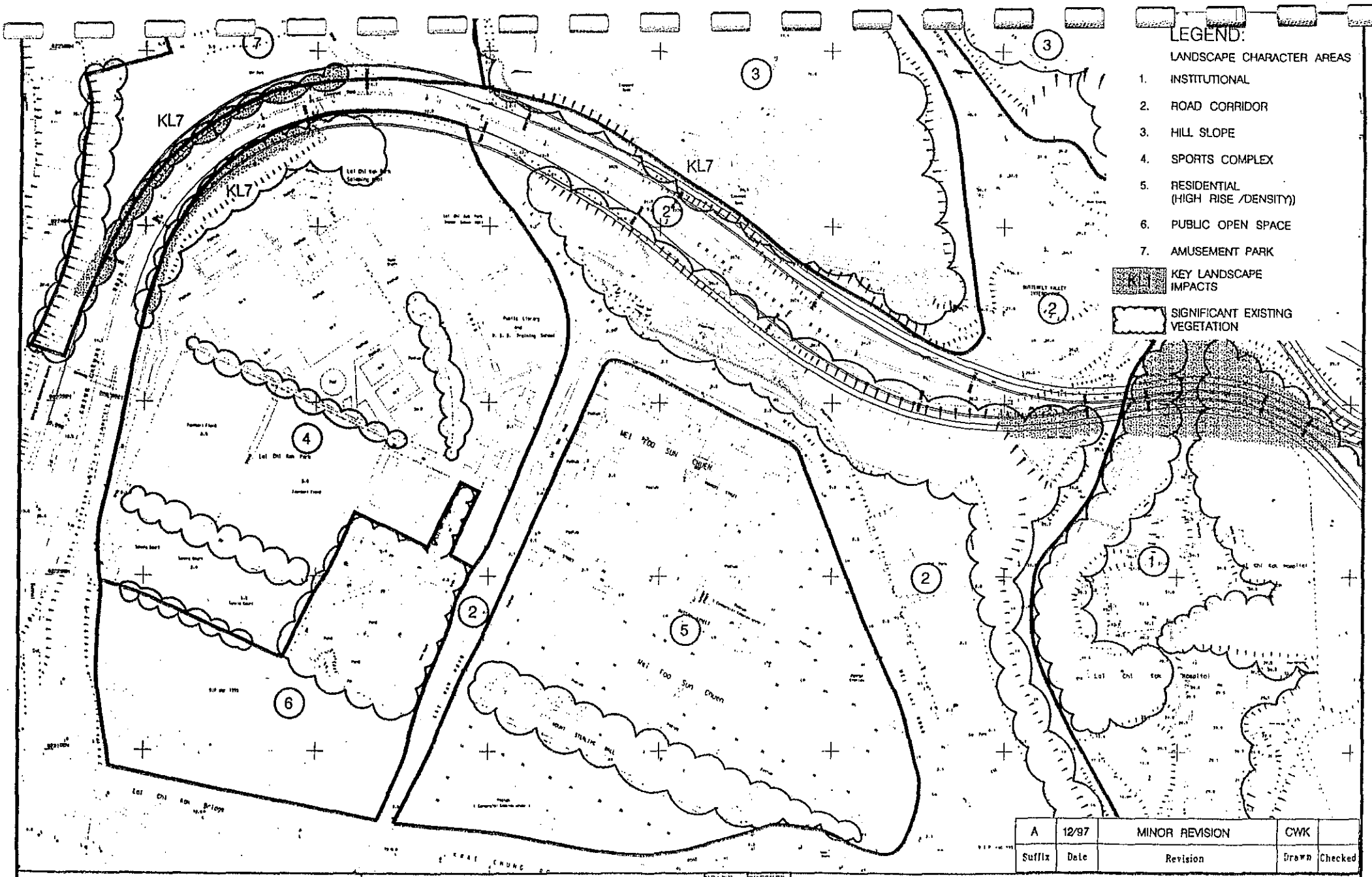
DATE 9 /97
SCALE 1 : 5000

ROUTE 16 INVESTIGATION ASSIGNMENT

DRG TITLE
LANDSCAPE IMPACT – KOWLOON

DRG NO FIGURE 3.6a

REV A



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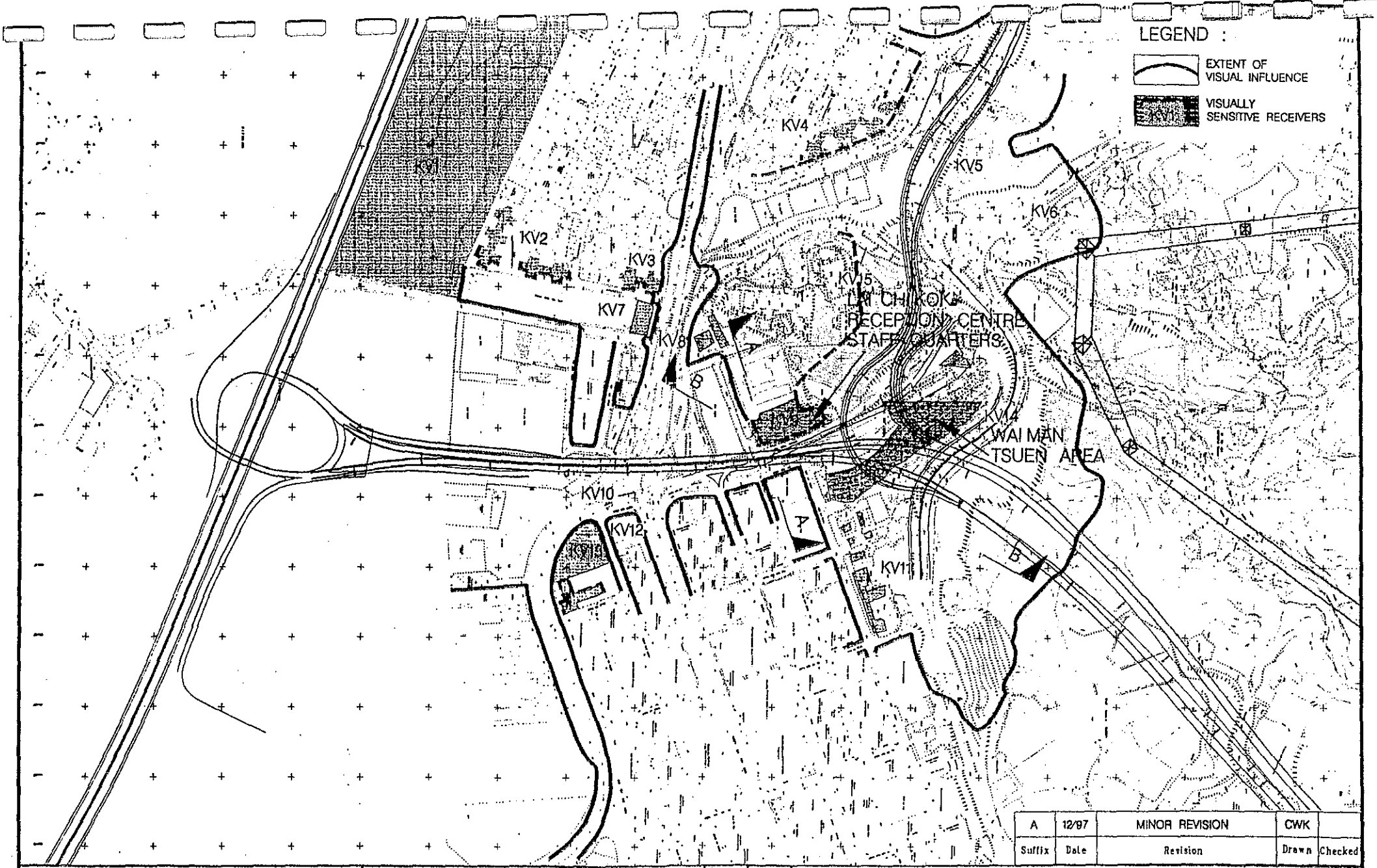
ROUTE 16 INVESTIGATION ASSIGNMENT

DRG TITLE: LANDSCAPE IMPACT ASSESSMENT – KOWLOON

DRG NO: FIGURE 3.6b

REV: A

SW CAD P:\R16\L&V\FIGURE2.DGN 30 SEP 1997 Scale 1 : 2000 420 x 297



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SCALE 1 : 5000

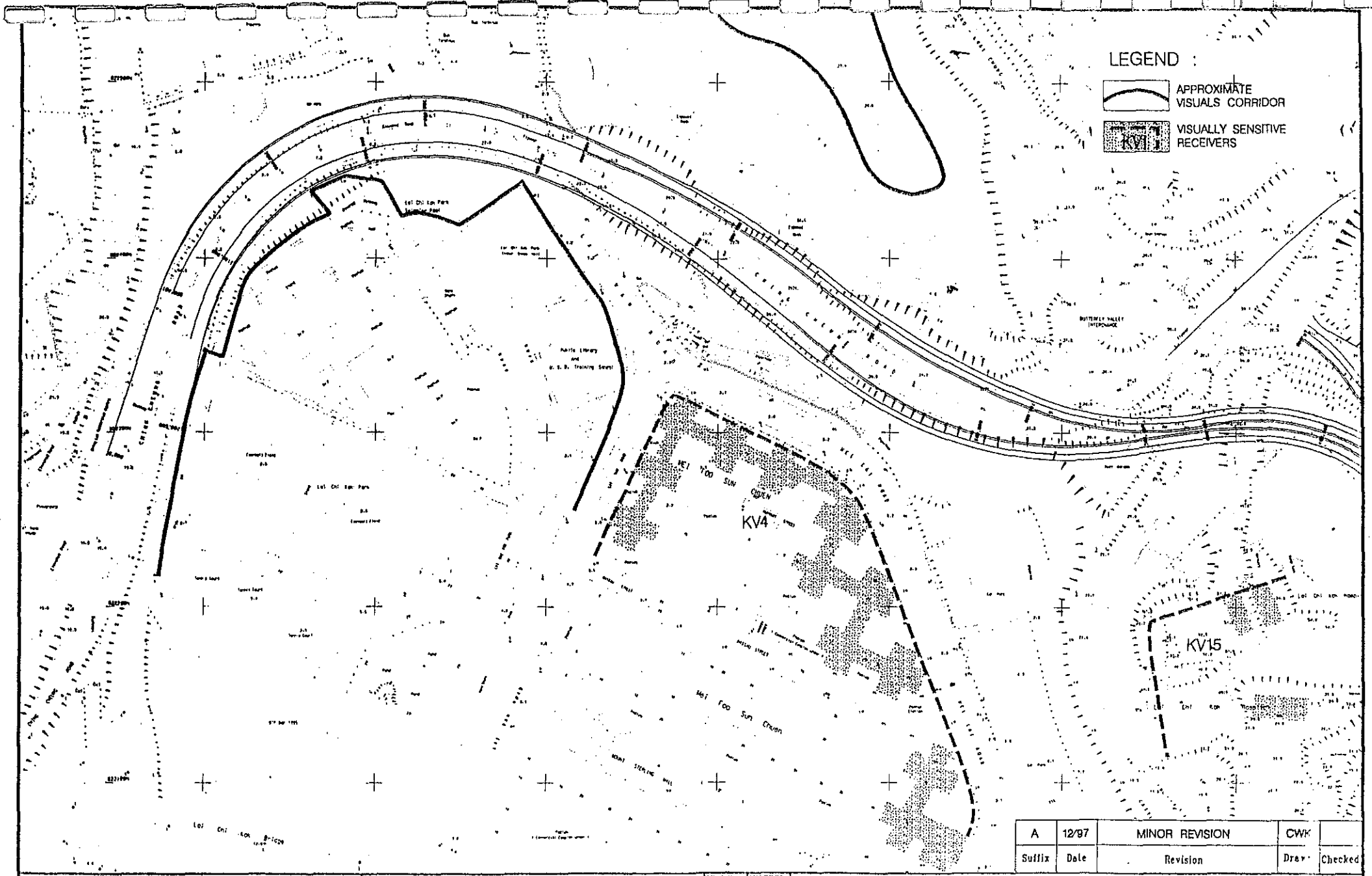
ROUTE 16 INVESTIGATION ASSIGNMENT

DRG TITLE: VISUAL IMPACT – KOWLOON

DRG NO: FIGURE 3.6c

REV: A

SW CAD P:\R16\I &V\FIGURE3.DGN 30 SEP 1997 Scale 1 : 5000 420 x 297



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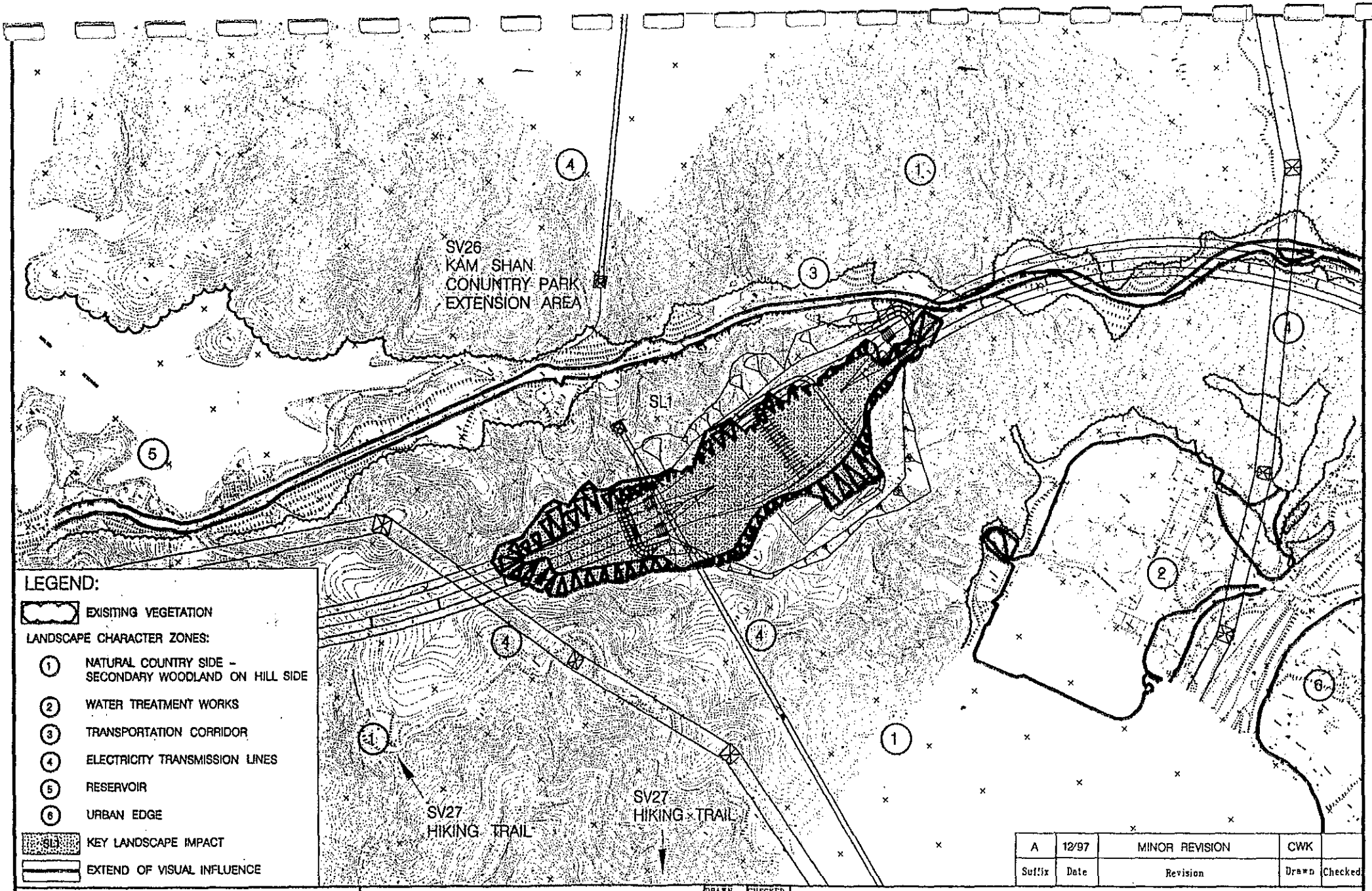
SCALE 1:2000	

ROUTE 16 INVESTIGATION ASSIGNMENT

DRG TITLE: VISUAL IMPACT ACCESSMENT - KOWLOON

DRG NO: FIGURE 3.6d

REV: A



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ROUTE 16 INVESTIGATION ASSIGNMENT

DRG. TITLE: VISUAL AND LANDSCAPE ASSESSMENT PLAN - TOLL PLAZA

DRG NO.: FIGURE 3.6f

REV.: A

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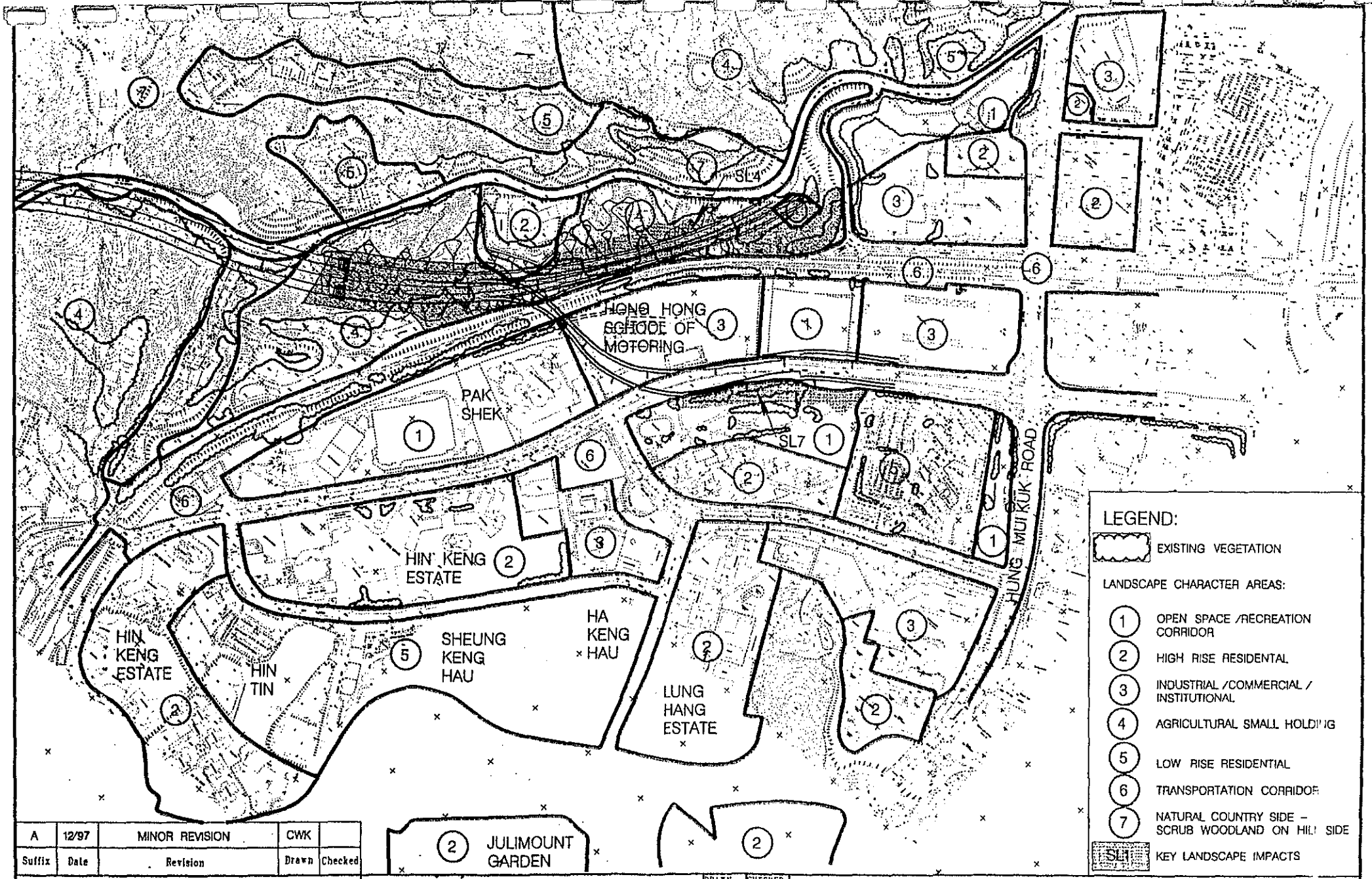

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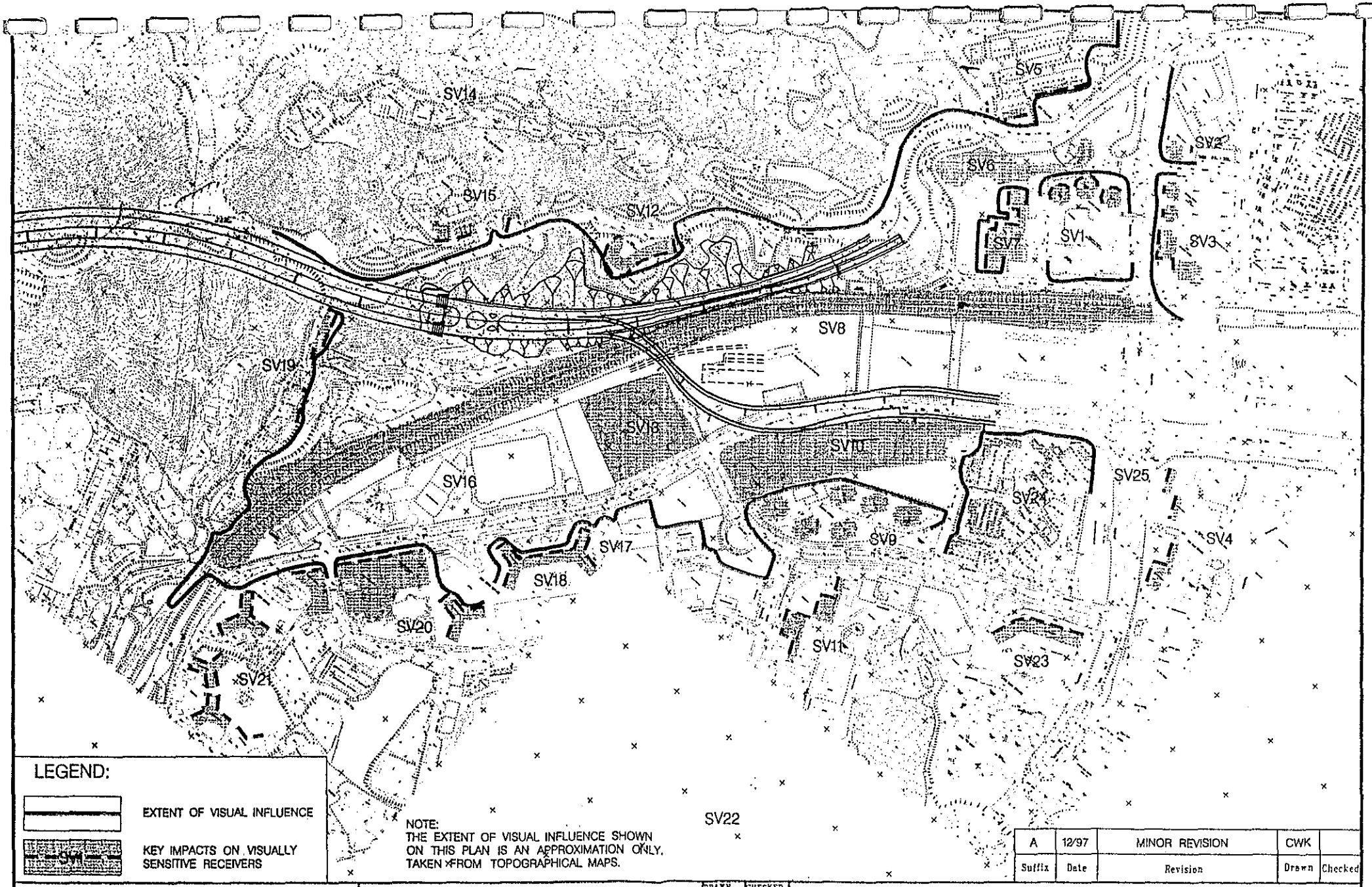
ROUTE 16 INVESTIGATION ASSIGNMENT

DRG. TITLE: LANDSCAPE IMPACT – SHATIN

DRG NO. FIGURE 3.6g

REV A

SW CAD P:\R16\L&V\FIGURE7.DGN 30 SEP 1997 Scale 1 : 5000 420 x 297



LEGEND:

EXTENT OF VISUAL INFLUENCE

SV1 KEY IMPACTS ON VISUALLY SENSITIVE RECEIVERS

NOTE:
THE EXTENT OF VISUAL INFLUENCE SHOWN ON THIS PLAN IS AN APPROXIMATION ONLY, TAKEN FROM TOPOGRAPHICAL MAPS.

Suffix	Date	Revision	Drawn	Checked
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SCALE: 1 : 5000

ROUTE 16 INVESTIGATION ASSIGNMENT

DRG. TITLE: VISUAL IMPACT ASSESSMENT PLAN – SHATIN

DRG NO.: FIGURE 3.6h

REV: A

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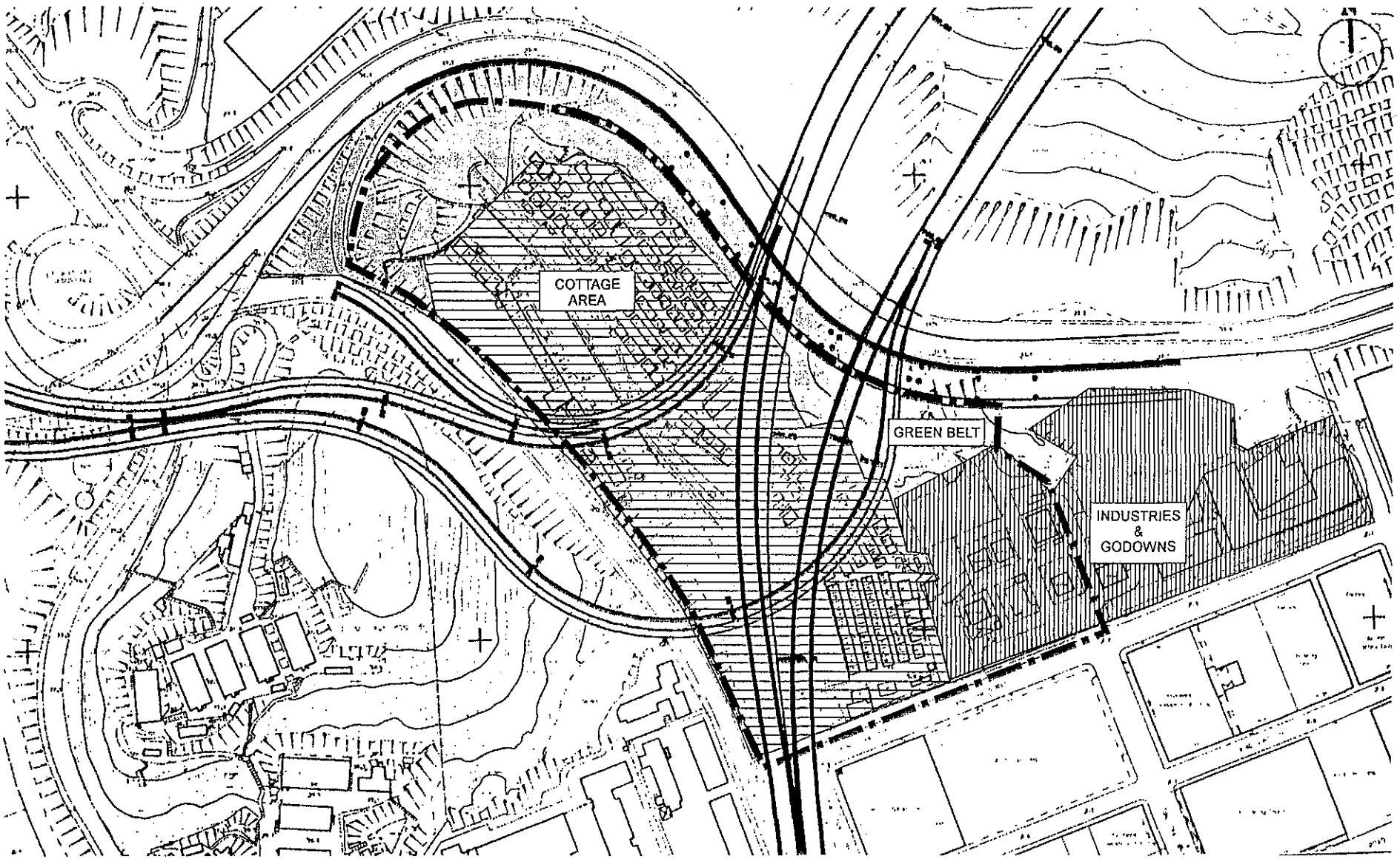

FIGURE 3.7a - EXISTING LAND USES WITHIN BUTTERFLY VALLEY

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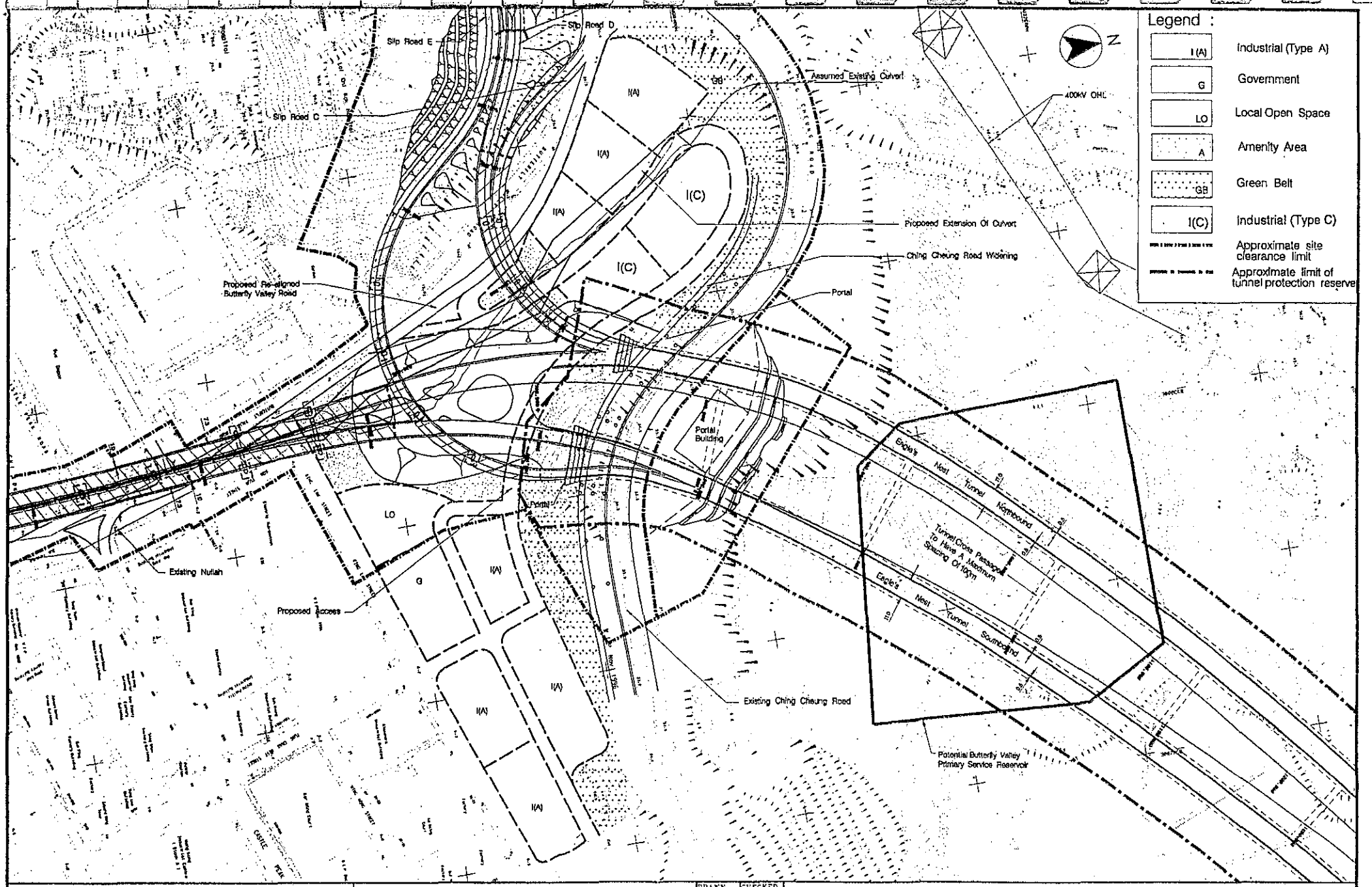

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Route 16

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INVESTIGATION ASSIGNMENT

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DATE 22-12-97	
SCALE 1 : 2000	

ROUTE 16 INVESTIGATION ASSIGNMENT

DRG. TITLE: INDUSTRIAL (TYPE A) DEVELOPMENT

DRG. NO: FIGURE 3.7b

REV.

4. OPERATIONAL PHASE: APPRAISAL OF ENVIRONMENTAL IMPACTS

4.1 Noise

4.1.1 Introduction

An assessment has been carried out to predict the noise impact from the operational phase of the Route 16 alignment. Traffic noise will be the dominant noise impact from the Route 16 project to the nearby NSRs. Practical mitigation measures are recommended where the nearby NSRs are being affected by unacceptable noise levels. Additionally, plant noise from the ventilation building for the main tunnel may also be a source of impact to nearby NSRs. An assessment has also been carried out in the this study to establish the noise specifications, which will ensure that no unacceptable noise impacts will result from the operation of the ventilation building at the nearby NSRs.

4.1.2 Traffic Noise Impact

4.1.2.1 Noise Sensitive Receivers

Worst impacted representative NSRs have been identified. In West Kowloon, they include Lai Chi Kok Reception Centre Staff Quarters, Lai Chi Kok Hospital, Mei Foo Sun Chuen (Phase 4 & 6), the KMB Bus Depot (to be redeveloped as a Comprehensive Development Areas (CDA)) next to Mei Foo Sun Chuen and Haking Wong Technical Institute.

In Shatin, the representative NSRs include Shatin Heights, Woodcrest Hill, low rise residential buildings along Keng Hau Road, Tun Kwun Lau Pak Lok College, Christian Alliance Cheng Wing Chee College, Hin Keng Estate, Carmel Alison Lam Primary School, Carado Garden, Tin Sam Village and Sun Chui Estate. Additional, two potential development site (DD187, Lot 525 and Lot 561) near the toll plaza area have been included.

The noise levels for each NSR have been predicted at three different floor levels (low, medium and high) where applicable and the representative floors and the corresponding mPD height of each NSRs are also shown in *Table 4.1a* below. The NSRs locations are shown in *Figures 3.1c, 4.1a & b.*

Table 4.1a Location of Worst Case Representative Noise Sensitive Receivers

NSRs		Representative floors	Representative floors mPD (m)
West Kowloon Section			
WK - N1	Haking Wong T T	1st/ 3rd	14.7 / 13.8
WK - N2	Mei Foo Sun Chuen, Phase 4 (Block 113)	1st / 10th / 19th	14.7 / 39.9 / 65.1
WK - N3a	LCK Reception Centre Staff Quarters	1st / 5th / 11th	8.7 / 19.9 / 36.7
WK - N3b	LCK Reception Centre Staff Quarters	1st / 5th / 9th	8.7 / 19.9 / 31.1
WK - N3c	LCK Reception Centre Staff Quarters	1st / 3rd / 6th	8.7 / 14.3 / 22.7

NSRs		Representative floors	Representative floors mPD (m)
WK - N4a	LCK Hospital	Ground / 1st	48.4 / 51.2
WK - N4b	LCK Hospital	Ground / 1st	30.9 / 33.7
WK - N5	Mei Foo Sun Chuen, Phase 6 (Block 9)	1st / 10th / 19th	9.2 / 34.4 / 59.6
WK - N6	Mei Foo Sun Chuen, Phase 5 (Block 9)	1st / 10th / 19th	9.2 / 34.4 / 59.6
WK - N7a	LCK Reception Centre - New Staff Quarters	1st / 7th / 15th	39 / 50.2 / 72.6
WK - N7b	LCK Reception Centre - New Staff Quarters	3rd / 7th / 15th	33.4 / 50.2 / 72.6
WK - N8	KMB Bus Depot CDA site	1st / 10th / 20th	8.7 / 33.9 / 61.9
Toll Plaza Area			
TP - N1	DD 187, Lot 525	Ground / 2nd	117 / 121
TP - N2	DD 187, Lot 561	Ground / 2nd	136 / 140
Shatin Section			
ST - N1a	Woodcrest Hill	1st / 3rd	82.4 / 88
ST - N1b	Woodcrest Hill	1st / 3rd	84.4 / 90
ST - N2a	Keng Hau Tsuen	Ground / 3rd	71.4 / 77
ST - N2b	Keng Hau Tsuen	Ground / 3rd	71.4 / 77
ST - N3a	Shatin Heights	1st / 4th / 8th	49 / 57.4 / 68.6
ST - N3b	Shatin Heights	1st / 4th / 8th	49 / 57.4 / 68.6
ST - N3c	Shatin Heights	1st / 4th / 8th	49 / 57.4 / 68.6
ST - N4	Christian Alliance Cheng Wing Chee College	1st / 3rd / 6th	14.2 / 21 / 31.2
ST - N5	Carmel Alison Lam Primary School	1st / 3rd / 6th	16.2 / 23 / 33.2
ST - N6a	Carado Garden	1st / 14th / 28th	13.4 / 49.8 / 89
ST - N6b	Carado Garden	1st / 14th / 28th	13.4 / 49.8 / 89
ST - N7a	Tin Sam Village	Ground / 3rd	7.9 / 13.5
ST - N7b	Tin Sam Village	Ground / 3rd	7.9 / 13.5
ST - N8	Tun Kwun Lau Pak Lok College	1st / 3rd / 6th	14.2 / 21 / 31.2
ST - N9	Hin Keng Estate	1st / 15th / 30th	16.9 / 56.1 / 98.1
ST - N10	Sun Chui Estate	1st / 15th / 30th	12.4 / 51.6 / 93.6

NSRs		Representative floors	Representative floors mPD (m)
ST - N11	MOS Depot (Planned Landuse)	1st / 15th / 30th	13.9 / 53.1 / 95.1
ST - N12	Cheung Wong Wai Primary School	1st / 3rd / 6th	16.2 / 23 / 33.2
ST - N13	Ng Yuk Secondary School/Shatin Tsung Tsin Secondary School	1st / 3rd / 6th	16.2 / 23 / 33.2

4.1.3 Traffic Noise Assessment Methodology

The surrounding road scheme was divided up into 511 road segments, each of which was assigned one of 98 road layouts. A road layout defines the road width, surface type, traffic conditions and (if applicable) the height and location of roadside barriers. The segmentation process was carried out in accordance with Calculation of Road Traffic Noise (CRTN) procedures and the noise model was built using the HFA Noise traffic noise model which fully implements CRTN procedures and methodologies. Hard ground as defined in CRTN was assumed throughout the Study Area except for vegetated areas. All other features that could add noise screening or reflection to the modelling process were included.

In accordance with CRTN, calculations for future road traffic noise have been based on the peak hour flow in respect of the maximum traffic projection within a 15 year's period upon commencement of operation of the proposed roadworks. As Route 16 are expected to be in operation by the year 2004, for the purpose of this Study, 2019 year traffic flows will therefore be used as the prediction year. The Peak Hour traffic flows for both the 2000 prevailing flow and the 2019 flow are shown in *Figures 2.4 a&b* and *2.4 c&d* respectively. Also shown in this Figure are the % heavy vehicles. Traffic speeds of 50 kph at all locals roads and 70 kph at Route 16 were assumed in this assessment. Road surfaces were assumed to be standard wearing course.

Traffic noise impacts are assessed against the Hong Kong Planning Standards and guidelines (HKPSG) noise levels of $L_{10,\ peak\ hour}$ 70 dB(A) for residential area and $L_{10,\ peak\ hour}$ 65 dB(A) for education institutions, as the target levels for all 'direct' forms of mitigation (i.e. those that can be applied to the road itself). Any predicted levels exceeding the HKPSG levels are considered to constitute significant impacts and practicable direct mitigation measures will be recommended in order to alleviate the noise impact to acceptable levels. In cases where practical direct mitigation are not available or the identified measures cannot provide adequate protection, provision of indirect technical remedies in the form of acoustic insulation and air-conditioning should be considered under the ExCo directive "Equitable Redress for Persons Exposed to Increased Noise Resulting from the use of New Roads". The eligibility for indirect technical remedies should be tested against the following three criteria and recommendations should be presented to ExCo for approval.

The eligibility of noise insulation for education institutions should also be assessed against the three criteria as stated below:

i) The predicted overall noise level from the new road together with other traffic noise in the vicinity must be above the specified noise levels ($L_{10,\ peak\ hour}$ 65 and 70 dB(A) for educational institutions and residential dwellings respectively);

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

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

For the purpose of this Study, all roads are described as either:

- 'existing' which are unchanged by the proposed project except for possibly taking additional traffic; or
- 'new' which in the context of this report describes all roads that are completely new or are substantially altered by the proposed project (eg the location of the road has altered or has been widened substantially).

The 'new' road adopted for this Study are the Route 16 alignment, slip road connections to and from Ching Cheung Road, slip road connections from Castle Peak Road and Che Kung Miu Road Connection. It is assumed that existing roads cannot be mitigated by using direct mitigation measures, as there is currently no standing policy to redress traffic noise impact from existing road in the form of roadside noise barriers and enclosures. However, direct mitigation measures will be incorporated into the new road design where necessary to mitigate any unacceptable noise levels at nearby NSRs.

4.1.4 Assessment of Traffic Noise Impacts

The potential noise impacts on the NSRs by 2019 with the operation of Route 16 are discussed below and the unmitigated predicted noise levels are given in *Tables D1 in Annex D.* The 1997 prevailing noise levels, the 2019 predicted noise levels and the HKPSG criteria are also given in *Table D1 (Annex D).*

West Kowloon Section

As indicated in *Table D1* in *Annex D,* the noise levels at Mei Foo Sun Chuen (Phase 4, 5 & 6) and Haking Wong TT by the year 2019 will be dominated by road traffic noise from the existing road network (Kwai Chung Road). The noise levels from the existing road will already exceed the HKPSG $L_{10,\ peak\ hour}$ 70 dB(A) criteria. *Table D1* indicates that the noise contribution from Route 16 are in general 10 dB(A) below the existing road networks. These NSRs are therefore excluded from the consideration of mitigation measures as it would not be effective to provide mitigation measures on Route 16.

The KMB Lai Chi Kok Bus Depot site is zoned as 'Comprehensive Development Area'. As the design layout plans are not available, the noise levels at the site boundaries have been predicted to give an indication of the noise impact. *Table D1* indicates that the site will be mainly affected by the existing Kwai Chung Road and Lai Chi Kok Road. This NSR is therefore excluded from the consideration of mitigation measures as it would not be effective to provide mitigation measures on Route 16.

At Lai Chi Kok Reception Centre Staff Quarters the predicted noise levels with no mitigation are above the 70 dB(A) level by at least 10 dB(A) at all NSRs at all floors, implying that the eastern façade of the building will receive unacceptable impact due to Butterfly Valley Road and Route 16. Since the existing noise levels are already above the 70 dB(A) limit, the HKPSG criterion cannot be achieved by direct mitigation measures on new roads alone. However direct mitigation measures will be assessed to alleviate the noise impact from Route 16 at the NSRs.

The noise levels at the new Lai Chi Kok Reception Centre Staff Quarters are mainly from traffic noise on the existing road network (i.e. Kwai Chung Road, Castle Peak Road and Cheung Sha Wan Road). The noise levels from the existing roads will already exceed the $L_{10, peak\ hour}$ 70 dB(A) limit. However direct mitigation measures will be assessed to alleviate the noise impact from the proposed Route 16 road alignment on this NSR.

The noise levels at Lai Chi Kok Hospital are above the HKPSG criteria and hence mitigation measures are required. The main noise contribution are from traffic noise on the existing road network and the proposed Route 16 alignment. Direct mitigation measures will be assessed to further alleviate the noise impact at these NSRs.

Shatin Section

As indicated in *Table D1*, the noise levels at Woodcrest Hill and Sun Chui Estate are dominated by road traffic noise from the existing road network (Tai Po Road and Che Kung Miu Road). The noise levels from the existing road will already exceed the HKPSG $L_{10, peak\ hour}$ 70 dB(A). Due to noise screening from natural topography and separation from Route 16, the noise contribution from Route 16 are in general 10 dB(A) below the existing road networks. These NSRs are therefore excluded from the consideration of mitigation measures as it would not be effective to provide mitigation measures on Route 16.

The predicted noise levels at Shatin Heights with no mitigation are above the 70 dB(A) level at all NSRs. *Table D1* indicates that Shatin Heights are affected by both existing roads and Route 16. Direct mitigation measures will therefore be assessed to alleviate the noise impact from Route 16 at the NSRs.

For Tun Kwun Lau Pak Lok and Cheng Wing Chee College, *Table D1* indicates that the noise contribution from Route 16 alone (stopping at the Route 16 and T3 junction) is in the region of 63 to 70 dB(A) (without mitigation), suggesting that the section of Route 16 within the Study area of this assessment will cause unacceptable noise levels at the school. Direct mitigation measures will therefore be assessed to alleviate the noise impact from Route 16.

Three schools along Che Kung Miu Road including Cheung Wong Wai Primary School, Shatin Tsung Tsin Secondary School and Ng Yuk Secondary School have already been provided with insulation for traffic noise protection. However, predicted results indicate that the noise levels at these schools are dominated by road traffic noise from existing road network (Che Kung Miu Road and Mei Tin Road), the noise contribution from Route 16 is in the region of 16 to 20 dB(A) below the existing road networks.

For Carmel Alison Primary School, *Table D1* indicates that the noise levels from the existing road (Che Kung Miu Road) exceed the $L_{10, peak\ hour}$ 65 dB(A) limit, and the noise contribution from Route 16 and Che Kung Miu Road Connection will be in the region of 70 to 72 dB(A) without mitigation. Direct mitigation measures will therefore be assessed to alleviate the noise impact from Route 16.

At Hin Keng Estate, Carado Gardens and Tin Sam Tsuen, the predicted noise levels with no mitigation are above the 70 dB(A) levels at all NSRs as shown in *Table D1*, implying that there will be exceedances of the $L_{10, peak\ hour}$ 70 dB(A) for all dwellings facing Che Kung Miu Road. The noise levels at these NSRs are mainly from traffic noise on both existing roads, Che Kung Miu Road and Route 16. From *Table D1*, the noise levels from existing roads will already exceed the $L_{10, peak\ hour}$ 70 dB(A) limit. However, direct mitigation measures will be assessed to alleviate the noise contribution from Route 16 and Che Kung Miu Road Connection at the NSR.

For the planned MOS depot site, the unmitigated noise levels at 10m from the site boundary are in the region of 74 to 80 dB(A). The site will be affected by both Route 16 and the surrounding existing road network (noise contribution from existing roads and Route 16 are in the region of 67 to 76 dB(A) and 65 to 80 dB(A) respectively).

Toll Plaza

Two potential development sites have been proposed near the toll plaza area. It has been proposed that low rise New Territories Exempted Houses will be developed on these sites. As the layout plan of this potential residential site is not available at this stage, the potential traffic noise levels could only be predicted at the site boundary. Due to screening provided by natural topography, predicted noise levels at the boundary of the development site are below the HKPSG $L_{10,\ peak\ hour}$ 70 dB(A) criteria, implying traffic noise from the toll plaza will not cause any significant noise impact at the NSRs. It is considered that no direct mitigation measure is required.

4.1.5 Traffic Noise Mitigation Measures

The assessment in the above section indicates that the most affected area will be at the Lai Chi Kok Reception Centre Staff Quarters and Lai Chi Kok Hospital in West Kowloon, and at Shatin Heights, Hin Keng Estate, Carado Garden and Tin Sam Tsuen in Shatin. Mitigation measures will be required to reduce these impacts to within the HKPSG criteria.

A progressively extensive set of mitigation measures for the West Kowloon area and Shatin Area have been investigated in order to reduce the noise contribution from the Route 16 alignment. The different mitigation options are described in the section below.

4.1.5.1 Mitigation Option 1

Low noise road surface (i.e. friction course) is considered a practical mitigation option for the proposed roads and has been modelled on all the proposed alignment excluding the tunnel section.

West Kowloon Section

For the West Kowloon Area, *Table D2* in *Annex D* indicates that for most of the NSRs, the predicted noise levels are still above the HKPSG criteria.

As indicated in *Table D2*, the noise levels at the Lai Chi Kok Reception Centre New Staff Quarters and Lai Chi Kok Hospital are dominated by road traffic noise from the existing road network (Kwai Chung and Castle Peak Road). The noise levels from the existing road will already exceed the HKPSG $L_{10,\ peak\ hour}$ 70 dB(A). *Table D2* indicates that the noise contribution from Route 16 are in general 7 to 18 dB(A) below the existing road networks. These NSRs are therefore excluded from the consideration of further mitigation measures as it would not be effective to provide mitigation measures on Route 16 and the overall noise levels will not be further reduced.

However, at Lai Chi Kok Reception Centre Staff Quarters, Route 16 are the dominant traffic noise source to these NSRs. Further mitigation measures are added to this option to investigate additional noise protection.

Shatin Section

For the Shatin Area, *Table D2* indicates that for most of the NSRs, the predicted noise levels are still above the HKPSG criteria.

The NSRs at low rise residential building along Keng Hau Road, eastern part of Tin Sam Tsuen (N7b), Tun Kwun Lau Pak Lok, Cheng Wing Chee College and Carmel Alison Primary School are mainly affected by the traffic noise from the existing roadworks and not from Route 16. In general, with the use of low noise road surfacing, the noise contribution from Route 16 are in the region of 6 to 9 dB(A) below the existing road networks. These NSRs are therefore excluded from the consideration of mitigation measures as it would not be effective to provide mitigation measures on Route 16 and the overall noise levels will not be further reduce.

However, at Shatin Heights, Hin Keng Estate, Carado Garden and western part of Tin Sam Tsuen (N7a), Route 16 is the dominant traffic noise source to these NSRs. Further mitigation measures are added to this option to investigate additional noise protection.

4.1.5.2 Mitigation Option 2a (West Kowloon)

At Lai Chi Kok Reception Centre Staff Quarters, low noise road surfaces and 5m high roadside noise barriers of length 300m located at 1m from road kerb of the northbound carriageway of Route 16 has been modelled (see Figure 4.1c). As shown in *Table D3* in *Annex D*, the predicted noise levels indicate that the barriers are effective at the lower floors, however, the barriers are not effective in mitigating the noise at high levels. The locations of the Staff Quarters close to Route 16 are such that the upper floor residents will look down onto the roads at a steep angle, and consequently the 5m barriers will have limited effect. Addition mitigation measures are added to this option to investigate further noise protection.

4.1.5.3 Mitigation Option 2b (Shatin)

This mitigation package comprises:

- low noise road surfaces on the proposed Route 16 alignment (excluding the tunnel section);
- 1.4m high roadside noise barriers located along the eastern side kerb of the northbound and southbound carriageway of Che Kung Miu Slip Road connection (facing Che Kung Miu Road);
- 2m high roadside noise barriers located along the eastern side kerb of the northbound and southbound carriageway of Route 16 alignment (facing Che Kung Miu Road); and
- 7m high reinforced earth embankment along the north side of the northbound carriageway (see Figure 4.1d).

Table D3 indicates that whilst the 70 dB(A) level cannot be achieved, Hin Keng Estate are mainly affected by the traffic noise from the existing roadworks and not from Route 16. With the use of the above mitigation measures package, noise reduction of 7 to 10 dB(A) from Route 16 has been achieved. The noise contribution from Route 16 are therefore in the region of 8 to 16 dB(A) below the existing road networks. This NSR is excluded from the consideration of further mitigation measures as it would not be effective to provide mitigation measures on Route 16 and the overall noise levels will not be further reduced. Hence, the recommended mitigation option is sufficient to ensure that the new road alignment does not further deteriorate the future noise environment.

Table D3 indicates that the mitigation measures are effective in reducing the noise levels from Route 16 at the low and mid level receivers of Carado Garden (noise reduction of 7 to 10 dB(A)), however, the barriers are not as effective in mitigating the noise at high levels (reduction of 4 to 5 dB(A)). Addition mitigation measures are therefore required to further reduce the noise impacts at the high level receivers from the Route 16 Alignment.

The Hong Kong School of Motoring site is currently operating on short-term tenancy. In the adopted Pak Shek layout Plan L/ST 17/IC, provisions have been made for the planned Ma On Shan Railway line and depot by reserving the temporary bicycle park and School of Motoring sites to be rezoned as Other Specified Uses annotated 'Possible Railway Depot with Commercial/Residential Development above'. Table D3 indicates that the mitigation measures are effective in reducing the noise levels from Route 16 at the low and mid level receivers. However, as the site are affected by both traffic from the existing road network and Route 16, the overall benefit from the noise barrier is limited.

At Shatin Heights, the 7m high reinforce earth embankment has been modelled. The effect of this mitigation measure, is to reduce the noise contribution from the Route 16 Alignment. As indicated in *Table D3*, noise levels of up to 78 dB(A) are still predicted at Shatin Heights, with the main contribution from both existing roads (Tai Po Road) and Route 16. Addition mitigation measures are therefore required to further reduce the noise impacts at the high level receivers from the Route 16 Alignment.

4.1.5.4 Mitigation Option 3a (West Kowloon)

Low noise road surfaces, 5m high roadside noise barriers located at 1m from road kerb of the northbound carriageway of Route 16 and 3m high roadside noise barrier located at 1m from road kerb of the southbound carriageway of Route 16 have been modelled (see Figure 4.1e). The effect of the noise barriers and the low noise road surfaces, is shown in *Table D4* in *Annex D*. The results indicate that for all receivers, whilst the 70 dB(A) level cannot be achieved because of contributions from existing roads, the noise levels from Route 16 have been significantly reduced (maximum by 8 to 14 dB(A) at top floor). However, the traffic noise on the existing roads (ie Butterfly Valley Road) has a high noise impact on the NSRs. Further mitigation measures have not been considered as it would not be effective to provide mitigation measures on Route 16 alone and the overall noise levels will not be further reduced. It is considered that the combination of the 3m, 5m noise barriers and low noise road surfaces does represent a package of direct mitigation measures which would ensure the new Route 16 alignment does not further deteriorate the future noise environment. The residual impacts at this location will be assessed against noise insulation criteria in *Section 4.1.5.6*.

4.1.5.5 Mitigation Option 3b (Shatin)

This mitigation package comprises:

- low noise road surfaces on the proposed Route 16 alignment excluding the tunnel section;
- 2m high roadside noise barriers located along the both side kerb of the Che Kung Miu Slip Road connection (facing Che Kung Miu Road);
- 3m high roadside noise barriers located along the south side kerb of the northbound and southbound carriageway of Route 16 alignment (facing Che Kung Miu Road);

- 7m high reinforced earth embankment along the western side of the northbound and southbound carriageway (see Figure 4.1f); and
- 2m high noise barrier along the top of the northbound earth embankment.

Table D4 indicates that whilst the 70 dB(A) level cannot be achieved, top levels of Carado Garden are still affected by the traffic noise from both the existing roadworks and Route 16. Addition mitigation measures are therefore required to further reduce the noise impacts at the high level receivers from the Route 16 Alignment.

Table D4 indicates that even with the use of the 9m high reinforced earth embankment and noise barrier, the noise levels at high levels of Shatin Heights are still impacted by high levels of road traffic noise. The use of full enclosure located along the entire Route 16 main alignment is explored. As the Route 16 main alignment is situated on reinforced earth embankment, it would be structurally unstable to erect a full noise enclosure along the entire Route 16 main alignment. The increased lateral loads from noise enclosure due to wind effects would further worsen the situation. Therefore the use of full noise enclosure is not considered feasible. In addition, the use of full enclosure would also result in potential air quality problems at the northern end of the alignment, as emissions from the portal ends would raise pollutants levels of the area and the Air Quality Objectives would be exceeded at the nearby existing Air Sensitive Receivers.

4.1.5.6 Mitigation Option 4 (Shatin)

This mitigation package comprises:

- low noise road surfaces on the proposed Route 16 alignment excluding the tunnel section;
- 3m high roadside absorptive noise barriers located along the both side kerb of the Che Kung Miu Slip Road connection;
- 4m high roadside noise barriers located along the south side kerb of the northbound and southbound carriageway of Route 16 alignment (facing Che Kung Miu Road);
- 7m high reinforced earth embankment along the western side of the northbound and southbound carriageway (see Figure 4.1g); and
- 2m high noise barrier along the top of the northbound earth embankment.

Table D5 indicates that whilst the 70 dB(A) level cannot be achieved, Carado Garden are mainly affected by the traffic noise from the existing roadworks and not from Route 16. With the use of the above mitigation measures package, noise reduction of 7 to 15 dB(A) from Route 16 has been achieved. The noise contribution from Route 16 are therefore in the region of 6 to 17 dB(A) lower than the existing road networks. This NSR is therefore excluded from the consideration of further mitigation measures as it would not be effective to provide mitigation measures on Route 16 alone. Hence, mitigation option 4 is considered sufficient to ensure the new road alignment does not further deteriorate the future noise environment.

For the planned MOS depot, exceedances of the HKPSG are still predicted at 10m from the site boundary. The 4m high noise barrier erected along the south side kerb of the northbound and southbound carriageways are considered to be the best practicable height as the barriers are erected on top of reinforced earth embankment rather than on solid platform. It is expected that higher barriers on reinforced earth embankment would

be structurally unstable due to the increased lateral loads from wind effects. As the proposed structural form for the Che Kung Mui Road connection viaduct are externally prestressed concrete girder bridge which are relatively less heavy structures, higher barriers on the viaduct would not be engineering feasible.

Since the best practicable direct mitigation measures have been exhausted for the protection of the planned landuse, it is therefore recommended that this future development should take account of noise constraints of Route16 in their design in accordance with HKPSG to mitigate the road traffic impact.

4.1.5.7 Number of Dwellings Affected

Without any form of noise mitigation measures, it is estimated that the total number of dwellings and classrooms in the Study Area that would be subject to exceedances of the HKPSG noise criteria is approximately 2130 and 200 respectively. However, out of the 2130 dwellings, only approximately 900 dwellings and 25 classrooms would actually be affected by Route 16 as the other dwellings and classrooms would be mainly affected by existing roads. With the implementation of Mitigation 3a (West Kowloon) and Mitigation 4 (Shatin), approximately 875 dwellings and 25 classrooms would benefit from noise reduction of 1 to 4 dB(A). However, there would still be approximately 2125 dwellings and 200 classrooms that would subject to noise levels exceeding the noise criteria, due mainly to noise contribution from existing roads.

4.1.5.8 Residual Impacts

As discussed above, the use of direct mitigation measures is evaluated and the best practicable package comprising options 3a and 4 is recommended. However, owing to either environmental constraints or high existing background noise levels, residual impacts are predicted at some NSRs even with the use of the recommended direct mitigation measures. The residual impacts at these receivers have been assessed against the noise insulation criteria as stated in *Section 4.1.3* above. In order to assess the number of existing dwellings that could be qualified for noise insulation as a last resort, the mitigated noise levels have been compared with the three noise criteria as presented in *Table D7* in *Annex D.*

From the assessment results presented in *Table D7*, it is found that the middle and top floors of Shatin Heights will meet the insulation criteria. Predicted results indicate that approximately 24 dwellings will be eligible for indirect technical remedies in the form of window insulation and air conditioning subject to ExCo approval. Pending on ExCo's approval, it is recommended that a Detailed Noise Insulation Study be carried out at the Detailed Design stage to identify the exact requirements of noise insulation.

For the planned MOS depot, exceedances of the HKPSG criteria are predicted at the facade facing the Route 16 alignment even with the use of mitigation option 4. Owing to engineering constraints, higher noise barrier or noise enclosure is not considered feasible. As the site will be affected by road traffic noise from three different directions and the geometry of the site, increasing the set back distance from the road traffic noise sources would not be viable. Mitigation measures such as the use of podium together with the use of tolerant building as screening structures, (ie multi-storey car parks, commercial buildings and recreational facilities) along the site boundary facing the Route 16 Che Kung Miu Slip Road connections should be considered for reducing the noise levels along the facade facing Che Kung Miu Slip Road. For the site boundary facing the Route 16 main alignment, assessment indicates that the planned development will mainly be affected by existing roads rather than from the operation of Route 16. It is expected that the operation of Route 16 would not worsen the overall

noise situation at the future development. It is recommended that the new development should take account of traffic noise constraints and incorporate measures to design against the road traffic noise.

4.1.6 Fixed Plant Noise Impact

The limiting $L_{eq, period}$ levels at 1m from the louvers of the ventilation building have been predicted to establish the limiting atmospheric noise specifications, which will ensure that no exceedances of the noise criteria will result from the operation of the plant.

The location of the ventilation building for the main tunnel is shown in *Figure 3.1b*. Four receivers (as defined by the NCO) namely Bamboo Villa, Pinehill, Park Mansion and a new residential development site have been identified near the proposed ventilation building and are also shown in *Figure 3.1b*. The target levels at the receivers are the nighttime Acceptable Noise Level (ANL) minus 5 (in line with the HKPSG), i.e. $L_{eq, 30 min}$ 55 dB(A), since an Area Sensitivity Rating (ASR) of C (Tai Po Road being the Influencing Factor) will be applicable to the residential buildings along Tai Po Road. The worst case distance between the louvers and the NSRs are given in *Table4.1b* below.

Table 4.1b Minimum distance to NSRs

NSRs	Minimum distance to NSRs (m)
Bamboo Villa	400
Pinehill	210
Park Mansion	550
Residential Development	190
Public open space (Not NSR)	50

It is assumed that public access to the area within the boundary of the ventilation building will be restricted to the public and thus the nearest public area will be at the site boundary. Although public open areas and pedestrian area are not considered as NSRs, a limiting noise criterion of $L_{eq, 30 min}$ 70 dB(A) has been adopted to ensure the public will not be affected by unacceptably high noise levels when occupying the public areas.

The area within the site boundary of the ventilation building is assumed to be restricted from the public and is not considered sensitive to noise. However for health and safety reasons, a limiting noise levels of $L_{eq, 30 min}$ 80 dB(A) at 1m is recommended as a cut-off maximum noise level for any louver at the ventilation building.

The preliminary design of the ventilation building indicates the exhaust louvers will be of an area 825 m^2 located at the south-eastern facade of the ventilation building facing Tai Po Road. Assuming a limiting noise levels of $L_{eq, 30 min}$ 80 dB(A) at 1m (ie SWL of the louvre will be 109 dB(A)), the 1m façade noise levels of each of the NSRs taking into account distance correction are given in *Table 4.1c*.

Table 4.1c Predicted façade noise levels ($L_{eq,30\,min}$ dB(A))

NSRs	Predicted Facade Noise Levels
Bamboo Villa	52
Pinehill	58
Park Mansion	49
Residential Development	59
Public open space (Not NSR)	67[1]

[1] Freefield Noise Levels

The noise levels predicted at the NSRs are the worst case estimate as directivity and screening corrections have not been taken into account in the assessment. From *Table 4.1c*, it indicates that exceedances of the HKPSG night-time criteria are predicted at Pinehill and at the Residential development. It is therefore recommended if the maximum cut-off noise levels is reduced to $L_{eq,30\,min}$ 75 dB(A), no exceedances of the noise criteria will result at the NSRs. It is anticipated that sizeable fan silencers will be needed to achieve the recommended 75 dB(A) at 1m specification and adequate space should be allocated to silencers in the ventilation building design.

4.1.7 Conclusion

This assessment has predicted that the traffic noise levels from Route 16 at 2019 will result in exceedances of the HKPSG traffic noise criterion at the Lai Chi Kok Reception Centre Staff Quarters, Shatin Heights, Hin Keng Estate and Carado Garden.

A series of direct mitigation measures have been considered for Route 16 to reduce the noise impacts at the Lai Chi Kok Reception Centre Staff Quarters, Hin Keng Estate, Carado Garden and Shatin Heights. The best practicable mitigation package is recommended, comprising a combination of 3 and 5m high roadside noise barriers and low noise road surfaces for the West Kowloon Section and a combination of 3 and 4m noise barriers, low noise road surfaces and 9m high reinforced earth embankment for the Shatin Section.

Residual impacts at the identified receivers with the implementation of the recommended direct mitigation measures have been assessed against the insulation criteria as stated in the "Equitable Redress for Persons Exposed to Increase Noise Resulting from the Use of New Roads". The assessment indicates that approximately 24 dwellings of Shatin Heights will meet the criteria for noise insulation as a last resort subject to ExCo approval. It is recommended that a Detailed Noise Insulation Works Study be carried out at the Detailed Design stage to identify the exact requirements of noise insulation.

The specification of the fans for the ventilation building should be attenuated to the $L_{eq,30\,min}$ 75 dB(A) at 1m from the main louvres area to ensure no exceedance of the NCO criteria at the nearby NSRs.

4.2 Air Quality

4.2.1 Introduction

This section provides a quantitative assessment of the air quality associated with the operation of Route 16 on Air Sensitive Receivers (ASRs). Vehicular emissions from open section of Route 16 and the associated network are the major sources of pollutants within the Study Area. Exhaust gases emitted from the tunnel portals and ventilation shaft will be another pollutant sources. Worst case impacts on the receivers have been modelled and presented below. Baseline conditions have been described in *Section 3.2.*

4.2.2 Environmental Legislation and Guidelines

In addition to the statutory AQOs limits described in *Section 3.2,* the Tunnel Air Quality Guidelines (TAQG), specified under the EPD's *Practice Note on Control of Air Pollution in Vehicle Tunnels, 1995* should be attained and maintained inside a vehicle tunnel. *Table 4.2a* shows the guideline values.

Table 4.2a Tunnel Air Quality Guidelines (TAQG)

Air Pollutant	Averaging Time	Maximum Concentration (ppm)
Carbon Monoxide (CO)	5 minutes	100
Nitrogen dioxide (NO_2)	5 minutes	1
Sulphur dioxide (SO_2)	5 minutes	0.4

In addition, the visibility in tunnel should be controlled to a maximum level equivalent to an extinction coefficient of 0.005 m^{-1} during any 5-minute interval.

4.2.3 Air Sensitive Receivers

In addition to the ASRs listed in *Section 3.2,* additional ASRs have been included to account for the future landuse of the area in operational phase. They are Wai Man Tsuen East and Wai Man Tsuen West and KMB Bus Depot Development. Also, a ventilation building is proposed near Tai Po Road and three new ASRs located near the ventilation building have been identified. Location of the additional ASRs for the operation phase and their horizontal distance from the alignment are listed in *Table 4.2b.*

Table 4.2b Additional ASRs for Operational Phase

Section	ASR	Name	Horizontal Distance from Alignment/ Ventilation Building (m)
West Kowloon	WK-A9	Wai Man Tsuen East	25
	WK-A10	Wai Man Tsuen West	25
	WK-A11	KMB Bus Depot Development	200
Ventilation Building	VB-A1	Pinehill Villa	50

VB-A2	Residential Redevelopment of Carlton Hotel	75
VB-A3	Park Mansion	120

Location of ASRs in West Kowloon are shown in *Figure 3.2a* and location of ASRs near the Ventilation Building are presented in *Figure 4.2a*. The air quality impacts on ASR ST-A14 and ST-A15 have not been assessed in the operational phase as they are located adjacent to Tai Po Road with large separation from the Route 16 alignment (horizontal separation over 70 m and vertical separation over 45 m). Tai Po Road is the major pollutant sources at the two receivers.

4.2.4 Potential Source of Impacts

Vehicular emissions from the road will be the major air pollutants during the operation of Route 16. NO_2, CO, and RSP are the major compositions of the pollutant.

Air quality inside the two tunnel sections (Eagle's Nest Tunnel and Shatin Height Tunnel) is another area of concern. Design of the ventilation system will ensure that the TAQG will be met at the two tunnels. Due to the existing poor air quality in the West Kowloon Study Area, the tunnel will have no emission at the West Kowloon end. Pollutants generated within the Eagle's Nest Tunnel will be dispersed via the ventilation building at Tai Po Road and via the portal at the Shatin end. For the shorter Shatin Height Tunnel, it will be ventilated by jet fans only. The tunnel will be ventilated in the direction of traffic. Details of ventilation design will be described in Design Report and will be submitted to the Government for approval.

4.2.5 Assessment Methodology

Open Road Section Emission

The CALINE4 model was used to predict the pollutant levels of NO_2, RSP and CO from the open section of the Route 16 alignment and the surrounding networks.

The Route 16 is scheduled to be opened in year 2004 and traffic flows for the year 2006, 2011 and 2019 are used for this Study. Traffic flows and fleet emissions of vehicle exhausts, in term of NO_x, for the projected years are presented in *Table 4.2c*. It is indicated that the vehicle exhaust will be peaked at year the 2019 and its emission will be 35% higher than that of 2006. The projected traffic flow for the worst case scenario, pm peak hour traffic for the year 2019, were used as presented in *Section 2.4*.

Table 4.2c NO_x Emission of R16 Main Alignment

Year	2006	2011	2019
Traffic Flow (veh hr^{-1})	6300	7100	9300
NOx emission Rate (g km^{-1} veh^{-1})	2.966	2.764	2.714 (1)
Fleet Emission (kg km^{-1})	18.69	19.62	25.24
% increase in fleet emission	+0	+5	+35

(1) Emission rate of year 2011 assumed for year 2019.

Emissions factors of NO_x, RSP and CO for each vehicular type up to 2011 were supplied by EPD and compound emission factors were calculated to represent average emission rates for the traffic within the Study Area. As only emission factors up to 2011 were available, the assessment was therefore based on the 2011 emission factors and 2019 traffic flow to model the worst case scenario. It is, however, believed that the 2019 emission rates will be lower than 2011, as more vehicle will be fitted with advanced emission control system in year 2011. The predicted results were therefore conservative.

Peak hour traffic of the Study Area will occur during daytime and worst case scenario of neutral meteorological conditions were assumed in the model. Typical input parameters for the model are listed below:

- Wind Speed — 1 ms^{-1}
- Wind Direction — worst case for each receivers
- Stability Class — D
- Mixing Height — 500 m
- Standard Deviation — 20 degree
- Temperature — 25 °C

In the West Kowloon Section, the Discrete Parcel Method was used to compute NO_2 concentrations with the CALINE 4 model. It is assumed that the NO_2 reactions take place within parcels. The reaction rates are assumed to be governed by the initial concentrations of NO, NO_2 and O_3, and are independent of the dispersion mechanism. Background concentration of NO and NO_2 listed in *Table 3.2b* were assumed used in the model. The annual average of the maximum daily ozone levels monitored at Kwai Chung Station for the year 1995 (56 $\mu g\ m^{-3}$) was taken as the background ozone concentration of the area. In the Shatin section, NO_2 emissions attributed to vehicle exhaust emissions and tunnel portal emissions were assessed. The Discrete Parcel method is the preferred model to assess the NO_2 dispersion. However, such method is not available in the ISCST3 model for calculation of tunnel portal emissions. It is therefore assumed that NO_2 behave as inert gas, and that 20% of the NO_x emission would be converted to NO_2 in both the CALINE 4 and ISCST3 model.

Currently, there is no hourly criteria for RSP. The hourly results were converted to daily average to check the compliance of the daily criteria of 180 $\mu g\ m^{-3}$. It was assumed that the peak hour traffic would last for 10 hours and the wind would be blowing at the direction of worst impact for 24 hours. Conversion factor of 0.4 was used to convert hourly RSP to daily RSP.

Portal and Ventilation Building Emission

Portal emissions were assessed in accordance with the Permanent International Association of Road Congresses (PIARC), 1991 recommendation. Portal air jets have been assumed along the axis of the roads in the direction of traffic flow. They were taken as volume source and their dispersions will be calculated using the *Industrial Source Short Term Complex* (ISCST3) dispersion model.

Exhaust gas will also be discharged via portal ventilation buildings. They will be directed horizontally under the action of exhaust fans. Emissions from the portal

ventilation building will be taken as volume source and modelled using the ISCST3 model.

Meteorological data at Cheung Sha Wan and Shatin station for the year 1993 were employed for the model run. The peak hour traffic of the Route 16 alignment will occur during daytime and it was assumed that the night-time traffic flow will be reduced by half during 22.00 - 07.00 hours in the model.

It was assumed that 20% of the NO_x emission would be converted to NO_2 for tunnel portal and ventilation building emissions.

The emission rates of portal and ventilation for NO_2 and CO were calculated by the ventilation engineer based on peak hour traffic flow. A summary of ventilation data employed in this Study are shown in *Table 4.2d*. It was assumed that the daily RSP emissions from the portal and ventilation building were low and their emission were negligible in this assessment.

Table 4.2d Portal and Ventilation Building Emission

Tunnel Portal/ Ventilation Building		NO_2 [1] Emission Rate ($g\ s^{-1}$)	Flow Rate (gs^{-1})	CO [2] Emission Rate ($g\ s^{-1}$)	Flow Rate ($g\ s^{-1}$)
Eagle's Nest Tunnel					
SB	South Portal	0	0	0	0
	North Portal	0	0	0	0
NB	South Portal	0	0	0	0
	North Portal	2.52	669	4.45	669
Shatin Height Tunnel Portal					
SB	South Portal	2.04	540	6.34	570
	North Portal	0	0	0	0
NB	South Portal	0	0	0	0
	North Portal	0.78	209	5.54	200
Ventilation Building					
NB		2.16	713	16.83	1194
SB		3.2	893	14	1258

(1)Traffic Speed at 50 kph; NO_2 emission rate is 20% of total NO_x emission.

(2)Traffic Speed at 0 kph.

4.2.6 Evaluation of Impacts

Vehicular Emissions from Open Road and portal emissions

Averages of pollutants at two elevations, ground level and elevated Route 16 alignment levels, attributed to the open sections and portal emissions have been modelled. Both the existing and planned road network have been included in the model.

West Kowloon Section

Air quality modelling results for the West Kowloon section are presented in *Table 4.2e*. Vehicular emissions from the open section of the road is the major source of pollutants. With the tunnel ventilation designed to have no emission at the West Kowloon end, the predicted air quality impact from open section of the road network is the worst case scenario.

It is predicted that NO_2 levels range from 150 $\mu g\ m^{-3}$ to 226 $\mu g\ m^{-3}$ at the ASRs. The NO_2 criteria of 300 $\mu g\ m^{-3}$ will be met at all receivers. Higher levels of NO_2 of 226 $\mu g\ m^{-3}$ is expected at the WK-A3 (Cheung Sha Wan Cooked Food Market). The vehicle exhaust emissions from the existing Kwai Chung Road and Lai Chi Kok Interchange are the major pollutant sources.

The NO_2, CO and RSP criteria will be satisfied at all ASRs.

Table 4.2e Air Quality Modelling Results (West Kowloon Section)

ASR	Relative Height to Alignment	Predicted Pollutant Level ($\mu g\ m^{-3}$)		
	(m)	1-hr NO_2	1-hr CO	24-hr RSP
WK-A1	-8.5	207	4095	114
	+0	169	3635	102
WK-A2	-8.5	188	3750	106
	+0	188	3520	100
WK-A3	-8.5	226	5360	129
WK-A4	-8.5	226	3750	108
	+0	188	3290	96
WK-A5	-8.5	188	3175	94
	+0	169	2945	92
WK-A6	-8.5	169	3750	104
	+0	150	3405	98
WK-A7	-8.5	188	3980	106
	+0	169	3635	100
WK-A8	-8.5	150	2715	86
	+0	150	2600	84
WK-A9	-8.5	188	3635	103
	+0	207	3865	105
WK-A10	-8.5	169	3175	93
	+0	169	3060	90
WK-A11	-8.5	169	3635	103
	+0	150	3405	98
AQO		300	30 000	180

Background included in the above prediction.

Isopleths of the critical pollutant, NO_2, at the ground and alignment level of Route 16 have been plotted and are shown in *Figure 4.2b-1 & 4.2b-2*. It is indicated that the AQO along the alignment would be satisfied in the West Kowloon section except for the temporary carpark to the south of Cheung Sha Wah Cooked Food Centre. The temporary carpark is zoned as 'G/C' on the approved Cheung Sha Wan OZP No S/K 15/13 and is designated for use of a 'proposed DSD Maintenance Depot' on the draft Cheung Sha Wan and Sham Shui Po (Northern Part) ODP No D/K5A/1A. The Route 16 main alignment is located at 70 m from the DSD Depot and its contribution is low (less than 38 $\mu g\ m^{-3}$). Mitigation measures for the DSD Depot are described in *Section 4.2.7*.

It is understood that acoustic barriers along the carriageway of Route 16 near WK-A4 have been proposed to mitigate the noise impact. With the barriers, pollutants would be dispersed above the barrier and higher level ASRs might receive a higher air quality impact from the alignment. Analysis of the modelling data show that Kwai Chung Road, locating perpendicular to Route 16 alignment, is the major pollutant source at WK-A4. The contribution of the Route 16 is less than 10 %. An increase in the pollutant level from Route 16 alignment will only raise the overall pollutant levels slightly at the receiver and the AQO will still be satisfied with the acoustic barrier.

Shatin

For the Shatin section, the AQOs will be satisfied at all the ASRs and the modelling results are shown in *Table 4.2e*. Cumulative impacts from portal emissions of Shatin Height Tunnel have also been taken into account in the model. Portal emissions of the Eagle's Nest Tunnel are low and only those ASRs near the tunnel portal (ST-A1 to ST-A3) will be impacted. Other ASRs (ST-A4 to ST- A13) are located far away (over 500m) from the tunnel portals and will not be affected.

ASR ST-A1 and ST-A2 near the portal ends will receive higher air quality impact. The high pollutant levels are attributed to the traffic emissions of Tai Po Road and portal emissions of Shatin Height Tunnel.

Table 4.2e Air Quality Modelling Results (Shatin Section)

ASR	Relative Height to Alignment	Predicted Level (μgm^{-3})		
	(m)	1-hr NO_2	1-hr CO	24-hr RSP
ST-A1	+1.5	156	2960	70
ST-A2	+1.5	203	3543	81
	+10	161	2934	72
ST-A3	+1.5	91	1926	60
	+10	88	1925	59
ST-A4	+1.5	106	2151	63
	+10	102	2150	62
ST-A5	-8.5	139	2836	69
ST-A6	-8.5	116	2491	65

ASR	Relative Height to Alignment	Predicted Level (μgm^{-3})		
	(m)	1-hr NO_2	1-hr CO	24-hr RSP
	+0	112	2376	65
ST-A7	-8.5	105	2260	63
	+0	105	2260	63
ST-A8	-8.5	154	2951	75
	+0	135	2720	71
ST-A9	-8.5	105	2145	64
	+0	101	2144	63
ST-A10	-8.5	127	2604	67
ST-A11	-8.5	135	2837	68
	+0	135	2953	68
ST-A12	-8.5	138	3603	70
ST-A13	-8.5	101	2142	62
	+0	97	2142	61
ST-A14	-8.5	108	2370	63
ST-A15	-8.5	138	2715	70
AQO		300	30 000	180

Note: Background included in the above prediction.

Isopleths of the critical parameter, NO_2, at the ground and alignment level, are shown in *Figure 4.2c-1 and 4.2c-2.*

A new road T3 connecting the Route 16 main alignment and the Tai Po Road has been planned which may also affect the sensitive receivers in Tai Wai (ie ST-A5 to ST-A9). Concentration of the critical pollutants, NO_2, attributed to T3 road network, including portion of Route 16, were predicted in the *Sha Tin New Town - Stage II Trunk Road T3 (Tai Wai), Environmental Impact Assessment Study, Draft Updated Air Quality Assessment Report, Maunsell, September 1997,* and are summarize in *Table 4.2f* below.

Table 4.2f Cumulative Air Quality Impact at Tai Wai

ASR	Predicted NO_2 level in $\mu g\ m^{-3}$ (1)		Cumulative NO_2 level in
	Route 16	T3	$\mu g\ m^{-3}$ (2)
ST-A5	95	71	210
ST-A6	72	170	286
ST-A7	61	120	225
ST-A8	110	109	263
ST-A9	61	164	269

(1) background excluded.

(2) Route 16 + T3 + background

It should be pointed out that ASR ST-A5 to ST-A9 are located at the interface of Route 16 and T3 alignment. The wind directions give rise to the maximum pollutants level at the ASRs are southwesterly for Route 16 and northeasterly for T3. Maximum pollutant levels at the ASRs are attributed by either Route 16 or T3 alignment. The prediction in *Table 4.2f* will therefore give a more conservative prediction. Nevertheless, the cumulative pollutant levels at the ASRs will satisfy the AQO of 300 $\mu g\ m^{-3}$.

It is understood that a package of mitigatiory barrier comprising 3m high acoustic barriers along Che Kwu Miu Road, 4 m high barriers along the main alignment, and an embankment have been proposed for Route 16. The proposed barriers will increase the pollutant levels at the proximity of the barrier. Since the ASRs are located more than 80 m from the barriers, the ASRs will receive similar air quality impacts as without the barrier and the AQO will be satisfied.

Ventilation Building Emissions

Pollutants of NO_2 and CO will be emitted through the ventilation exhaust louvers. The ventilation exhausts are located at 40 m above ground (140 mPD) and the surrounding buildings are located lower than the ventilation exhausts. Vehicular emissions from Tai Po Road, located at 90-100 mPD, will be the major pollutant sources to the ASRs.

Pollutant levels at ASRs near the ventilation building have been modelled and the results are shown in *Table 4.2g*. It has been assessed that the pollutant levels at the ASRs will comply with the AQOs and the surrounding landuse will support the ventilation building in terms of air quality.

Table 4.2g Predicted Pollutant Levels at ASRs near Ventilation Building

ASR	Height in mPD	Predicted Pollutant Level in $\mu g\ m^{-3}$ (1)(2)	
		NO_2	CO
VB-A1	100	225	2967
	110	161	2213
	120	153	1946
	130	183	2154
	140	201	2221
VB-A2	100	216	2959
	110	142	2048
	120	114	1739
	130	110	1584
	140	110	1519
VB-A3	100	177	2491
	110	125	1921
	120	105	1710
	130	103	1543
	140	113	1668

(1) Background included in the above results.

(2) Vehicle exhaust of Tai Po Road included in the prediction.

4.2.7 Mitigation Measures and EM&A

It is predicted that the air quality at most ASRs will comply with the AQO. However, the proposed DSD Maintenance in West Kowloon will experience high air quality impact from the existing road network. It is suggested that the affected area, 20m from the kerb of Lai Chi Kok Road, should be used as carpark or amenity area (excluding passive recreational use). Should there be any development inside the AQO exceedance region, they should be fully air-conditioned with the fresh air intakes located more than 20m from Lai Chi Kok Road, outside the AQO exceedance region.

EPD's *Practice Note on Control of Air Pollution in Vehicle Tunnels* should be followed to ensure sufficient tunnel ventilation such that the TAQG is maintained. To ensure compliance of TAQG, monitoring of air quality within the tunnel is recommended and the requirements of which are presented in the EM&A Manual.

4.2.8 Conclusions

Vehicular emissions from open section of the road and tunnel portals/ventilation shaft are the major pollutant sources of Route 16. Due to the existing poor air quality in the West Kowloon Area, portal emissions at the Kowloon end is not recommended. Emissions from the main tunnel section could be dispersed via the ventilation buildings at Tai Po Road and portals at the Shatin end. Modelled results indicate that emissions from tunnels will comply with the relevant criteria.

Modelling results indicate that the cumulative air quality impact on most ASRs from the development of Route 16 will comply with the AQOs requirements. However, some areas will receive high air quality impact exceeding the AQO. The usage of the AQO exceedance region should be limited to non-sensitive areas such as carpark, landscaping or amenity areas. Should there be any development inside the AQO exceedance region, central air-conditioning with fresh air intakes outside the AQO exceedance region should be provided. EM&A requirements are recommended to monitor the air quality within the tunnel.

4.3 Water Quality

4.3.1 Introduction

This section provides an assessment of the potential water quality impacts associated with the operation of the Route 16 alignment.

Key issues addressed in this section are the road runoff and generation of sewage effluents which may cause adverse water quality impacts on WSRs during operation if not properly controlled. Appropriate mitigation measures are proposed to control potential water quality impacts wherever necessary.

Baseline conditions, WSRs, and government legislation and standards have been detailed in Section 3.3.2 of this report.

4.3.2 Potential Sources of Impacts

Potential sources of impact on water quality from the operation of the Route 16 could include the following:

- runoff from road and open space; and
- sewage effluents generation at the Toll Plaza.

4.3.3 Evaluation of Impacts

4.3.3.1 Runoff from Road and Open Area

The operation of the proposed Route 16 is not expected to generate a large volume of discharge. However, the road drainage discharges will contain minimal amounts of oil, grease and grit that may cause downstream water quality impact to the public stormwater drains.

The tunnel sections will be both confined and underground, therefore the volume of operational tunnel drainage or seepage is expected to be minimal. Appropriate measures to minimise potential sources of contamination will still be taken to ensure full compliance with the standards stipulated in the TM for discharges into stormwater systems, and nearby water bodies.

4.3.3.2 Sewage Effluents

Domestic sewage will be generated by the Toll Plaza staff. Uncontrolled discharge of sewage will cause unacceptable water quality impacts on the WSRs. Owing to the lack of established guidelines for sewage generation rates for construction sites, the recommended design rate for offices, specified in the Guidelines for the Design of Small Sewage Treatment Plants, EPD Solids Waste Control Group, March 1990 has been used for this assessment. Based on the Previous EIA, it is estimated that a maximum

of about 120 staff per day will be stationed at Toll Plaza. About 6.6 m^3 per day of sewage effluent will be generated by the stationed staff at Toll Plaza. In addition, the administrative building at the Toll Plaza will be facilitated with a kitchen of about 7.25 m x 8 m in area and about 29 m^3 per day of sewage effluent will be generated from the kitchen.

Sewage effluents generated at the Toll Plaza will be treated at the on-site septic tanks and soakaway. Grease contaminated effluent from the kitchen should be treated by grease interceptor before discharge into the septic tank and soakaway. Minimum clearance away from streams and catchments and other requirements for the proposed septic tank and soakaway will be referred to EPD's Practice Note for Professional Persons, Drainage Plans subject to Comment by the Environmental Protection Department (ProPECC PN 5/93).

4.3.4 Mitigation Measures

It is important that appropriate measures are implemented to control road runoff and domestic sewage effluents entering the Victoria Harbour and Tolo Harbour to cause impact on the identified WSRs. The following recommendations should be implemented, as appropriate, to ensure that the potential water quality impacts during the operation of the Route 16 are minimised and meet the existing regulatory requirements:

- a surface water drainage system should be provided to collect road runoff and operational tunnel drainage. Where oils and lubricating fluids could be spilt, the road and tunnel drainage discharges will pass through the oil and grit interceptors to remove oil, grease and sediment before pumped to the public stormwater drainage system;
- sewage effluents generated at Toll Plaza will be treated at the on-site septic tanks. Septic tanks should be located far away from the streams and catchwaters wherever possible. Adequate clearance and maintenance should be undertaken to ensure proper functioning of the tanks without polluting any streams and watercourses nearby;
- the efficiency of silt traps and oil interceptors is dependent on regular cleaning and maintenance. These installations should be regularly cleaned and maintained in good working condition; and
- oily contents of the oil interceptors should be collected for reuse, or transferred to an appropriate disposal facility.

4.3.4.1 Conclusions

With the adoption and incorporation of appropriate drainage and effluent collection and treatment systems, no detrimental operational water quality impacts are expected. It is considered that provided these drainage facilities are implemented, along with regularly cleaning and maintenance practices, operational water quality will comply with the WPCO standards.

4.4 Ecological Impacts

4.4.1 Baseline Conditions

The baseline conditions are as presented in *Section 3.4.3.*

4.4.2 Impact Assessment

As indicated in *Section 3.4.4*, the main ecological impacts will be associated with the construction of the route. It is considered that impacts arising from the operation of the road would be limited. However operation of the highway would fragment the woodland areas and water pollution from road run off during usage could be a potential negative impact on the vegetation surrounding the road, if uncontrolled.

It is therefore recommended that within the engineering constraints, the road alignment should be designed to minimize the landtake of the woodland. Careful consideration of design features in the drainage system is recommended to maintain the water quality of the stream, as presented in *Section 3.3*.

4.4.3 Possible Residual Impacts

The presence of the road would form a barrier segregating two areas of woodland. It would thus fragment the habitat and territory available, particularly for large mammals. The extent of the impact is difficult to predict but it is unlikely to be substantial given the extensive area of the surrounding Country Park woodland areas; it is considered that birds would move back into the area once the major disturbance during the construction period was complete.

4.4.4 Conclusion

The operation of the road is not considered to be of key significance to the ecological issues associated with the project.

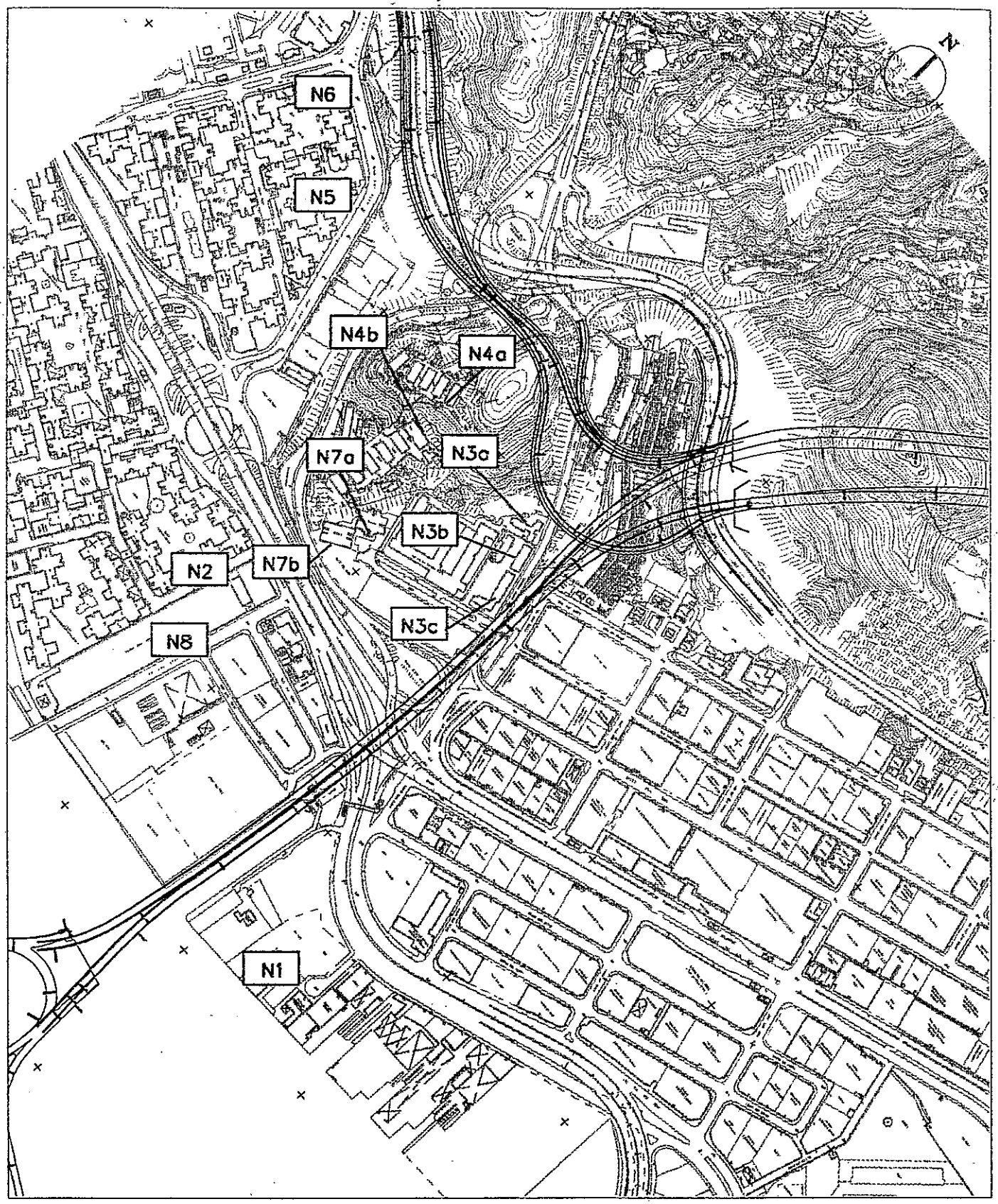

FIGURE 4.1a - LOCATION OF NOISE SENSITIVE RECEIVERS (WEST KOWLOON)

Date : Oct 97

Drawing No. /Contract/C1641/41a

KEY

N1 NSR

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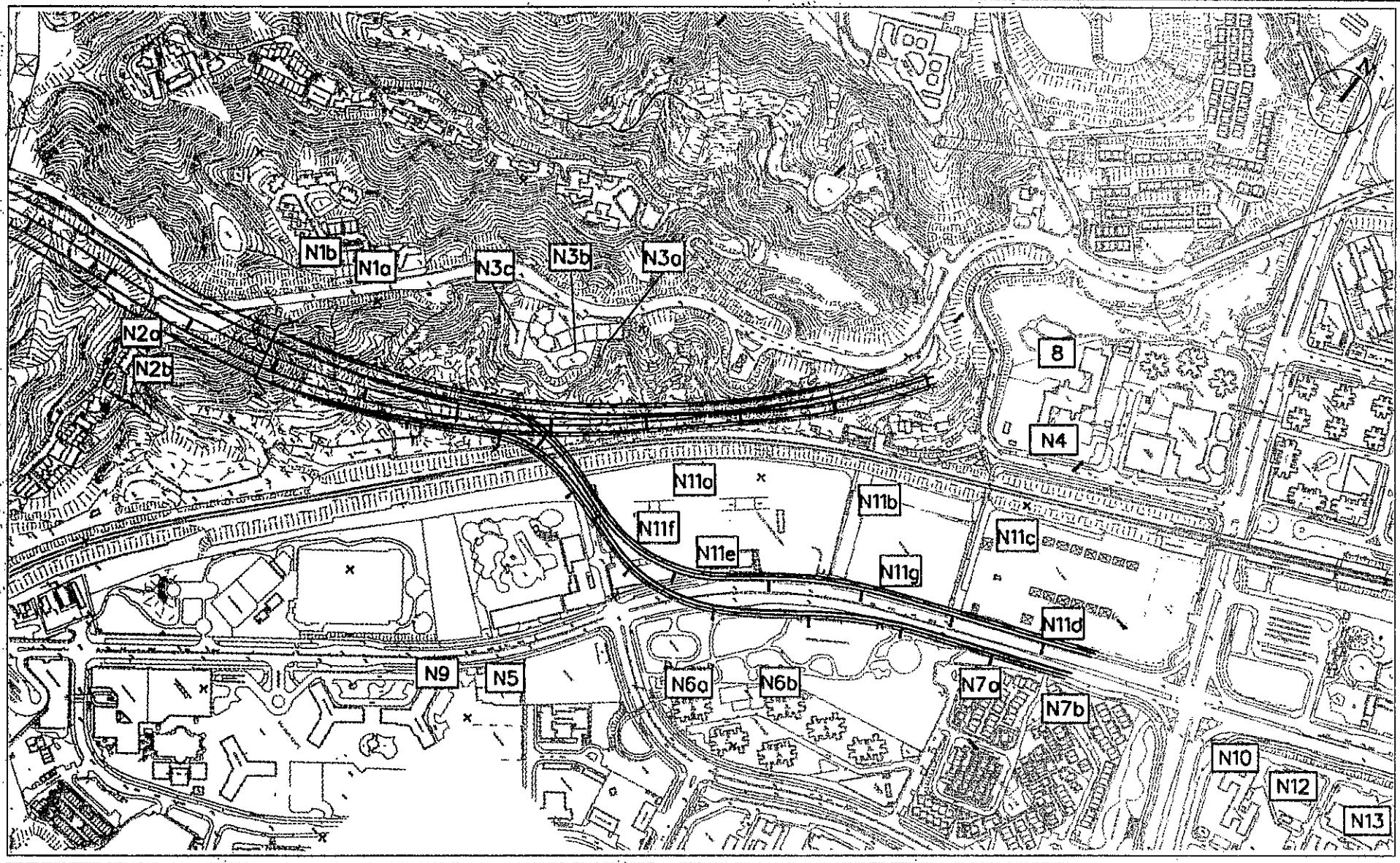

FIGURE 4.1b - LOCATIONS OF NOISE SENSITIVE RECEIVERS (SHATIN)

Date : Oct 97	Drawing No. /Contract/C1641/41b

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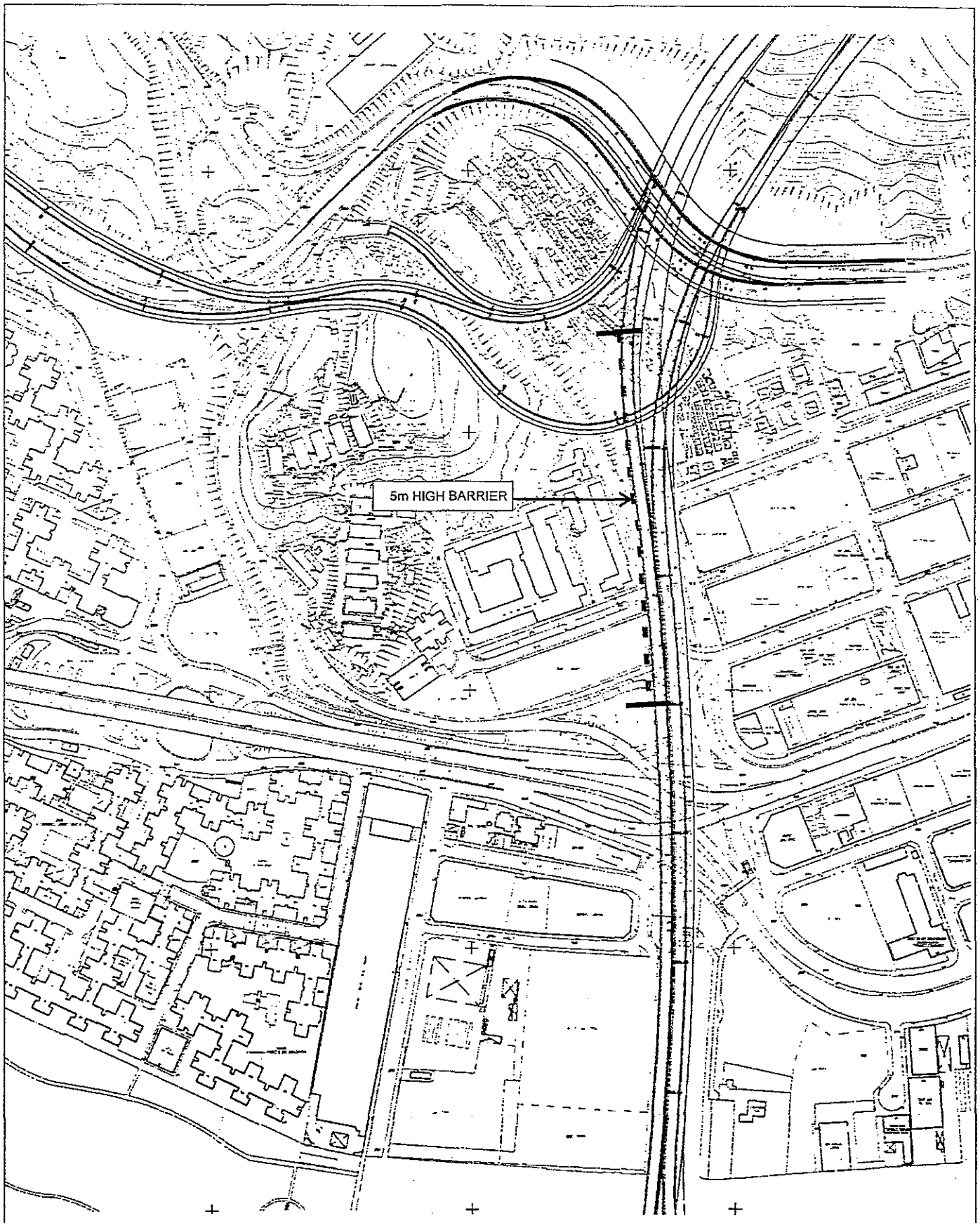

FIGURE 4.1c - LOCATION OF 5m HIGH ROADSIDE NOISE BARRIER (MITIGATION OPTION 2A)

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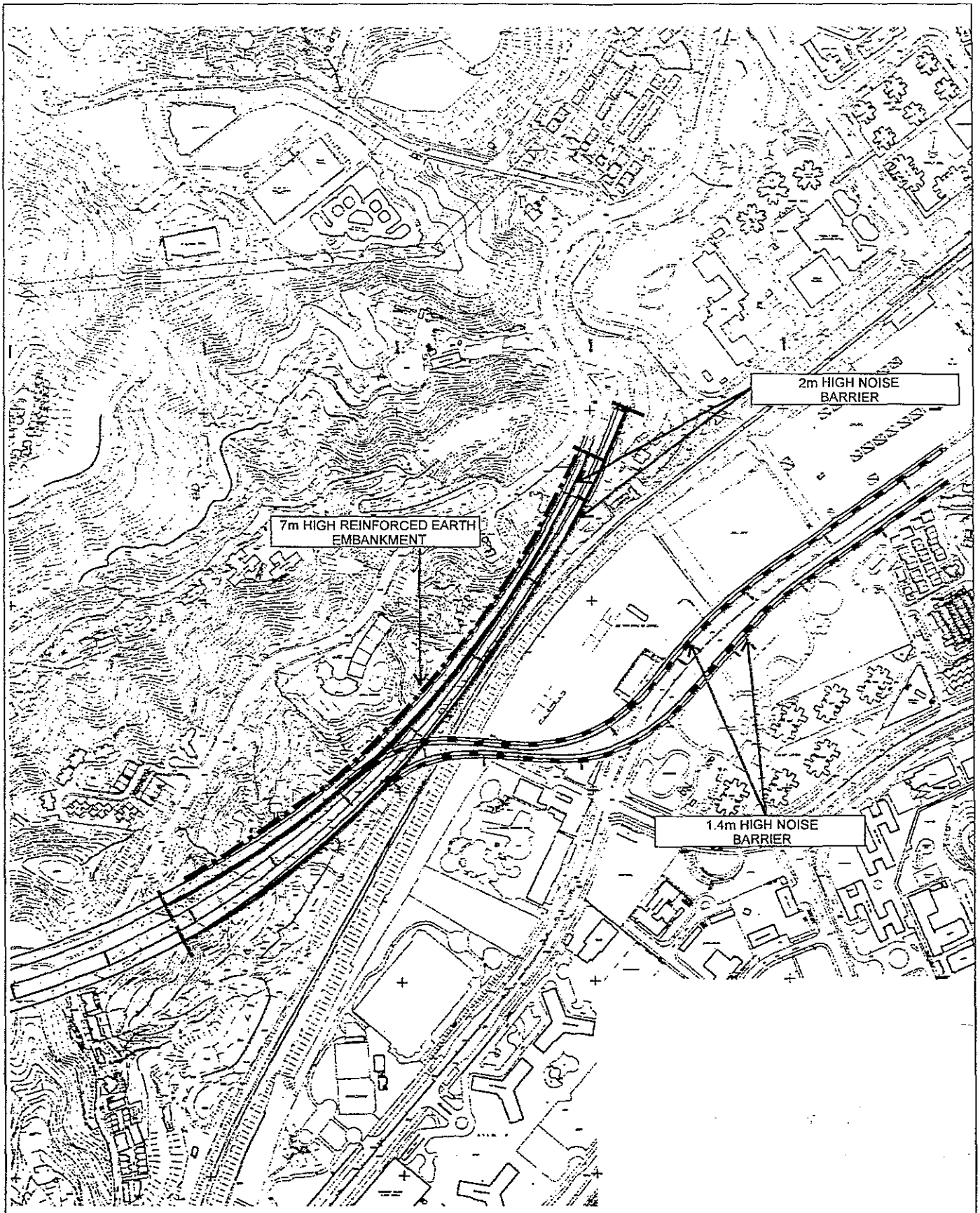

FIGURE 4.1d - LOCATION OF 1.4m + 2m (HIGH ROADSIDE NOISE OPTION 2B)

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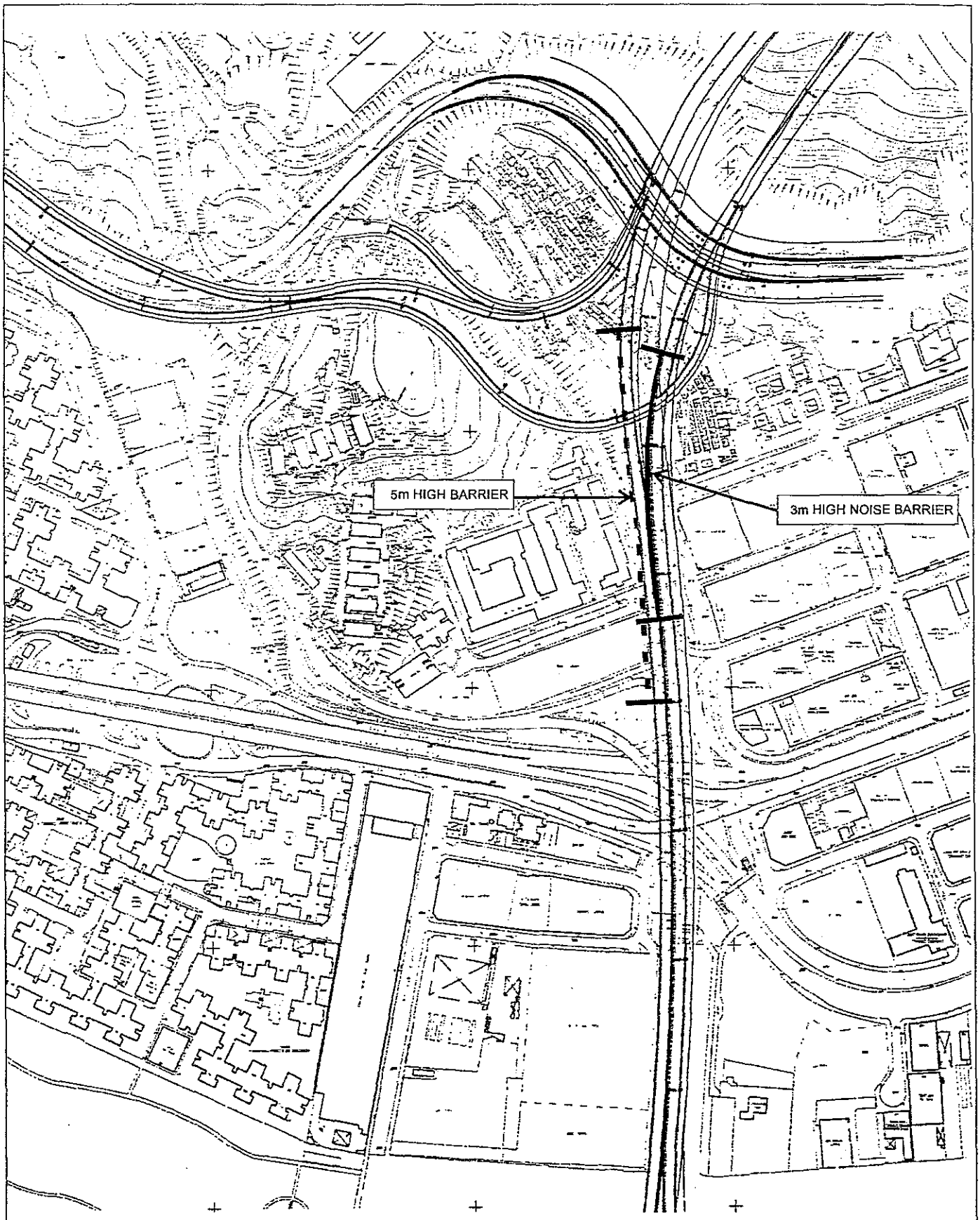

FIGURE 4.1e - LOCATION OF 3m + 5m ROADSIDE NOISE BARRIER
(MITIGATION OPTION 3A)

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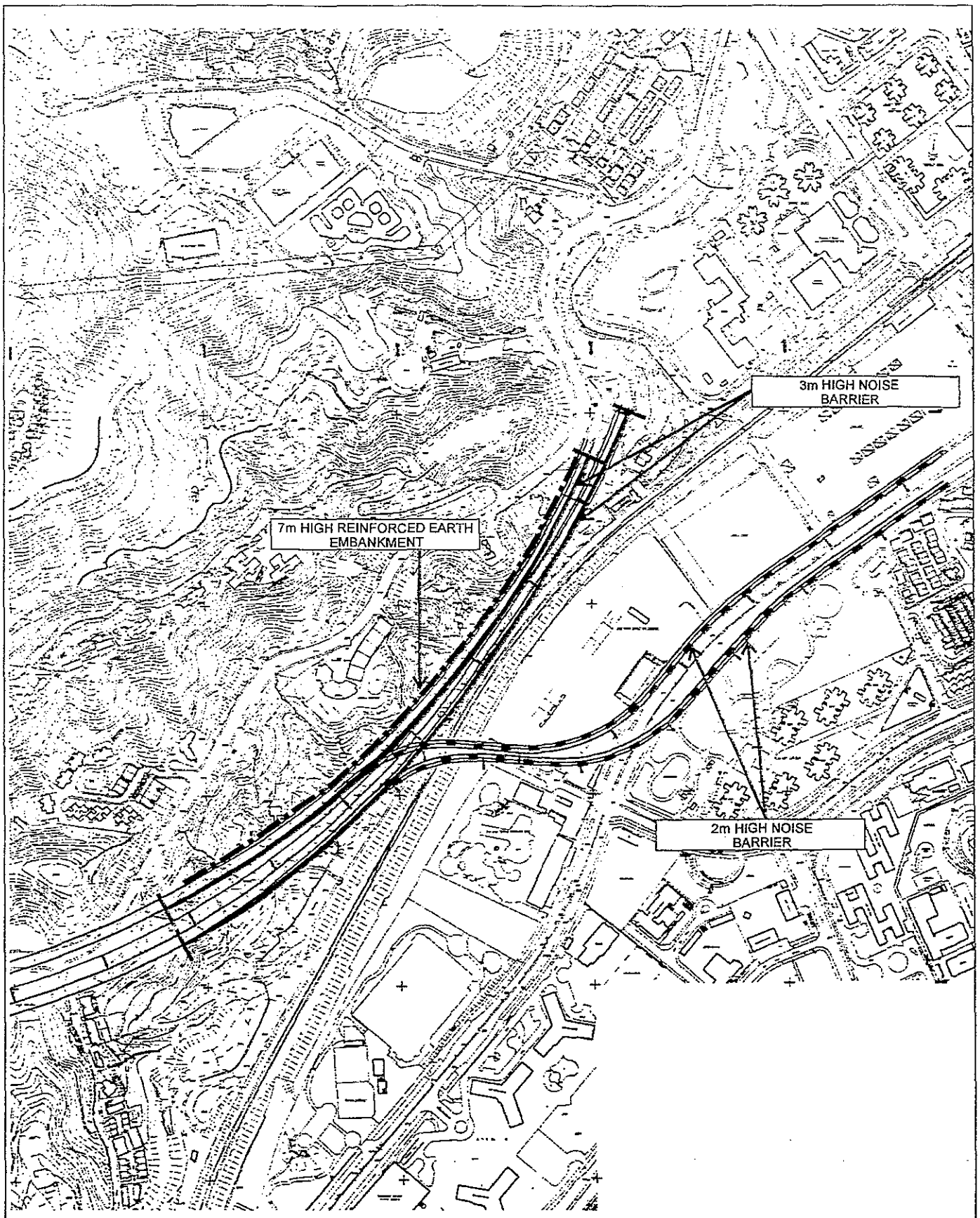

FIGURE 4.1f - LOCATION OF 2m + 3m (HIGH ROADSIDE NOISE OPTION 3B)

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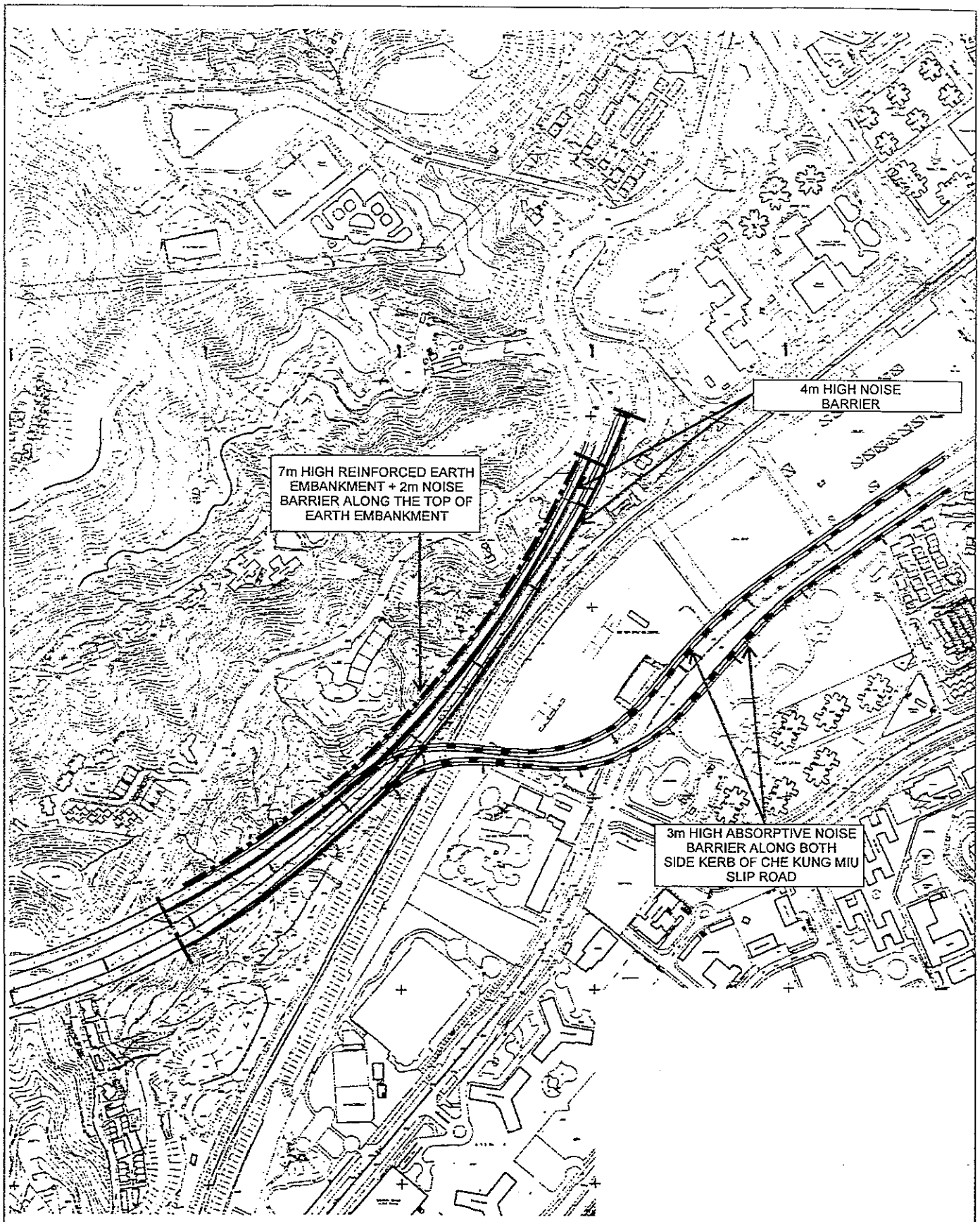

FIGURE 4.1g - LOCATION OF 3m + 4m (HIGH ROADSIDE NOISE OPTION 4)

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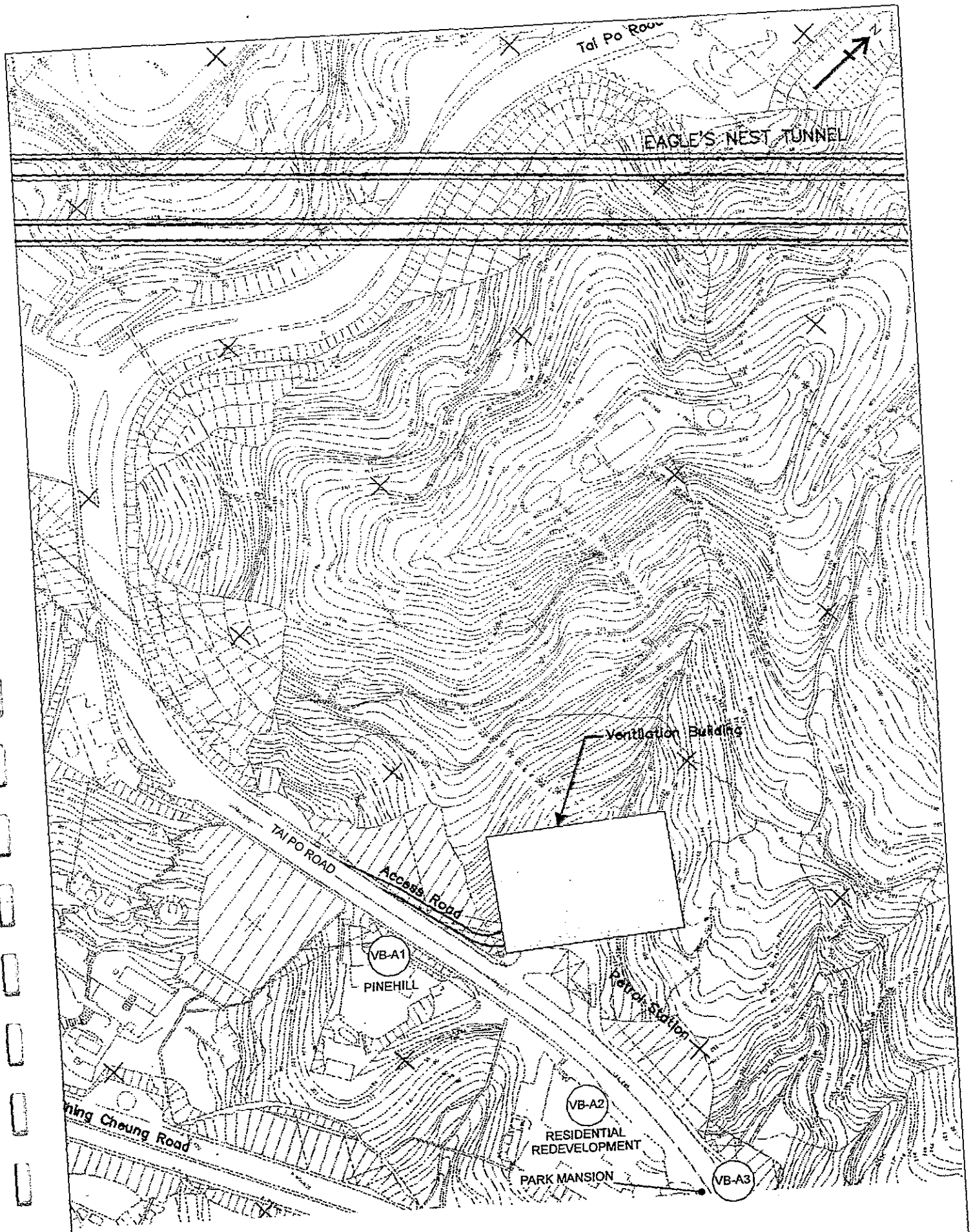

FIGURE 4.2a - LOCATION OF AIR SENSITIVE RECEIVER (VENTILATION BUILDING)

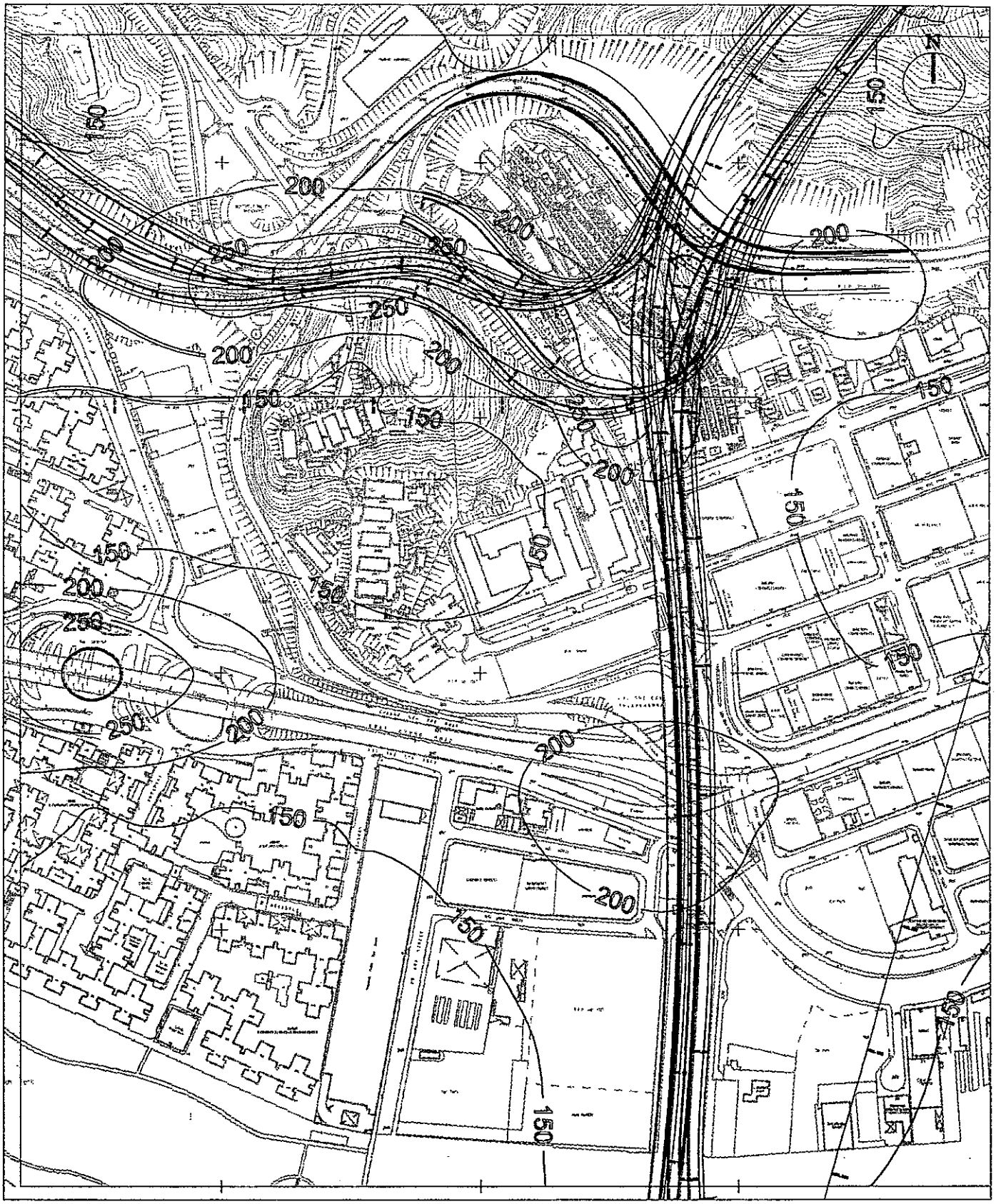

FIGURE 4.2b-1 ISOPLETHS OF NO2 AT ALIGNMENT LEVEL (WEST KOWLOON)

Date : Jan 98

Drawing No. /Contract/C1641/C1641_9

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KEY

AQO (hourly NO2): 300 $\mu g/m^3$

~300~ : NO2 Level in $\mu g/m^3$

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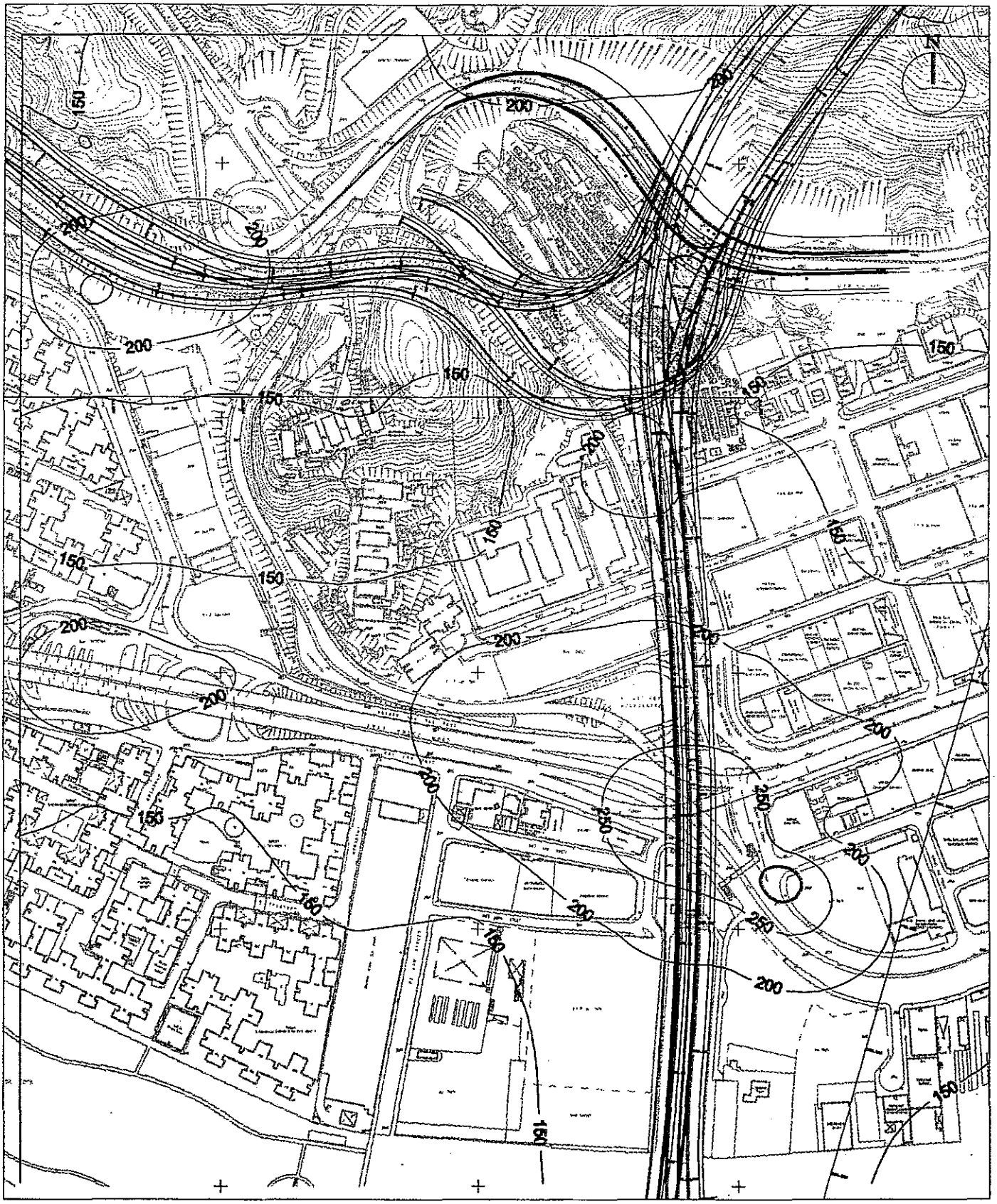

FIGURE 4.2b-2 ISOPLETHS OF NO2 AT GROUND LEVEL (WEST KOWLOON)

Date : Jan 98	Drawing No. /Contract/C1641/C1641_10

KEY

AQO (hourly NO2): 300 $\mu g/m^3$

~300~ : NO2 Level in $\mu g/m^3$

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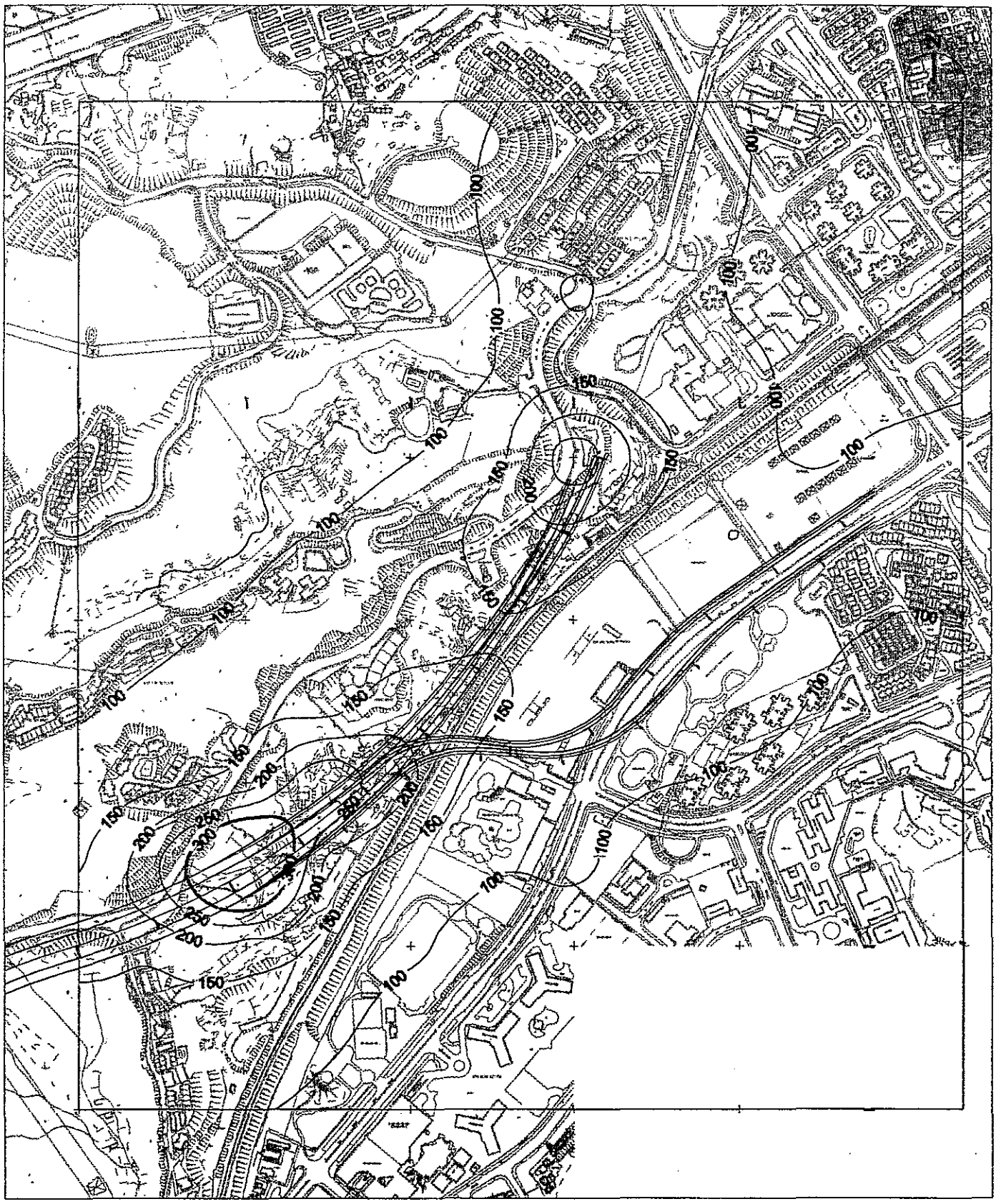

FIGURE 4.2c-1 ISOPLETH OF NO2 AT ALIGNMENT LEVEL (SHATIN)

Date : Jan 98

Drawing No. /Contract/C1641/C1641_7

Sources:

Prepared by ERM's GIS & MAPPING Group

KEY

AQO (hourly NO2): 300 $\mu g/m^3$

300 : NO2 Level in $\mu g/m^3$

ERM Hong Kong
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

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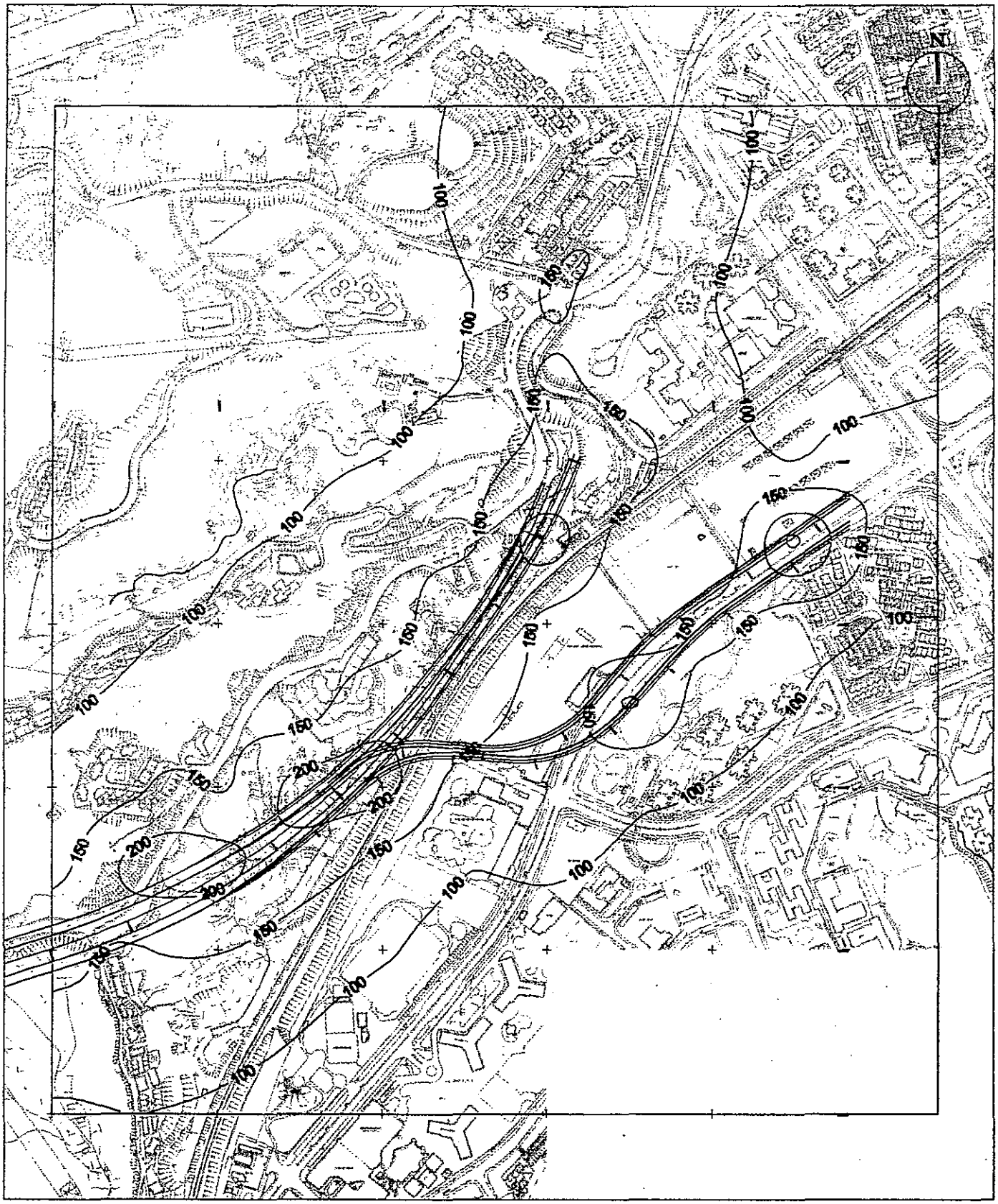

FIGURE 4.2c-2 ISOPLETH OF NO2 AT GROUND LEVEL (SHATIN)

Date : Jan 98	Drawing No. /Contract/C1641/C1641_8
Sources:	

Prepared by ERM's GIS & MAPPING Group

KEY
AQO (hourly NO2): 300 µg/m³
~300~ : NO2 Level in µg/m³

ERM Hong Kong
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

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5. ENVIRONMENTAL MONITORING & AUDIT

5.1 Introduction

This section presents a brief summary of the Environmental Monitoring and Audit (EM&A) requirements that have been included into the separate EM&A Manual for the Project. This Section describes the necessary EM&A requirements based on the findings of the assessment in the previous sections of this report. As discussed in *Sections 3 and 4*, construction noise and dust will lead to exceedance of environmental criteria and therefore EM&A at the affected sensitive receivers are recommended, as summarised below. The Manual also covers general audit requirements in relation to water quality, waste management, ecology and landscaping mitigation measures.

5.2 Objectives of Environmental Monitoring & Audit

The objectives of carrying out EM&A for the Project include the following:

- to provide a database against which any short or long term environmental impacts of the project can be determined;
- to provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards;
- to monitor the performance of the project and the effectiveness of mitigation measures;
- to verify the environmental impacts predicted in the EIA Study;
- to determine project compliance with regulatory requirements, standards and government policies;
- to take remedial action if unexpected problems or unacceptable impacts arise; and
- to provide data to enable an environmental audit.

The following sections summarises the recommended EM&A requirements proposed.

5.3 Construction Noise

Noise produced during the construction phase will impact upon nearby noise sensitive receivers (NSRs) as assessed in *Section 3.1*. The primary noise sources include bulldozer, excavators, dump trucks, breakers, rock drillers, loaders and rollers. The construction noise criteria of 75 dB(A) will be exceeded at some of the representative NSRs if construction noise is unmitigated.

It is anticipated that if the mitigation measures described in *Section 3.1.8* can be successfully applied, the noise levels experienced by the affected receivers will be reduced to within the noise criteria.

Noise monitoring requirements have been recommended in the EM&A Manual in order to ensure compliance with the criteria. Noise monitoring should be carried out at Lai Chi Kok Reception Centre Staff Quarters (WK-N3), Mei Foo Sun Chuen (Phase 6) (WK-N5), Lai Chi Kok Hospital (WK-N4), Pinehill (VB-N2), Lot 525 (TP-N1), Shatin Heights

(ST-N3), Ching Wing Chee College (ST-N4) and Tin Sam Tsuen (ST-N7) (see *Figures 3.1a to 3.1d)* and additional locations considered necessary, in agreement with the Environmental Protection Department (EPD).

5.4 Construction Dust

The construction work will inevitably lead to dust (total suspended particulates (TSP)) emissions, mainly from bulldozing, excavation, truck haulage, blasting and material handling activities. It is predicted that the dust generated will exceed the hourly criteria of 500 ug m^{-3} at some air sensitive receivers.

Mitigation measures are recommended in *Section 3.2.8* to limit the dust emission and dispersion. With proper dust control measures as part of good construction site practice, the TSP levels at the affected air sensitive receivers will comply with the dust criteria.

Dust monitoring requirements have been recommended in the EM&A Manual to ensure the efficacy of the control measures. Monitoring stations should be set up at the Lai Chi Kok Reception Centre (WK-A4), Lau Pak Lok Secondary School (ST-A4) and Ken Hau Village (ST-A1) (see *Figures 3.2a-b*), and additional locations considered necessary, in agreement with the Environmental Protection Department (EPD).

6. OVERALL CONCLUSION

This EIA Final Assessment Report has assessed the potential environmental impacts associated with the construction and operation of the proposed Route 16 Dual-3 Scheme, based on the previous Dual-2 Scheme endorsed alignment selected from a number of alternative alignment options, updating the information from the Previous EIA study. Environmental control and landscaping measures have been recommended for incorporation into the Preliminary Design as far as engineering and site constraints allowed to minimise potential environmental.

The findings of the report indicate that the proposed Route 16 development, with the recommended good housekeeping practice and mitigation measures, will comply with the Government environmental criteria. The environmental control requirements should be incorporated into the Contract Specifications of the Route 16 project. Table 6.1a presents the environmental implementation schedule of the Project. The recommended environmental monitoring and audit (EM&A) procedures will ensure the efficiency of the environmental control measures as detaled in the separate EM&A Manual.

Table 6.1a Environmental Mitigation Implementation Schedule

Location	Recommendation	Responsibilities	Timing
Within the works boundary	Environmental pollution control measures for minimizing construction impacts	HyD/Contractor	Within the construction period
All open new roads	Low noise road surface	HyD	Before completion of the road works
Opposite Lai Chi Kok Reception Centre Staff Quarters	5m high plain barrier on western side of northbound carriageway and 3m high absorptive barrier on western side of southbound carriageway	HyD	Before completion of the road works
Shatin main alignment - western sides of northbound carriageway	7m high reinforced earth embankments + 2m fence wall	HyD	Before completion of the road works
Shatin main alignment - western sides of southbound carriageway	7m high reinforced earth embankments	HyD	Before completion of the road works
Shatin main alignment - eastern sides of northbound and southbound carriageways	4m high plain barriers	HyD	Before completion of the road works
Che Kung Miu Road slip roads - both sides	3m high absorptive barriers	HyD	Before completion of the road works

Location	Recommendation	Responsibilities	Timing
Shatin Heights	Detailed Noise Insulation Works Study	HyD	Before the construction of Route 16
Eligible dwellings at Shatin Heights	Window insulation with air-conditioning	HyD	Before completion of the road works
Within the works boundary	Tree Survey	HyD	Before construction of Route 16
Within the project boundary at Pak Shek village area, Wai Man Tsuen area and area to the north of Butterfly Interchange	Woodland planting	HyD	After completion of Route 16
Proposed DSD maintenance Depot	Fresh air intakes outside the AQO exceedance region	PlanD/ArchSD	Before finalisation of Depot design.
Toll plaza and ventilation building	Design measures to reduce the area of landtaking	HyD	Detailed Design
Ventilation building	Design of ventilation building (including the use of silencer) to mitigate the noise impact	HyD	Detailed Design
Ventilation System	Design of ventilation system to maintain air quality within the tunnels in accordance with the Tunnel Air Quality Guidelines	HyD	Detailed Design
MOS Railway Depot CDA Site	Take account of traffic noise constraints and incorporate mitigation measures to design against road traffic noise	PlanD/Developer	Before finalisation of MOS Depot CDA design
Within the works boundary	Landscaping works	HyD	Before completion of the road works

Annex A

Plant Inventory

Table A1 - Plant Inventory (No mitigation measures)					
Sitework					
WEST KOWLOON WORK					
Preparatory Works	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Bulldozer	CNP030	2	115	118
	Excavator	CNP081	1	112	112
	Dump truck	CNP067	5	117	124
	Water pump	CNP281	1	88	88
				Area Total SWL	125
Portal construction	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator	CNP101	1	108	108
	Air compressor	CNP002	4	102	108
	Excavator	CNP081	1	112	112
	Vibrator	CNP170	3	113	118
	Lorry	CNP141	2	112	115
	Concrete pump	CNP047	1	109	109
	Concrete lorry mixer	CNP044	2	109	112
	Grader	CNP104	1	113	113
	Roller	CNP186	1	108	108
	Rock drill	CNP182	2	123	126
	Breaker	CNP 027	2	122	125
	Dump truck	CNP067	8	117	126
				Area Total SWL	131
LCK interchange	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
viaduct substructure	Excavator	CNP081	1	112	112
	Concrete lorry mixer	CNP044	2	109	112
	Concrete pump	CNP047	1	109	109
	Generator	CNP101	1	108	108
	Air compressor	CNP003	2	104	107
	Vibrator	CNP170	2	113	116
	Piling	CNP166	1	100	100
	Lorry	CNP141	2	112	115
	Mobile crane	CNP048	1	112	112
	Compactor	CNP050	1	105	105
				Area Total SWL	122
viaduct superstructure	mobile crane	CNP048	1	112	112
				Area Total SWL	112
LCK viaduct	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Excavator	CNP081	1	112	112
	Concrete lorry mixer	CNP044	2	109	112
	Concrete pump	CNP047	1	109	109
	Generator	CNP101	1	108	108
	Air compressor	CNP003	2	104	107
	Vibrator	CNP170	2	113	116
	Piling	CNP166	1	100	100
	Lorry	CNP141	2	112	115
	Mobile crane	CNP048	2	112	115
	compactor	CNP050	1	105	105
				Area Total SWL	122
Road pavement	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Road roller	CNP185	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry	CNP141	1	112	112
	Compactor	CNP050	2	105	108
	Ballast tamper	CNP029	2	105	108
				Area Total SWL	116

Table A1 - Plant Inventory (No mitigation measures)					
Sitework					
VENTILATION BUILDING	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Loading and unloading spoil	Loader	CNP081	2	112	115
	Lorry	CNP141	2	112	115
	Dump truck	CNP067	10	117	127
	Ventilation fan	CNP241	8	108	117
				Area Total SWL	128
ventilation building foundation	Dump truck	CNP067	10	117	127
	Concrete lorry mixer	CNP044	2	109	112
	Bentonite filtering plant	CNP162	1	105	105
	Piling	CNP166	1	100	100
	Excavator	CNP081	2	112	115
	Water pump	CNP282	5	88	95
				Area Total SWL	127
superstructure	Concrete pump	CNP081	2	112	115
	Mobile crane	CNP048	3	112	117
	Concrete lorry mixer	CNP081	2	112	115
				Area Total SWL	120

Table A1 - Plant Inventory (No mitigation measures)					
Sitework					
TOLL PLAZA AREA					
Earthwork excavation	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Bulldozer	CNP030	2	115	118
	Excavator	CNP081	1	112	112
	Dump truck	CNP067	10	117	127
	Water pump	CNP281	4	88	94
				Area Total SWL	128
Portal construction	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator	CNP101	3	108	113
	Air compressor	CNP003	3	104	109
	Excavator	CNP081	1	112	112
	Vibrator(Hand held)	CNP170	12	113	124
	Lorry	CNP141	2	112	115
	Concrete pump	CNP047	3	109	114
	Tower crane	CNP049	2	95	98
	Rock driller	CNP181	4	128	134
	Concrete lorry mixer	CNP044	4	109	115
	Mobile crane	CNP048	2	112	115
	Compactor	CNP050	2	105	108
	Grader	CNP104	1	113	113
	Piling	CNP166	4	100	106
	Ventilation fan	CNP241	8	108	117
				Area Total SWL	135
Loading and Unloading spoil	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Loader	CNP081	1	112	112
	Lorry	CNP141	2	112	115
	Dump truck	CNP067	10	117	127
				Area Total SWL	127
Road pavement	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Road roller	CNP185	1	108	108
	Roller	CNP186	2	108	111
	Asphalt paver	CNP004	1	109	109
	Lorry	CNP141	2	112	115
				Area Total SWL	118

Table A1 - Plant inventory (No mitigation measures)					
Sitework					
SHATIN WORKS					
Earthwork excavation	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Bulldozer	CNP030	2	115	118
	Excavator	CNP081	1	112	112
	Dump truck	CNP067	10	117	127
	Lorry	CNP141	2	112	115
				Area Total SWL	128
Slip road viaducts	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Substructure	Concrete lorry mixer	CNP044	2	109	112
	Concrete pump	CNP047	1	109	109
	Generator	CNP101	1	108	108
	Air compressor	CNP003	4	104	110
	Compactor	CNP050	2	105	108
	Vibrator(Hand held)	CNP170	3	113	118
	Lorry	CNP141	2	112	115
	Piling	CNP166	4	100	106
	Grader	CNP104	1	113	113
				Area Total SWL	122
Superstructure	Mobile crane	CNP048	2	112	115
				Area Total SWL	115
Road pavement	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Road roller	CNP185	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry	CNP141	2	112	115
	Roller	CNP186	2	108	111
	Ballast tamper	CNP029	2	105	108
				Area Total SWL	118
Tunnel portal	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator	CNP101	1	108	108
	Air compressor	CNP002	2	102	105
	Excavator	CNP081	1	112	112
	Vibrator(Hand held)	CNP170	3	113	118
	Breaker	CNP026	4	114	120
	Breaker	CNP027	2	122	125
	Concrete pump	CNP047	1	109	109
	Concrete lorry mixer	CNP044	2	109	112
				Area Total SWL	127
Loading and Unloading spoil	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Loader	CNP081	2	108	111
	Lorry	CNP141	6	100	108
	Dump truck	CNP067	8	112	121
	Ventilation fan	CNP241	8	113	122
				Area Total SWL	125

Table A2 - Plant Inventory (Mitigation measures 1 - using Quiet plant)					
Sitework					
WEST KOWLOON WORK					
Preparatory Works	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Bulldozer(QP)	CNP030	2	110	113
	Excavator(QP)	CNP081	1	105	105
	Dump truck(QP)	CNP067	5	109	116
	Water pump(QP)	CNP281	1	88	88
				Area Total SWL	118
	Noise Source	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Portal construction	Generator(QP)	CNP101	1	100	100
	Air compressor(QP)	CNP002	4	100	106
	Excavator(QP)	CNP081	1	105	105
	Vibrator(QP)	CNP170	3	110	115
	Lorry(QP)	CNP141	2	105	108
	Concrete pump(QP)	CNP047	1	105	105
	Concrete lorry mixer	CNP044	2	109	112
	Grader	CNP104	1	113	113
	Roller	CNP186	1	108	108
	Rock drill	CNP182	2	123	126
	Breaker(QP)	CNP 027	2	110	113
	Dump truck(QP)	CNP067	8	109	118
				Area Total SWL	128
	Noise Source	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
LCK interchange	Excavator(QP)	CNP081	1	105	105
viaduct substructure	Concrete lorry mixer	CNP044	2	109	112
	Concrete pump(QP)	CNP047	1	105	105
	Generator(QP)	CNP101	1	100	100
	Air compressor(QP)	CNP003	2	100	103
	Vibrator(QP)	CNP170	2	110	113
	Piling	CNP166	1	100	100
	Lorry(QP)	CNP141	2	105	108
	Mobile crane	CNP048	1	112	112
	Compactor	CNP050	1	105	105
				Area Total SWL	119
	mobile crane	CNP048	1	112	112
viaduct superstructure				Area Total SWL	112
	Noise Source	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
LCK viaduct	Excavator(QP)	CNP081	1	105	105
	Concrete lorry mixer	CNP044	2	109	112
	Concrete pump(QP)	CNP047	1	105	105
	Generator(QP)	CNP101	1	100	100
	Air compressor(QP)	CNP003	2	100	103
	Vibrator(QP)	CNP170	2	110	113
	Piling	CNP166	1	100	100
	Lorry(QP)	CNP141	2	105	108
	Mobile crane	CNP048	2	112	115
	compactor	CNP050	1	105	105
				Area Total SWL	119
	Noise Source	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Road pavement	Road roller	CNP185	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry(QP)	CNP141	1	105	105
	Compactor	CNP050	2	105	108
	Ballast tamper	CNP029	2	105	108
				Area Total SWL	115

Table A2 - Plant inventory (Mitigation measures 1 - using Quiet plant)					
Sitework					
VENTILATION BUILDING	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Loading and unloading spoil	Loader(QP)	CNP081	2	105	108
	Lorry(QP)	CNP141	2	105	108
	Dump truck(QP)	CNP067	10	109	119
	Ventilation fan	CNP241	8	108	117
				Area Total SWL	122
	Dump truck(QP)	CNP067	10	109	119
ventilation building foundation	Concrete lorry mixer	CNP044	2	109	112
	Bentonite filtering plant	CNP162	1	105	105
	Piling	CNP166	1	100	100
	Excavator(QP)	CNP081	2	105	108
	Water pump(QP)	CNP282	5	88	95
				Area Total SWL	120
	Concrete pump(QP)	CNP081	2	105	108
superstructure	Mobile crane	CNP141	3	112	117
	Concrete lorry mixer	CNP081	2	112	115
				Area Total SWL	119

Table A2 - Plant Inventory (Mitigation measures 1 - using Quiet plant)					
Sitework					
TOLL PLAZA AREA					
Earthwork excavation	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Bulldozer(QP)	CNP030	2	110	113
	Excavator(QP)	CNP081	1	105	105
	Dump truck(QP)	CNP067	10	109	119
	Water pump(QP)	CNP281	4	88	94
				Area Total SWL	120
	Noise Source	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Portal construction	Generator(QP)	CNP101	3	100	105
	Air compressor(QP)	CNP003	3	100	105
	Excavator(QP)	CNP081	1	105	105
	Vibrator(Hand held)	CNP170	12	110	121
	Lorry(QP)	CNP141	2	105	108
	Concrete pump(QP)	CNP047	3	105	110
	Tower crane	CNP049	2	95	98
	Rock driller	CNP181	4	128	134
	Concrete lorry mixer	CNP044	4	109	115
	Mobile crane	CNP048	2	112	115
	Compactor	CNP050	2	105	108
	Grader	CNP104	1	113	113
	Piling	CNP166	4	100	106
	ventilation fan	CNP241	8	108	117
				Area Total SWL	134
	Noise Source	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Loading and Unloading spoil	Loader(QP)	CNP081	1	105	105
	Lorry(QP)	CNP141	2	105	108
	Dump truck(QP)	CNP067	10	109	119
				Area Total SWL	119
	Noise Source	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Road pavement	Road roller	CNP185	1	108	108
	Roller	CNP186	2	108	111
	Asphalt paver	CNP004	1	109	109
	Lorry(QP)	CNP141	2	105	108
				Area Total SWL	115

Table A2 - Plant Inventory (Mitigation measures 1 - using Quiet plant)					
Sitework					
SHATIN WORKS					
Earthwork excavation	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Bulldozer(QP)	CNP030	2	110	113
	Excavator(QP)	CNP081	1	105	105
	Dump truck(QP)	CNP067	10	109	119
	Lorry(QP)	CNP141	2	105	108
				Area Total SWL	120
Slip road viaducts	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Substructure	Concrete lorry mixer	CNP044	2	109	112
	Concrete pump(QP)	CNP047	1	105	105
	Generator(QP)	CNP101	1	100	100
	Air compressor(QP)	CNP003	4	100	106
	Compactor	CNP050	2	105	108
	Vibrator(Hand held)	CNP170	3	110	115
	Lorry(QP)	CNP141	2	105	108
	Piling	CNP166	4	100	106
	Grader	CNP104	1	113	113
				Area Total SWL	120
Superstructure	Mobile crane	CNP048	2	112	115
				Area Total SWL	115
Road pavement	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Road roller	CNP185	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry(QP)	CNP141	2	105	108
	Roller	CNP186	2	108	111
	Ballast tamper	CNP029	2	105	108
				Area Total SWL	116
Tunnel portal	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator(QP)	CNP101	1	100	100
	Air compressor(QP)	CNP002	2	100	103
	Excavator(QP)	CNP081	1	105	105
	Vibrator(Hand held)	CNP170	3	110	115
	Breaker(QP)	CNP026	4	110	116
	Breaker	CNP027	2	122	125
	Concrete pump(QP)	CNP047	1	105	105
	Concrete lorry mixer	CNP044	2	109	112
				Area Total SWL	126
Loading and Unloading spoil	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Loader(QP)	CNP081	2	105	108
	Lorry(QP)	CNP141	6	105	113
	Dump truck(QP)	CNP067	8	109	118
	Ventilation fan	CNP241	8	113	122
				Area Total SWL	124

Table A3 - Plant Inventory (Mitigation measures 2 - use of quiet plant & limiting the no. of pl					
Sitework					
WEST KOWLOON WORK					
Preparatory Works	Noise Source	Ref. No.	No.	SWL/unit	sub-SWL
	Bulldozer (QP)	CNP030	1	110	110
	Excavator (QP)	CNP081	1	105	105
	Dump truck (QP)	CNP067	2	109	112
	Water pump (QP)	CNP281	1	88	88
				Area Total SWL	115
	Noise Source	Ref. No.	No.	SWL/unit	sub-SWL
Portal construction	Generator (QP)	CNP101	1	100	100
	Air compressor (QP)	CNP002	2	100	103
	Excavator (QP)	CNP081	1	105	105
	Vibrator (QP)	CNP170	1	110	110
	Lorry (QP)	CNP141	1	105	105
	Concrete pump (QP)	CNP047	1	105	105
	Concrete lorry mixer	CNP044	1	109	109
	Grader	CNP104	1	113	113
	Roller	CNP186	1	108	108
	Rock drill	CNP182	1	123	123
	Breaker (QP)	CNP 027	1	110	110
	Dump truck (QP)	CNP067	4	109	115
				Area Total SWL	125
	Noise Source	Ref. No.	No.	SWL/unit	sub-SWL
LCK interchange	Excavator (QP)	CNP081	1	105	105
viaduct substructure	Concrete lorry mixer	CNP044	1	109	109
	Concrete pump (QP)	CNP047	1	105	105
	Generator (QP)	CNP101	1	100	100
	Air compressor (QP)	CNP003	1	100	100
	Vibrator (QP)	CNP170	1	110	110
	Piling	CNP166	1	100	100
	Lorry (QP)	CNP141	1	105	105
	Mobile crane	CNP048	1	112	112
	Compactor	CNP050	1	105	105
				Area Total SWL	117
	mobile crane	CNP048	1	112	112
viaduct superstructure				Area Total SWL	112
	Noise Source	Ref. No.	No.	SWL/unit	sub-SWL
LCK viaduct	Excavator (QP)	CNP081	1	105	105
	Concrete lorry mixer	CNP044	1	109	109
	Concrete pump (QP)	CNP047	1	105	105
	Generator (QP)	CNP101	1	100	100
	Air compressor (QP)	CNP003	1	100	100
	Vibrator (QP)	CNP170	1	110	110
	Piling	CNP166	1	100	100
	Lorry (QP)	CNP141	1	105	105
	Mobile crane	CNP048	1	112	112
	compactor	CNP050	1	105	105
				Area Total SWL	117
	Noise Source	Ref. No.	No.	SWL/unit	sub-SWL
Road pavement	Road roller	CNP185	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry (QP)	CNP141	1	105	105
	Compactor	CNP050	1	105	105
	Ballast tamper	CNP029	1	105	105
				Area Total SWL	114

Table A3 - Plant Inventory (Mitigation measures 2 - use of quiet plant & limiting the no. of pl					
Sitework					
VENTILATION BUILDING					
Loading and unloading spoil	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Loader (QP)	CNP081	1	105	105
	Lorry (QP)	CNP141	1	105	105
	Dump truck (QP)	CNP067	5	109	116
	Ventilation fan	CNP241	4	108	114
				Area Total SWL	119
	Dump truck (QP)	CNP067	5	109	116
ventilation building foundation	Concrete lorry mixer	CNP044	1	109	109
	Bentonite filtering plant	CNP162	1	105	105
	Piling	CNP166	1	100	100
	Excavator (QP)	CNP081	1	105	105
	Water pump (QP)	CNP282	2	88	91
				Area Total SWL	117
	Concrete pump (QP)	CNP081	1	105	105
superstructure	Mobile crane	CNP141	1	112	112
	Concrete lorry mixer	CNP081	1	112	112
				Area Total SWL	115

Table A3 - Plant Inventory (Mitigation measures 2 - use of quiet plant & limiting the no. of pl					
Sitework					
TOLL PLAZA AREA					
Earthwork excavation	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Bulldozer (QP)	CNP030	1	110	110
	Excavator (QP)	CNP081	1	105	105
	Dump truck (QP)	CNP067	5	109	116
	Water pump (QP)	CNP281	2	88	91
				Area Total SWL	117
	Noise Source	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Portal construction	Generator (QP)	CNP101	1	100	100
	Air compressor (QP)	CNP003	1	100	100
	Excavator (QP)	CNP081	1	105	105
	Vibrator(Hand held)	CNP170	6	110	118
	Lorry (QP)	CNP141	1	105	105
	Concrete pump (QP)	CNP047	1	105	105
	Tower crane	CNP049	1	95	95
	Rock driller	CNP181	2	128	131
	Concrete lorry mixer	CNP044	2	109	112
	Mobile crane	CNP048	1	112	112
	Compactor	CNP050	1	105	105
	Grader	CNP104	1	113	113
	Piling	CNP166	2	100	103
	ventilation fan	CNP241	4	108	114
				Area Total SWL	132
	Noise Source	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Loading and Unloading spoil	Loader (QP)	CNP081	1	105	105
	Lorry (QP)	CNP141	1	105	105
	Dump truck (QP)	CNP067	5	109	116
				Area Total SWL	117
	Noise Source	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Road pavement	Road roller	CNP185	1	108	108
	Roller	CNP186	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry (QP)	CNP141	1	105	105
				Area Total SWL	114

Table A3 - Plant Inventory (Mitigation measures 2 - use of quiet plant & limiting the no. of pl					
Sitework					
SHATIN WORKS					
Earthwork excavation	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Bulldozer (QP)	CNP030	2	110	113
	Excavator (QP)	CNP081	1	105	105
	Dump truck (QP)	CNP067	5	109	116
	Lorry (QP)	CNP141	2	105	108
				Area Total SWL	118
Slip road viaducts	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
Substructure	Concrete lorry mixer	CNP044	1	109	109
	Concrete pump (QP)	CNP047	1	105	105
	Generator (QP)	CNP101	1	100	100
	Air compressor (QP)	CNP003	2	100	103
	Compactor	CNP050	1	105	105
	Vibrator(Hand held)	CNP170	1	110	110
	Lorry (QP)	CNP141	2	105	108
	Piling	CNP166	1	100	100
	Grader	CNP104	1	113	113
				Area Total SWL	117
Superstructure	Mobile crane	CNP048	1	112	112
				Area Total SWL	112
Road pavement	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Road roller	CNP185	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry (QP)	CNP141	1	105	105
	Roller	CNP186	1	108	108
	Ballast tamper	CNP029	1	105	105
				Area Total SWL	114
Tunnel portal	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator (QP)	CNP101	1	100	100
	Air compressor (QP)	CNP002	1	100	100
	Excavator (QP)	CNP081	1	105	105
	Vibrator(Hand held)	CNP170	3	110	115
	Breaker (QP)	CNP026	2	110	113
	Breaker	CNP027	1	122	122
	Concrete pump (QP)	CNP047	1	105	105
	Concrete lorry mixer	CNP044	1	109	109
				Area Total SWL	124
Loading and Unloading spoil	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Loader (QP)	CNP081	1	105	105
	Lorry (QP)	CNP141	3	105	110
	Dump truck (QP)	CNP067	4	109	115
	Ventilation fan	CNP241	4	113	119
				Area Total SWL	121

Table A4 - Plant inventory (Mitigation measures 3 - using Quiet plant, limiting the no. of plant & movable barrier)						
Sitework						
WEST KOWLOON WORK						
Preparatory Works	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**Barrier Atten.**	**sub-SWL**
	Bulldozer(QP)	CNP030	1	110	5	105
	Excavator(QP)	CNP081	1	105	5	100
	Dump truck(QP)	CNP067	2	109	0	112
	Water pump(QP)	CNP281	1	88	10	78
					Area Total SWL	113
Portal construction	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**Barrier Atten.**	**sub-SWL**
	Generator(QP)	CNP101	1	100	10	90
	Air compressor(QP)	CNP002	2	100	10	93
	Excavator(QP)	CNP081	1	105	5	100
	Vibrator(QP)	CNP170	1	110	10	100
	Lorry(QP)	CNP141	1	105	0	105
	Concrete pump(QP)	CNP047	1	105	10	95
	Concrete lorry mixer	CNP044	1	109	5	104
	Grader	CNP104	1	113	0	113
	Roller	CNP186	1	108	5	103
	Rock drill	CNP182	1	123	5	118
	Breaker(QP)	CNP 027	1	110	5	105
	Dump truck(QP)	CNP067	4	109	0	115
					Area Total SWL	121
LCK interchange	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**Barrier Atten.**	**sub-SWL**
viaduct substructure	Excavator(QP)	CNP081	1	105	5	100
	Concrete lorry mixer	CNP044	1	109	0	109
	Concrete pump(QP)	CNP047	1	105	10	95
	Generator(QP)	CNP101	1	100	10	90
	Air compressor(QP)	CNP003	1	100	10	90
	Vibrator(QP)	CNP170	1	110	10	100
	Piling	CNP166	1	100	0	100
	Lorry(QP)	CNP141	1	105	0	105
	Mobile crane	CNP048	1	112	5	107
	Compactor	CNP050	1	105	5	100
					Area Total SWL	113
viaduct superstructure	mobile crane	CNP048	1	112	5	107
					Area Total SWL	107
LCK viaduct	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**Barrier Atten.**	**sub-SWL**
	Excavator(QP)	CNP081	1	105	5	100
	Concrete lorry mixer	CNP044	1	109	0	109
	Concrete pump(QP)	CNP047	1	105	10	95
	Generator(QP)	CNP101	1	100	10	90
	Air compressor(QP)	CNP003	1	100	10	90
	Vibrator(QP)	CNP170	1	110	10	100
	Piling	CNP166	1	100	0	100
	Lorry(QP)	CNP141	1	105	0	105
	Mobile crane	CNP048	1	112	5	107
	compactor	CNP050	1	105	5	100
					Area Total SWL	113
Road pavement	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**Barrier Atten.**	**sub-SWL**
	Road roller	CNP185	1	108	5	103
	Asphalt paver	CNP004	1	109	0	109
	Lorry(QP)	CNP141	1	105	0	105
	Compactor	CNP050	1	105	0	105
	Ballast tamper	CNP029	1	105	0	105
					Area Total SWL	113

Table A4 - Plant Inventory (Mitigation measures 3 - using Quiet plant, limiting the no. of plant & movable barrier)						
Sitework						
VENTILATION BUILDING						
Loading and unloading spoil	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**Barrier Atten.**	**sub-SWL**
	Loader(QP)	CNP081	1	105	0	105
	Lorry(QP)	CNP141	1	105	0	105
	Dump truck(QP)	CNP067	5	109	0	116
	Ventilation fan	CNP241	4	108	0	114
					Area Total SWL	119
ventilation building foundation	Dump truck(QP)	CNP067	5	109	0	116
	Concrete lorry mixer	CNP044	1	109	0	109
	Bentonite filtering plant	CNP162	1	105	0	105
	Piling	CNP166	1	100	0	100
	Excavator(QP)	CNP081	1	105	5	100
	Water pump(QP)	CNP282	2	88	10	81
					Area Total SWL	117
superstructure	Concrete pump(QP)	CNP081	1	105	10	95
	Mobile crane	CNP141	1	112	5	107
	Concrete lorry mixer	CNP081	1	112	0	112
					Area Total SWL	113

Table A4 - Plant Inventory (Mitigation measures 3 - using Quiet plant, limiting the no. of plant & movable barrier)						
Sitework						
TOLL PLAZA AREA						
Earthwork excavation	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten.	sub-SWL
	Bulldozer(QP)	CNP030	1	110	5	105
	Excavator(QP)	CNP081	1	105	5	100
	Dump truck(QP)	CNP067	5	109	5	111
	Water pump(QP)	CNP281	2	88	5	86
					Area Total SWL	112
Portal construction	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten.	sub-SWL
	Generator(QP)	CNP101	1	100	10	90
	Air compressor(QP)	CNP003	1	100	10	90
	Excavator(QP)	CNP081	1	105	5	100
	Vibrator(Hand held)	CNP170	6	110	10	108
	Lorry(QP)	CNP141	1	105	5	100
	Concrete pump(QP)	CNP047	1	105	10	95
	Tower crane	CNP049	1	95	5	90
	Rock driller	CNP181	2	128	5	126
	Concrete lorry mixer	CNP044	2	109	5	107
	Mobile crane	CNP048	1	112	5	107
	Compactor	CNP050	1	105	5	100
	Grader	CNP104	1	113	5	108
	Piling	CNP166	2	100	5	98
	ventilation fan	CNP241	4	108	0	114
					Area Total SWL	127
Loading and Unloading spoil	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten.	sub-SWL
	Loader(QP)	CNP081	1	105	5	100
	Lorry(QP)	CNP141	1	105	5	100
	Dump truck(QP)	CNP067	5	109	5	111
					Area Total SWL	112
Road pavement	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten.	sub-SWL
	Road roller	CNP185	1	108	5	103
	Roller	CNP186	1	108	5	103
	Asphalt paver	CNP004	1	109	5	104
	Lorry(QP)	CNP141	1	105	5	100
					Area Total SWL	109

Table A4 - Plant inventory (Mitigation measures 3 - using Quiet plant, limiting the no. of						
plant & movable barrier)						
Sitework						
SHATIN WORKS						
Earthwork excavation	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten.	sub-SWL
	Bulldozer(QP)	CNP030	2	110	5	108
	Excavator(QP)	CNP081	1	105	5	100
	Dump truck(QP)	CNP067	5	109	0	116
	Lorry(QP)	CNP141	2	105	0	108
					Area Total SWL	117
Slip road viaducts	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten.	sub-SWL
Substructure	Concrete lorry mixer	CNP044	2	109	5	107
	Concrete pump(QP)	CNP047	1	105	10	95
	Generator(QP)	CNP101	1	100	10	90
	Air compressor(QP)	CNP003	2	100	10	93
	Compactor	CNP050	1	105	5	100
	Vibrator(Hand held)	CNP170	3	110	10	105
	Lorry(QP)	CNP141	2	105	0	108
	Piling	CNP166	2	100	0	103
	Grader	CNP104	1	113	0	113
					Area Total SWL	116
Superstructure	Mobile crane	CNP048	1	112	5	107
					Area Total SWL	107
Road pavement	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten.	sub-SWL
	Road roller	CNP185	1	108	5	103
	Asphalt paver	CNP004	1	109	0	109
	Lorry(QP)	CNP141	1	105	0	105
	Roller	CNP186	1	108	5	103
	Ballast tamper	CNP029	1	105	0	105
					Area Total SWL	113
Tunnel portal	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten.	sub-SWL
	Generator(QP)	CNP101	1	100	10	90
	Air compressor(QP)	CNP002	1	100	10	90
	Excavator(QP)	CNP081	1	105	5	100
	Vibrator(Hand held)	CNP170	3	110	10	105
	Breaker(QP)	CNP026	2	110	5	108
	Breaker	CNP027	1	122	5	117
	Concrete pump(QP)	CNP047	1	105	10	95
	Concrete lorry mixer	CNP044	1	109	5	104
					Area Total SWL	118
Loading and Unloading spoil	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten.	sub-SWL
	Loader(QP)	CNP081	1	105	5	100
	Lorry(QP)	CNP141	3	105	0	110
	Dump truck(QP)	CNP067	2	109	0	112
	Ventilation fan	CNP241	4	113	0	119
					Area Total SWL	120

Annex B

Detailed Calculations of Construction Noise

Table B1 - Predicted Noise Levels (No mitigation measures)

								Distance (m)								
			Haking Wong TT	Mei Foo Sun Tsuen (blk 113)	Mei Foo Sun Chuen (blk 9)	LCK reception centre	LCK hospital	Haking Wong TT	Mei Foo Sun Tsuen (blk 113)	Mei Foo Sun Chuen (blk 9)	LCK reception centre	LCK hospital				
	WEST KOWLOON WORK	SWL	WK - N1	WK - N2	WK - N5	WK - N3	WK - N4	WK - N1	WK - N2	WK - N5	WK - N3	WK - N4				
construction activity	***No Mitigation measure***															
a	Preparatory works/earthwork excavation	125	#VALUE!	#VALUE!	#VALUE!	82	#VALUE!	-	-	-	80	-				
b	Portal construction	131	#VALUE!	#VALUE!	#VALUE!	80	#VALUE!	-	-	-	200	-				
c	LCK interchange - viaduct substructure	122	#VALUE!	#VALUE!	82	93	77	-	-	55	15	90				
d	LCK interchange - viaduct superstructure	112	#VALUE!	#VALUE!	72	83	68	-	-	55	15	90				
e	LCK viaduct	122	73	68	#VALUE!	93	#VALUE!	155	270	-	15	-				
f	Road pavement	116	68	63	77	88	72	155	270	55	15	90				

							Distance (m)									
			Bamboo Villa	Pinehill	Park Mansion	Residential	Bamboo Villa	Pinehill	Park Mansion	Residential						
	VENTILATION BUILDING	SWL	VB-N1	VB - N2	VB - N3	VB - N4	VB-N1	VB - N2	VB - N3	VB - N4						
construction activity	***No Mitigation measure***															
a	Loading and unloading spoil	128	71	78	68	75	400	180	550	250						
b	Ventilation building foundation	127	70	77	68	74	400	180	550	250						
c	Superstructure	120	63	70	61	67	400	180	550	250						

					Distance (m)											
			Lot 525	Lot 561	Lot 525	Lot 561										
	TOLL PLAZA AREA	SWL	TP - N1	TP N2	TP - N1	TP N2										
construction activity	***No Mitigation measure***															
a	Earthwork excavation	128	86	78	65	175										
b	Loading and unloading spoil	127	96	82	20	100										
c	Road pavement	118	76	68	65	175										
d	Portal construction	135	79	84	110	190										

									Distance (m)							
			Woodcrest Hill	Keng Hau Road	Shatin Heights	CWG college	Tin Sam Tsuen	Carado Garden	CAL school	Woodcrest Hill	Keng Hau Road	Shatin Heights	CWG college	Tin Sam Tsuen	Carado Garden	CAL school
	SHATIN WORKS	SWL	ST - N1	ST - N2	ST - N3	ST - N4	ST - N7	ST - N6	ST - N5	ST - N1	ST - N2	ST - N3	ST - N4	ST - N7	ST - N6	ST - N5
construction activity	***No Mitigation measure***															
a	Earth excavation	128	83	76	87	78	#VALUE!	#VALUE!	#VALUE!	100	210	60	185	-	-	-
b	slip road viaducts - substructure	122	#VALUE!	#VALUE!	76	69	97	80	72	-	-	110	250	10	75	170
c	slip road viaducts - superstructure	115	#VALUE!	#VALUE!	69	62	90	73	65	-	-	110	250	10	75	170
d	Road pavement	118	73	67	76	68	93	76	69	100	210	60	185	10	75	170
d	Loading and unloading spoil	125	80	78	70	#VALUE!	#VALUE!	#VALUE!	#VALUE!	100	130	300	-	-	-	-
e	Tunnel portal	127	72	80	73	#VALUE!	#VALUE!	#VALUE!	#VALUE!	100	130	300	-	-	-	-

Table B2 - Predicted Noise Levels (use of quiet plant)

								Distance (m)				
			Haking Wong TT	Mei Foo Sun Tsuen (blk 110)	Mei Foo Sun Chuen (blk 9)	LCK reception centre	LCK hospital	Haking Wong TT	Mei Foo Sun Tsuen (blk 110)	Mei Foo Sun Chuen (blk 9)	LCK reception centre	LCK hospital
	WEST KOWLOON WORK - Site C	**SWL**	WK - N1	WK - N2	WK - N5	WK - N3	WK - N4	WK - N1	WK - N2	WK - N5	WK - N3	WK - N4
Site work	***Mitigation measure 1***											
m	Preparatory works	118	#VALUE!	#VALUE!	#VALUE!	75	#VALUE!	-	-	-	80	-
	Portal construction	128	#VALUE!	#VALUE!	#VALUE!	77	#VALUE!	-	-	-	200	-
n	LCK interchange - viaduct substructure	119	#VALUE!	#VALUE!	79	90	74	-	-	55	15	90
o	LCK interchange - viaduct superstructure	112	#VALUE!	#VALUE!	72	83	68	-	-	55	15	90
p	LCK viaduct	119	71	66	#VALUE!	91	#VALUE!	155	270	-	15	-
q	Road pavement	115	66	61	75	86	71	155	270	55	15	90

							Distance (m)			
			Bamboo Villa	Pinehill	Park Mansion	Residential	Bamboo Villa	Pinehill	Park Mansion	Residentia l
	VENTILATION BUILDING - Site D	**SWL**	VB-N1	VB - N2	VB - N3	VB - N4	VB-N1	VB - N2	VB - N3	VB - N4
Site work	***Mitigation measure 1***									
a	Loading and unloading spoil	122	64	71	62	69	400	180	550	250
b	Ventilation building foundation	120	63	70	60	67	400	180	550	250
c	Superstructure	119	62	69	60	66	400	180	550	250

					Distance (m)		
			Lot 525	Lot 561	Lot 525	Lot 561	
	TOLL PLAZA AREA - Site E	**SWL**	TP - N1	TP N2	TP - N1	TP N2	
Site work	***Mitigation measure 1***						
a	Earthwork excavation	120	79	70	65	175	
b	Loading and unloading spoil	119	88	74	20	100	
c	Road pavement	115	74	65	65	175	
d	Portal construction	134	79	74	110	190	

									Distance (m)							
			Woodcres t Hill	Keng Hau Road	Shatin Heights	CWG college	Tin Sam Tsuen	Carado Garden	CAL school	Woodcres t Hill	Keng Hau Road	Shatin Heights	CWG college	Tin Sam Tsuen	Carado Garden	CAL school
	SHATIN WORKS - Site F	**SWL**	ST - N1	ST - N2	ST - N3	ST - N4	ST - N7	ST - N6	ST - N5	ST - N1	ST - N2	ST - N3	ST - N4	ST - N7	ST - N6	ST - N5
Site work	***Mitigation measure 1***															
a	Earth excavation	120	75	69	80	70	#VALUE!	#VALUE!	#VALUE!	100	210	60	185	-	-	-
b	slip road viaducts - substructure	120	#VALUE!	#VALUE!	74	67	95	77	70	-	-	110	250	10	75	170
c	slip road viaducts - superstructure	115	#VALUE!	#VALUE!	69	62	90	73	65	-	-	110	250	10	75	170
d	Road pavement	116	71	65	75	66	91	73	66	100	210	60	185	10	75	170
e	Loading and unloading spoil	124	79	77	69	#VALUE!	#VALUE!	#VALUE!	#VALUE!	100	130	300	-	-	-	-
f	Tunnel portal	126	71	79	72	#VALUE!	#VALUE!	#VALUE!	#VALUE!	100	130	300	-	-	-	-

Table B3 - Predicted Noise Levels (use of quiet plant & limiting no. of plant)

								Distance (m)								
			Haking Wong TT	Mei Foo Sun Tsuen (blk 110)	Mei Foo Sun Chuen (blk 9)	LCK reception centre	LCK hospital	Haking Wong TT	Mei Foo Sun Tsuen (blk 110)	Mei Foo Sun Chuen (blk 9)	LCK reception centre	LCK hospital				
	WEST KOWLOON WORK	SWL	WK - N1	WK - N2	WK - N5	WK - N3	WK - N4	WK - N1	WK - N2	WK - N5	WK - N3	WK - N4				
Site work	***Mitigation measure 2***															
m	Preparatory works	115	#VALUE!	#VALUE!	#VALUE!	72	#VALUE!	-	-	-	80	-				
r	Portal construction	125	#VALUE!	#VALUE!	#VALUE!	74	#VALUE!	-	-	-	200	-				
n	LCK interchange - viaduct substructure	117	#VALUE!	#VALUE!	77	88	73	-	-	55	15	90				
o	LCK interchange - viaduct superstructure	112	#VALUE!	#VALUE!	72	83	66	-	-	55	15	90				
p	LCK viaduct	117	68	63	#VALUE!	88	#VALUE!	155	270	-	15	-				
q	Road pavement	114	65	60	74	85	70	155	270	55	15	90				
							Distance (m)									
			Bamboo Villa	Pinehill	Park Mansion	Residential	Bamboo Villa	Pinehill	Park Mansion	Residential						
	VENTILATION BUILDING	SWL	VB-N1	VB - N2	VB - N3	VB - N4	VB-N1	VB - N2	VB - N3	VB - N4						
Site work	***Mitigation measure 2***															
a	Loading and unloading spoil	119	61	68	59	66	400	180	550	250						
b	Ventilation building foundation	117	60	67	58	64	400	180	550	250						
c	Superstructure	115	58	65	56	62	400	180	550	250						
					Distance (m)											
			Lot 525	Lot 561	Lot 525	Lot 561										
	TOLL PLAZA AREA	SWL	TP - N1	TP N2	TP - N1	TP N2										
Site work	***Mitigation measure 2***															
a	Earthwork excavation	117	76	67	65	175										
b	Loading and unloading spoil	117	86	72	20	100										
c	Road pavement	114	72	64	65	175										
d	Portal construction	132	76	71	110	190										
									Distance (m)							
			Woodcrest Hill	Keng Hau Road	Shatin Heights	CWG college	Tin Sam Tsuen	Carado Garden	CAL school	Woodcrest Hill	Keng Hau Road	Shatin Heights	CWG college	Tin Sam Tsuen	Carado Garden	CAL school
	SHATIN WORKS	SWL	ST - N1	ST - N2	ST - N3	ST - N4	ST - N7	ST - N6	ST - N5	ST - N1	ST - N2	ST - N3	ST - N4	ST - N7	ST - N6	ST - N5
Site work	***Mitigation measure 2***															
a	Earth excavation	118	73	67	78	68	#VALUE!	#VALUE!	#VALUE!	100	210	60	185	-	-	-
b	slip road viaducts - substructure	117	#VALUE!	#VALUE!	72	64	92	75	68	-	-	110	250	10	75	170
c	slip road viaducts - superstructure	112	#VALUE!	#VALUE!	66	59	87	69	62	-	-	110	250	10	75	170
d	Road pavement	114	69	63	74	64	89	72	65	100	210	60	185	10	75	170
e	Loading and unloading spoil	121	76	74	66	#VALUE!	#VALUE!	#VALUE!	#VALUE!	100	130	300	-	-	-	-
f	Tunnel portal	124	69	76	69	#VALUE!	#VALUE!	#VALUE!	#VALUE!	100	130	300	-	-	-	-

Table B4 - Predicted Noise Levels (using quiet plant, limiting the no. of plant & movable barrier)

								Distance (m)								
			Haking Wong TT	Mei Foo Sun Tsuen (blk 110)	Mei Foo Sun Chuen (blk 9)	LCK reception centre	LCK hospital	Haking Wong TT	Mei Foo Sun Tsuen (blk 110)	Mei Foo Sun Chuen (blk 9)	LCK reception centre	LCK hospital				
	WEST KOWLOON WORK - Site C	**SWL**	WK - N1	WK - N2	WK - N5	WK - N3	WK - N4	WK - N1	WK - N2	WK - N5	WK - N3	WK - N4				
Site work	***Mitigation measure 3***															
m	Preparatory works	113	#VALUE!	#VALUE!	#VALUE!	70	#VALUE!	-	-	-	80	-				
r	Portal construction	121	#VALUE!	#VALUE!	#VALUE!	70	#VALUE!	-	-	-	200	-				
n	LCK interchange - viaduct substructure	113	#VALUE!	#VALUE!	73	86	69	-	-	55	15	90				
o	LCK interchange - viaduct superstructure	107	#VALUE!	#VALUE!	67	78	63	-	-	55	15	90				
p	LCK viaduct	113	64	60	#VALUE!	86	#VALUE!	155	270	-	15	-				
q	Road pavement	113	64	59	73	84	69	155	270	55	15	90				
							Distance (m)									
			Bamboo Villa	Pinehill	Park Mansion	Residential	Bamboo Villa	Pinehill	Park Mansion	Residential						
	VENTILATION BUILDING - Site D	**SWL**	VB-N1	VB - N2	VB - N3	VB - N4	VB-N1	VB - N2	VB - N3	VB - N4						
Site work	***Mitigation measure 3***															
a	Loading and unloading spoil	119	61	68	59	66	400	180	550	250						
b	Ventilation building foundation	117	60	67	57	64	400	180	550	250						
c	Superstructure	113	56	63	53	60	400	180	550	250						
					Distance (m)											
			Lot 525	Lot 561	Lot 525	Lot 561										
	TOLL PLAZA AREA - Site E	**SWL**	TP - N1	TP N2	TP - N1	TP N2										
Site work	***Mitigation measure 3***															
a	Earthwork excavation	112	71	62	65	175										
b	Loading and unloading spoil	112	81	67	20	100										
c	Road pavement	109	67	59	65	175										
d	Portal construction	127	71	66	110	190										
			Woodcrest Hill	Keng Hau Road	Shatin Heights	CWG college	Tin Sam Tsuen	Carado Garden	CAL school	Woodcrest Hill	Keng Hau Road	Shatin Heights	CWG college	Tin Sam Tsuen	Carado Garden	CAL school
	SHATIN WORKS - Site F	**SWL**	ST - N1	ST - N2	ST - N3	ST - N4	ST - N7	ST - N6	ST - N5	ST - N1	ST - N2	ST - N3	ST - N4	ST - N7	ST - N6	ST - N5
Site work	***Mitigation measure 3***															
a	Earth excavation	117	72	66	77	67	#VALUE!	#VALUE!	#VALUE!	100	210	60	185	-	-	-
b	slip road viaducts - substructure	116	#VALUE!	#VALUE!	70	63	87	73	66	-	-	110	250	10	75	170
c	slip road viaducts - superstructure	107	#VALUE!	#VALUE!	61	54	82	64	57	-	-	110	250	10	75	170
d	Road pavement	113	68	61	72	62	84	70	63	100	210	60	185	10	75	170
d	Loading and unloading spoil	120	75	73	66	#VALUE!	#VALUE!	#VALUE!	#VALUE!	100	130	300	-	-	-	-
e	Tunnel portal	118	63	71	63	#VALUE!	#VALUE!	#VALUE!	#VALUE!	100	130	300	-	-	-	-

Annex C

Water Quality Objectives and Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters for the Victoria Harbour Phase II and Tolo Harbour and Channel Water Control Zones

Table C1 ***Water Quality Objectives for Victoria Harbour Phase Water Control Zone***

		Water Quality Objective	Part or parts of Zone
A.		AESTHETIC APPEARANCE	
	(a)	There should be 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, should be absent.	Whole zone
	(f)	The water should not contain substances which settle to form objectionable deposits.	Whole zone
B.		BACTERIA	
		The level of *Escherichia coli* should not exceed 1000 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Inland waters
C.		COLOUR	
		Human activity should not cause the colour of water to exceed 50 Hazen units.	Inland waters
D.		DISSOLVED OXYGEN	
	(a)	The level of dissolved oxygen should not fall below 4 mg per litre for 90% of the sampling occasions during the whole year, values should be calculated as the annual water column average (see Note). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Marine waters
	(b)	The level of dissolved oxygen should not be less than 4 mg per litre.	Inland waters
E.		pH	
	(a)	The pH of the water should be within the range of 6.5-8.5 units. In addition, human activity should not cause the natural pH range to be extended by more than 0.2 unit.	Marine waters
	(b)	Human activity should not cause the pH of the water to exceed the range of 6.0-9.0 units	Inland waters
F.		TEMPERATURE	
		Human activity should not cause the daily temperature range to change by more than 2.0°C.	Whole zone

	Water Quality Objective	Part or parts of Zone
G.	SALINITY	
	Human activity should not cause the salinity level to change by more than 10%.	Whole zone
H.	SUSPENDED SOLIDS	
	(a) Human activity should neither cause the suspended solids concentration to be raised more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine waters
	(b) Human activity should not cause the annual median of suspended solids to exceed 25 mg per litre.	Inland waters
I.	AMMONIA	
	The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
J.	NUTRIENTS	
	(a) Nutrients should not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
	(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.4 mg per litre, expressed as annual water column average (see Note).	Marine waters
K.	5-DAY BIOCHEMICAL OXYGEN DEMAND	
	The 5-day biochemical oxygen demand should not exceed 5 mg per litre.	Inland waters
L.	CHEMICAL OXYGEN DEMAND	
	The chemical oxygen demand should not exceed 30 mg per litre.	Inland waters
M.	TOXIC SUBSTANCES	
	(a) Toxic substances in the water should not attain such levels 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 interactions of toxic substances with each other.	Whole zone
	(b) Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone

Note: Expressed normally as the arithmetic mean of at least 3 measurements at 1 m below surface, mid depth and 1 m above the seabed. However in water of a depth of 5 m or less, the mean shall be that of 2 measurements (1 m below surface and 1 m above seabed), and in water of less than 3 m the 1 m below surface sample only shall apply.

Table C2 *Water Quality Objectives for Tolo Harbour and Channel Water Control Zone*

	Water Quality Objective	Part or parts of Zone
A.	AESTHETIC APPEARANCE	
	(a) There should be 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.	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) The water should not contain substances which settle to form objectionable deposits.	Whole zone
B.	BACTERIA	
	The level of Escherichia coli should be less than 1 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Whole zone
C.	COLOUR	
	Human activity should not cause the colour of water to exceed 30 Hazen units.	Whole zone
D.	DISSOLVED OXYGEN	
	The level of dissolved oxygen should not be less than 4 mg per litre.	Whole zone
E.	pH	
	Human activity should not cause the pH of the water to exceed the range of 6.5-8.5 units.	Whole zone
F.	TEMPERATURE	
	Human activity should not cause the natural daily temperature range to change by more than 2.0°C.	Whole zone
G.	SALINITY	
	Human activity should not cause the natural ambient salinity level to change by more than 10%.	Whole zone
H.	SUSPENDED SOLIDS	
	(b) Human activity should not cause the annual median of suspended solids to exceed 20 mg per litre.	Whole zone
I.	AMMONIA	
	The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
J.	5-DAY BIOCHEMICAL OXYGEN DEMAND	
	The 5-day biochemical oxygen demand should not exceed 3 mg per litre	Whole zone
K.	CHEMICAL OXYGEN DEMAND	

	Water Quality Objective	Part or parts of Zone
	The chemical oxygen demand should not exceed 15 mg per litre.	Whole zone
L.	TOXIC SUBSTANCES	
	(a) Toxic substances in the water should not attain such levels 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 interactions of toxic substances with each other.	Whole zone
	(b) Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone

Table C3 ***Standards for Effluents Discharged into the Marine Waters of Victoria Harbour Phase II Water Control Zone***

Flow rate (m^3/day)	≤10	>10 & ≤200	>200 & ≤400	>400 & ≤600	>600 & ≤800	>800 & ≤1000	>1000 & ≤1500	>1500 & ≤2000	>2000 & ≤3000	>3000 & ≤4000	>4000 & ≤5000	>5000 & ≤6000
Determinant												
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (°C)	45	45	45	45	45	45	45	45	45	45	45	45
Colour	4	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	700	600	600	500	375	300	200	150	100	75	60	40
BOD	700	600	600	500	375	300	200	150	100	75	60	40
COD	1500	1200	1200	1000	700	600	400	300	200	100	100	85
Oil & Grease	50	50	50	30	25	20	20	20	20	20	20	20
Iron	20	15	13	10	7.5	6	4	3	2	1.5	1.2	1
Boron	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Barium	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Mercury	0.1	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals	2	1.5	1	0.8	0.6	0.5	0.32	0.24	0.16	0.12	0.1	0.1
Total toxic metals	4	3	2	1.6	1.2	1	0.64	0.48	0.32	0.24	0.2	0.14
Cyanide	1	0.5	0.5	0.5	0.4	0.3	0.2	0.1	0.1	0.08	0.06	0.04
Phenols	0.5	0.5	0.5	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	100	100	100	100	100	100	100	100	100	50
Total phosphorus	10	10	10	10	10	10	10	10	10	10	10	5
Surfactants (total)	30	20	20	20	15	15	15	15	15	15	15	15
E. coli (count/100 ml)	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000

(All units in mgl^{-1} unless otherwise stated; all figures are upper limits unless otherwise indicated)

Table C4 ***Standards for Effluents Discharged into the Marine Waters of Tolo Harbour and Channel Water Control Zone***

Flow rate (m^3/day)	≤10	>10 & ≤200	>200 & ≤400	>400 & ≤600	>600 & ≤800	>800 & ≤1000	>1000 & ≤1500	>1500 & ≤2000	>2000 & ≤3000	>3000 & ≤4000	>4000 & ≤5000	>5000 & ≤6000
Determinand												
pH (pH units)	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9
Temperature (°C)	45	45	45	45	45	45	45	45	45	45	45	45
Colour (lovibond units) 25 mm cell length	1	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	30	30	30	30	30	30	15	15	15	15	15	15
BOD	20	20	20	20	20	20	10	10	10	10	10	10
COD	80	80	80	80	80	80	50	50	50	50	50	50
Oil & Grease	20	20	20	20	20	20	10	10	10	10	10	10
Iron	10	10	10	7	5	4	2.7	2	1.3	1	0.8	0.6
Boron	5	4	3	2.5	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2.5	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.5	0.5	0.4	0.1	0.1	0.1	0.1	0.1	0.1
Total toxic metals	2	2	1.6	1	1	0.8	0.2	0.2	0.2	0.2	0.14	0.1
Cyanide	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.03	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.25	0.25	0.25	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	20	20	20	15	15	15	15	15	10	10	10	10
Total phosphorus	8	8	5	5	5	5	5	5	5	5	5	5
Surfactants (total)	15	15	15	15	15	15	10	10	10	10	10	10.
E. coli (count/100 ml)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Annex D

Road Traffic Modelling Results

Table D1 *Predicted Traffic Noise Impact - No Mitigation ($L_{10, peak\ hour}$ dB(A))*

NSR	2000 Prevailing Traffic Noise Levels	HKPSG criteria	2019 Predicted Noise Levels TOTAL	2019 Predicted Noise Levels Existing Road	2019 Predicted Noise Levels New Road
WK - N1	Haking Wong TT				
1/F	74.1	65	76.3	75.9	65.5
3/F	74.4	65	76.7	76.2	67
WK - N2	Mei Foo Sun Cheun, Phase 4 (Block 113)				
1/F	75.9	70	77.5	77.4	58.5
10/F	79.4	70	80.7	80.7	62.1
19/F	77.8	70	79.3	79.1	65.7
WK - N3a	LCK Reception Centre Staff Quarters				
1/F	82.5	70	84.2	84	70.8
5/F	81.5	70	83.7	83	75.6
11/F	79.2	70	84.7	80.7	82.5
WK - N3b	LCK Reception Centre Staff Quarters				
1/F	84	70	85.7	85.5	71.3
5/F	81.7	70	84.2	83.2	77.4
9/F	79.7	70	85.5	81.2	83.5
WK - N3c	LCK Reception Centre Staff Quarters				
1/F	83.5	70	85.2	85	71.5
3/F	82.5	70	84.5	84	74.9
6/F	80.9	70	86.7	82.4	84.7
WK - N4a	LCK Hospital				
G/F	69.4	55	72.5	71.3	66.5
1/F	70.2	55	73.3	72.1	67.4
WK - N4b	LCK Hospital				
G/F	58.9	55	62.7	60.4	58.7
1/F	61.3	55	64.9	62.9	60.7
WK - N5	Mei Foo Sun Chuen, Phase 6 (Block 9)				
1/F	74.5	70	82.6	82.6	59.9
10/F	75.7	70	80.9	80.8	66.5
19/F	79.3	70	82.3	81.9	71.5
WK - N6	Mei Foo Sun Cheun, Phase 5 (Block 9)				
1/F	76.7	70	85.5	85.5	60.7
10/F	76.3	70	81.4	81.3	67.3
19/F	79.1	70	82.2	81.8	71.1
WK - N7a	LCK Reception Centre-New Staff Quarters				
1/F	82.7	70	84.3	84.2	69
7/F	82.3	70	83.9	83.8	70.4
15/F	81.3	70	83.2	82.8	73
WK - N7b	LCK Reception Centre-New Staff Quarters				
3/F	76.8	70	79.1	78.6	69.6
7/F	77.1	70	79.5	78.8	71.6
15/F	76.8	70	79.8	78.4	74.1
WK - N8	KMB Bus Depot CDA site				
1/F	61.2	70	66.2	63.2	63.2
10/F	68.4	70	72	69.8	68.1
20/F	70.3	70	74.8	71.8	71.8
TP - N1	DD 187, Lot 525				
1/F	-	70	64.7	-	64.7
3/F	-	70	70.2	-	70.2
TP - N2	DD 187, Lot 561				
1/F	-	70	60.4	-	60.4
3/F	-	70	62.2	-	62.2

Table D1	*Predicted Traffic Noise Impact - No Mitigation (L10, peak hour dB(A))*			
NSR	**HKPSG criteria**	**2019 Predicted Noise Levels TOTAL**	**2019 Predicted Noise Levels Existing Road**	**2019 Predicted Noise Levels New Road**
ST - N1a	Woodcrest Hill			
1/F	70	80.5	80.2	68
3/F	70	82.4	82.1	70.6
ST - N1b	Woodcrest Hill			
1/F	70	79.8	79.7	64.3
3/F	70	80.2	79.9	67.7
ST - N2a	Keng Hau Road			
G/F	70	75.2	74.8	64.1
3/F	70	76.3	75.9	65.8
ST - N2b	Keng Hau Road			
G/F	70	71.8	70.3	66.5
3/F	70	73.8	72.8	66.9
ST - N3a	Shatin Heights			
1/F	70	71.7	70.8	64.4
4/F	70	73.3	72	67.3
8/F	70	74.9	73	70.5
ST - N3b	Shatin Heights			
1/F	70	70.8	68.6	66.8
4/F	70	73.6	70.2	71
8/F	70	75.9	71.4	74
ST - N3c	Shatin Heights			
1/F	70	76.7	76.6	60.5
4/F	70	77.8	77.6	65.3
8/F	70	78.6	78	69.5
ST - N4a	Cheng Wing Chee College			
1/F	65	78.5	78.3	65.9
3/F	65	78.6	78.3	67
6/F	65	79.4	78.9	69.5
ST - N5	Carmel Alison Lam Primary			
1/F	65	77.1	76.1	70.3
3/F	65	76.8	75.6	70.5
6/F	65	77	75.5	71.8
ST - N6a	Carado Garden			
1/F	70	74.2	72.4	69.6
14/F	70	75.2	72.2	72.2
28/F	70	75.4	71.9	72.8
ST - N6b	Carado Garden			
1/F	70	74.3	72.5	69.7
14/F	70	75.9	72.7	73.1
28/F	70	76	72.5	73.5
ST - N7a	Tin Sam Tsuen			
G/F	70	78.3	77.1	72.1
3/F	70	80.5	77.5	77.5
ST - N7b	Tin Sam Tsuen			
G/F	70	76.8	76.6	61.2
3/F	70	77.7	77.5	65.5
ST - N8	Tun Kwun Lau Pak Lok College			
1/F	65	77	76.8	62.6

NSR	HKPSG criteria	2019 Predicted Noise Levels TOTAL	2019 Predicted Noise Levels Existing Road	2019 Predicted Noise Levels New Road	
3/F	65	77.2	77	63.6	
6/F	65	78.3	78.1	65.8	
ST - N9	Hin Keng Estate				
1/F	70	76.1	75	69.8	
15/F	70	75.2	73.1	71.1	
30/F	70	75.1	72.2	71.9	
ST - N10	Sun Chiu Estate				
1/F	70	78.9	78.9	62.2	
15/F	70	78.2	77.9	66.1	
30/F	70	76.9	76.5	66	
ST-N11a	Planned landuse				
1/F	70	78.1	67	77.7	
15/F	70	80.4	73	79.5	
30/F	70	79.4	73.8	78	
ST-N11b	Planned landuse				
1/F	70	76.9	74.9	72.5	
15/F	70	77.9	75.7	73.8	
30/F	70	77.3	75.2	73.1	
ST-N11c	Planned landuse				
1/F	70	76.4	76.1	65	
15/F	70	76.7	76.3	66.2	
30/F	70	75.9	75.5	66	
ST-N11d	Planned landuse				
1/F	70	78.7	75.6	75.8	
15/F	70	77.8	73.7	75.6	
30/F	70	75.7	72	73.3	
ST-N11e	Planned landuse				
1/F	70	74.7	73.9	66.6	
15/F	70	77.8	72	76.5	
30/F	70	75.8	70.3	74.3	
ST-N11f	Planned landuse				
1/F	70	74.2	71.1	71.3	
15/F	70	79.5	71.1	78.9	
30/F	70	77.7	70.8	76.7	
ST-N11g	Planned landuse				
1/F	70	76	74.8	70	
15/F	70	77.5	72.4	75.9	
30/F	70	75.3	70.6	73.6	
Cheung Wong Wai Primary School					
1/F	65	80.1	80	62.1	17.9
3/F	65	80	79.9	63.3	16.6
6/F	65	79.7	79.6	64.1	15.5
					0
Ng Yuk Secondary School					0
1/F	65	79	79	59.1	19.9
3/F	65	79	78.9	59.7	19.2
6/F	65	78.7	78.6	62.2	16.4

Table D2 ***Predicted Moise Levels with Mitigation Package 1***

NSR	2019 Noise Levels TOTAL (no mitigation)	HKPSG criteria	2019 Noise Levels TOTAL (Mitigated)	2019 Noise Levels Existing Road (Mitigated)	2019 Noise Levels New Road (Mitigated)
WK - N1	Haking Wong TT				
1/F	76.3	65	76.1	75.9	63
3/F	76.7	65	76.4	76.2	64.5
WK - N2	Mei Foo Sun Cheun, Phase 4 (Block 113)				
1/F	77.5	70	77.5	77.4	56
10/F	80.7	70	80.7	80.7	59.6
19/F	79.3	70	79.3	79.1	63.2
WK - N3a	LCK Reception Centre Staff Quarters				
1/F	84.2	70	84.1	84	68.3
5/F	83.7	70	83.4	83	73.1
11/F	85.5	70	83.3	80.7	80
WK - N3b	LCK Reception Centre Staff Quarters				
1/F	85.7	70	85.6	85.5	68.8
5/F	84.2	70	83.8	83.2	74.9
9/F	86.7	70	84.1	81.2	81
WK - N3c	LCK Reception Centre Staff Quarters				
1/F	85.2	70	85.1	85	69
3/F	84.5	70	84.3	84	72.4
6/F	82.3	70	85.3	82.4	82.2
WK - N4a	LCK Hospital				
G/F	72.5	55	72.1	71.4	64
1/F	73.3	55	72.9	72.1	64.9
WK - N4b	LCK Hospital				
G/F	62.7	55	61.8	60.4	56.2
1/F	64.9	55	64.1	62.9	58.2
WK - N5	Mei Foo Sun Chuen, Phase 6 (Block 9)				
1/F	82.6	70	82.6	82.6	57.4
10/F	80.9	70	80.9	80.8	64
19/F	82.3	70	82.1	81.9	69
WK - N6	Mei Foo Sun Cheun, Phase 5 (Block 9)				
1/F	85.5	70	85.5	85.5	58.2
10/F	81.4	70	81.4	81.3	64.8
19/F	82.2	70	82	81.8	68.6
WK - N7a	LCK Reception Centre-New Staff Quarters				
1/F	84.3	70	84.3	84.2	66.5
7/F	83.9	70	83.9	83.8	67.9
15/F	83.2	70	83	82.8	70.5
WK - N7b	LCK Reception Centre-New Staff Quarters				
3/F	79.1	70	78.9	78.6	67.1
7/F	79.5	70	79.2	78.8	69.1
15/F	79.8	70	79.2	78.4	71.6
WK - N8	KMB Bus Depot CDA site				
1/F	66.2	70	65.1	63.2	60.7
10/F	72	70	71.3	69.9	65.6
20/F	74.8	70	73.8	71.8	69.3

Table D2	*Predicted Traffic Noise Impact - Mitigation 1 (L10, peak hour dB(A))*			
NSR	**HKPSG**	**2019 Predicted**	**2019 Predicted**	**2019 Predicted**
	criteria	**Noise Levels**	**Noise Levels**	**Noise Levels**
		TOTAL	**Existing Road**	**New Road**
ST - N1a	Woodcrest Hill			
1/F	70	80.4	80.2	65.2
3/F	70	82.3	82.1	67.9
ST - N1b	Woodcrest Hill			
1/F	70	79.8	79.7	61.7
3/F	70	80.1	79.9	65.2
ST - N2a	Keng Hau Road			
G/F	70	75	74.8	60.8
3/F	70	76.1	75.9	62.7
ST - N2b	Keng Hau Road			
G/F	70	71.2	70.3	63.7
3/F	70	73.4	72.8	64.1
ST - N3a	Shatin Heights			
1/F	70	71.5	71	61.9
4/F	70	72.8	72	64.8
8/F	70	74	73	67.4
ST - N3b	Shatin Heights			
1/F	70	69.8	68.3	64.3
4/F	70	72.5	70.2	68.5
8/F	70	74.3	71.4	71.2
ST - N3c	Shatin Heights			
1/F	70	76.7	76.6	58
4/F	70	77.7	77.6	62.8
8/F	70	78.3	78	67
ST - N4a	Cheng Wing Chee College			
1/F	65	78.4	78.3	63.4
3/F	65	78.5	78.3	64.5
6/F	65	79.1	78.9	66
ST - N5	Carmel Alison Lam Primary			
1/F	65	76.7	76.1	67.8
3/F	65	76.5	75.8	68
6/F	65	76.2	75.4	68.4
ST - N6a	Carado Garden			
1/F	70	73.5	72.4	67.1
14/F	70	74.2	72.3	69.7
28/F	70	74.2	71.9	70.2
ST - N6b	Carado Garden			
1/F	70	73.6	72.5	67.2
14/F	70	74.8	72.8	70.6
28/F	70	74.8	72.5	70.9
ST - N7a	Tin Sam Tsuen			
G/F	70	77.8	77.1	69.6
3/F	70	79.4	77.5	75

NSR	HKPSG criteria	2019 Predicted Noise Levels TOTAL	2019 Predicted Noise Levels Existing Road	2019 Predicted Noise Levels New Road
ST - N7b	Tin Sam Tsuen			
G/F	70	76.7	76.6	58.7
3/F	70	77.6	77.5	63
ST - N8	Tun Kwun Lau Pak Lok College			
1/F	65	76.9	76.8	60.1
3/F	65	77.1	77	61.1
6/F	65	78.1	78	62.5
ST - N9	Hin Keng Estate			
1/F	70	75.7	75	67.3
15/F	70	74.5	73.3	68.6
30/F	70	74	72.2	69.3
ST - N10	Sun Chiu Estate			
1/F	70	78.9	78.9	59.6
15/F	70	78.1	77.9	63.5
30/F	70	76.7	76.5	63.2
ST-N11a	Planned landuse			
1/F	70	75.8	67	75.2
15/F	70	78.4	73	77
30/F	70	77.8	73.8	75.5
ST-N11b	Planned landuse			
1/F	70	76.1	74.9	70
15/F	70	77	75.7	71.3
30/F	70	76.5	75.2	70.6
ST-N11c	Planned landuse			
1/F	70	76.3	76.1	62.5
15/F	70	76.5	76.3	63.7
30/F	70	75.7	75.4	63.5
ST-N11d	Planned landuse			
1/F	70	77.6	75.6	73.3
15/F	70	76.4	73.7	73.1
30/F	70	74.5	72	70.8
ST-N11e	Planned landuse			
1/F	70	74.4	73.9	64.1
15/F	70	76.1	72	74
30/F	70	74.1	70.3	71.8
ST-N11f	Planned landuse			
1/F	70	73.1	71.1	68.8
15/F	70	77.5	71.2	76.4
30/F	70	75.8	70.8	74.2
ST-N11g	Planned landuse			
1/F	70	75.5	74.8	67.5
15/F	70	76	72.4	73.4
30/F	70	73.8	70.6	71.1

Table D3 *Mitigation Option 2*

NSR	2019 Noise Levels TOTAL (no mitigation)	HKPSG criteria	2019 Noise Levels TOTAL (Mitigated)	2019 Noise Levels Existing Road (Mitigated)	2019 Noise Levels New Road (Mitigated)
WK - N3a	LCK Reception Centre Staff Quarters				
1/F	84.2	70	84.9	84.8	62.9
5/F	83.7	70	83.8	83.8	66
11/F	84.7	70	82.5	81.3	76.4
WK - N3b	LCK Reception Centre Staff Quarters				
1/F	85.7	70	86.2	86.2	61.9
5/F	84.2	70	84	84	66.2
9/F	85.5	70	82.8	81.8	76.1
WK - N3c	LCK Reception Centre Staff Quarters				
1/F	85.2	70	84.7	84.7	61.4
3/F	84.5	70	83.7	83.7	63.8
6/F	86.7	70	82.4	82	71.2

Table D3	*Predicted Traffic Noise Impact - Mitigation 2 (L10, peak hour dB(A))*			
NSR	**HKPSG criteria**	**2019 Predicted Noise Levels TOTAL**	**2019 Predicted Noise Levels Existing Road**	**2019 Predicted Noise Levels New Road**
ST - N1a	Woodcrest Hill			
1/F	70	80.4	80.2	66.4
3/F	70	82.3	82.1	69.2
ST - N1b	Woodcrest Hill			
1/F	70	79.8	79.7	62.5
3/F	70	80.1	79.9	66.3
ST - N2a	Keng Hau Road			
G/F	70	75	74.8	61.4
3/F	70	76.1	75.9	63.5
ST - N2b	Keng Hau Road			
G/F	70	71.2	70.3	64
3/F	70	73.4	72.8	64.4
ST - N3a	Shatin Heights			
1/F	70	71.5	71	62.5
4/F	70	72.9	72	65.3
8/F	70	74.2	72.9	68.1
ST - N3b	Shatin Heights			
1/F	70	70	68.3	65.1
4/F	70	72.8	70.2	69.2
8/F	70	74.8	71.4	72.1
ST - N3c	Shatin Heights			
1/F	70	76.7	76.6	59.3
4/F	70	77.8	77.6	64
8/F	70	78.4	78	68.1
ST - N4a	Cheng Wing Chee College			
1/F	65	78.3	78.3	57.6
3/F	65	78.4	78.3	59
6/F	65	79	78.9	62.5
ST - N5	Carmel Alison Lam Primary			
1/F	65	76.2	76.1	59.4
3/F	65	75.9	75.8	60
6/F	65	75.6	75.4	60.9
ST - N6a	Carado Garden			
1/F	70	72.6	72.4	59.4
14/F	70	73.1	72.3	65.5
28/F	70	73.3	71.9	67.5
ST - N6b	Carado Garden			
1/F	70	72.8	72.5	60.9
14/F	70	73.9	72.8	67.6
28/F	70	74.1	72.5	69.1
ST - N7a	Tin Sam Tsuen			
G/F	70	77.5	77.1	67
3/F	70	79.1	77.5	74.1

NSR	HKPSG criteria	2019 Predicted Noise Levels TOTAL	2019 Predicted Noise Levels Existing Road	2019 Predicted Noise Levels New Road
ST - N7b	Tin Sam Tsuen			
G/F	70	76.7	76.6	57.2
3/F	70	77.6	77.5	61.4
ST - N8	Tun Kwun Lau Pak Lok College			
1/F	65	77	76.8	61.3
3/F	65	77.1	77	62
6/F	65	78.1	78	62.8
ST - N9	Hin Keng Estate			
1/F	70	75.1	75	58.6
15/F	70	73.5	73.3	61.7
30/F	70	72.9	72.2	64.6
ST - N10	Sun Chiu Estate			
1/F	70	78.9	78.9	53.7
15/F	70	78	77.9	60.7
30/F	70	76.6	76.5	60.8
ST-N11a	Planned landuse			
1/F	70	68.4	66.9	62.8
15/F	70	77.1	73	74.9
30/F	70	77.8	73.8	75.5
ST-N11b	Planned landuse			
1/F	70	75	74.9	58.2
15/F	70	76.2	75.7	66.4
30/F	70	76.4	75.2	70.2
ST-N11c	Planned landuse			
1/F	70	76.1	76.1	51.2
15/F	70	76.3	76.3	56.6
30/F	70	75.6	75.4	61.1
ST-N11d	Planned landuse			
1/F	70	77.6	75.6	73.2
15/F	70	76.4	73.7	73
30/F	70	74.4	72	70.8
ST-N11e	Planned landuse			
1/F	70	74.4	73.9	64
15/F	70	76.1	72	74
30/F	70	74.1	70.3	71.8
ST-N11f	Planned landuse			
1/F	70	71.7	71.1	62.9
15/F	70	77	71.2	75.7
30/F	70	75.7	70.8	74
ST-N11g	Planned landuse			
1/F	70	75.5	74.8	67.5
15/F	70	76	72.4	73.4
30/F	70	73.8	70.6	71.1

Table D4 *Mitigation Option 3*

NSR	2019 Noise Levels TOTAL (no mitigation)	HKPSG criteria	2019 Noise Levels TOTAL (Mitigated)	2019 Noise Levels Existing Road (Mitigated)	2019 Noise Levels New Road (Mitigated)
WK - N3a	LCK Reception Centre Staff Quarters				
1/F	84.2	70	84.8	84.8	62.8
5/F	83.7	70	83.8	83.8	65.6
11/F	84.7	70	82.0	81.2	74.0
WK - N3b	LCK Reception Centre Staff Quarters				
1/F	85.7	70	86.2	86.2	61.8
5/F	84.2	70	84.0	84.0	65.8
9/F	85.5	70	82.3	82.0	72.5
WK - N3c	LCK Reception Centre Staff Quarters				
1/F	85.2	70	84.7	84.7	61.4
3/F	84.5	70	83.7	83.7	63.6
6/F	86.7	70	82.3	82.0	70.6

Table D4	*Predicted Traffic Noise Impact - Mitigation 3 (L10, peak hour dB(A))*			
NSR	**HKPSG criteria**	**2019 Predicted Noise Levels TOTAL**	**2019 Predicted Noise Levels Existing Road**	**2019 Predicted Noise Levels New Road**
ST - N1a	Woodcrest Hill			
1/F	70	80.4	80.2	66.1
3/F	70	82.3	82.1	69
ST - N1b	Woodcrest Hill			
1/F	70	79.8	79.7	62.6
3/F	70	80.1	79.9	66.1
ST - N2a	Keng Hau Road			
G/F	70	75	74.8	61.5
3/F	70	76.1	75.9	63.6
ST - N2b	Keng Hau Road			
G/F	70	71.2	70.3	63.8
3/F	70	73.4	72.8	64.2
ST - N3a	Shatin Heights			
1/F	70	71	70.7	58.8
4/F	70	72.3	71.9	61.5
8/F	70	73.5	73	64.4
ST - N3b	Shatin Heights			
1/F	70	68.8	67.9	61.8
4/F	70	71.5	70.1	65.6
8/F	70	73.5	71.4	69.2
ST - N3c	Shatin Heights			
1/F	70	76.6	76.6	56.3
4/F	70	77.7	77.6	59.9
8/F	70	78.2	78	64.7
ST - N4a	Cheng Wing Chee College			
1/F	65	78.3	78.3	58.6
3/F	65	78.4	78.3	59.9
6/F	65	79	78.9	62.8
ST - N5	Carmel Alison Lam Primary			
1/F	65	76.2	76.1	57.2
3/F	65	75.9	75.8	57.6
6/F	65	75.5	75.4	58.4
ST - N6a	Carado Garden			
1/F	70	72.5	72.3	57.2
14/F	70	72.8	72.3	63.2
28/F	70	73	71.9	66.5
ST - N6b	Carado Garden			
1/F	70	72.6	72.5	58.9
14/F	70	73.5	72.8	65.7
28/F	70	73.9	72.5	68.5
ST - N7a	Tin Sam Tsuen			
G/F	70	77.4	77.1	64.8
3/F	70	78.5	77.5	71.9

NSR	HKPSG criteria	2019 Predicted Noise Levels TOTAL	2019 Predicted Noise Levels Existing Road	2019 Predicted Noise Levels New Road
ST - N7b	Tin Sam Tsuen			
G/F	70	76.7	76.6	55.3
3/F	70	77.5	77.5	59.1
ST - N8	Tun Kwun Lau Pak Lok College			
1/F	65	77	76.8	61.4
3/F	65	77.1	77	62.2
6/F	65	78.1	78	62.9
ST - N9	Hin Keng Estate			
1/F	70	75	75	56.2
15/F	70	73.4	73.3	58.9
30/F	70	72.6	72.2	61.9
ST - N10	Sun Chiu Estate			
1/F	70	78.9	78.9	51.6
15/F	70	78	77.9	60
30/F	70	76.6	76.5	60.2
ST-N11a	Planned landuse			
1/F	70	67.2	66.2	60.5
15/F	70	75.4	73	71.7
30/F	70	77.6	73.8	75.3
ST-N11b	Planned landuse			
1/F	70	74.6	74.6	55.8
15/F	70	75.9	75.7	62.7
30/F	70	76.1	75.1	68.9
ST-N11c	Planned landuse			
1/F	70	76.1	76.1	48.8
15/F	70	76.3	76.3	53.5
30/F	70	75.5	75.4	58
ST-N11d	Planned landuse			
1/F	70	76.3	75.6	68.3
15/F	70	76.4	73.8	73
30/F	70	74.4	72	70.7
ST-N11e	Planned landuse			
1/F	70	74.2	73.9	61.9
15/F	70	75.9	72	73.6
30/F	70	74.1	70.4	71.8
ST-N11f	Planned landuse			
1/F	70	71.4	71	60.7
15/F	70	76.8	71.2	75.4
30/F	70	75.5	70.7	73.7
ST-N11g	Planned landuse			
1/F	70	75.1	74.8	63.7
15/F	70	75.9	72.4	73.3
30/F	70	73.8	70.6	71

Table D5	*Predicted Traffic Noise Impact - Mitigation 4 (L10, peak hour dB(A))*			
NSR	**HKPSG criteria**	**2019 Predicted Noise Levels TOTAL**	**2019 Predicted Noise Levels Existing Road**	**2019 Predicted Noise Levels New Road**
ST - N1a	Woodcrest Hill			
1/F	70	80.4	80.2	65.8
3/F	70	82.3	82.1	68.8
ST - N1b	Woodcrest Hill			
1/F	70	79.8	79.7	62.4
3/F	70	80.1	79.9	65.9
ST - N2a	Keng Hau Road			
G/F	70	75	74.8	61.3
3/F	70	76.1	75.9	63.4
ST - N2b	Keng Hau Road			
G/F	70	71.1	70.3	63.3
3/F	70	73.3	72.8	63.8
ST - N3a	Shatin Heights			
1/F	70	71	70.7	58.8
4/F	70	72.3	71.9	61.5
8/F	70	73.5	73	64.4
ST - N3b	Shatin Heights			
1/F	70	68.8	67.9	61.8
4/F	70	71.5	70.1	65.6
8/F	70	73.5	71.4	69.2
ST - N3c	Shatin Heights			
1/F	70	76.6	76.6	56.3
4/F	70	77.7	77.6	59.9
8/F	70	78.2	78	64.7
ST - N4a	Cheng Wing Chee College			
1/F	65	78.3	78.3	58.5
3/F	65	78.4	78.3	59.7
6/F	65	79	78.9	62.4
ST - N5	Carmel Alison Lam Primary			
1/F	65	76.2	76.1	54.8
3/F	65	75.8	75.8	55.2
6/F	65	75.5	75.4	55.8
ST - N6a	Carado Garden			
1/F	70	72.4	72.3	54.9
14/F	70	72.5	72.3	60.1
28/F	70	72.6	71.9	64.4
ST - N6b	Carado Garden			
1/F	70	72.6	72.5	56.5
14/F	70	73.2	72.8	63.1
28/F	70	73.4	72.5	66.1
ST - N7a	Tin Sam Tsuen			
G/F	70	77.2	77.1	61.8
3/F	70	77.8	77.5	67

NSR	HKPSG criteria	2019 Predicted Noise Levels TOTAL	2019 Predicted Noise Levels Existing Road	2019 Predicted Noise Levels New Road
ST - N7b	Tin Sam Tsuen			
G/F	70	76.7	76.6	52.9
3/F	70	77.5	77.5	56.5
ST - N8	Tun Kwun Lau Pak Lok College			
1/F	65	77	76.8	61.4
3/F	65	77.1	77	62.2
6/F	65	78.1	78	62.7
ST - N9	Hin Keng Estate			
1/F	70	75	75	53.9
15/F	70	73.3	73.3	56
30/F	70	72.4	72.2	58.8
ST - N10	Sun Chiu Estate			
1/F	70	78.9	78.9	49.4
15/F	70	78	77.9	58.2
30/F	70	76.6	76.5	59.4
ST-N11a	Planned landuse			
1/F	70	66.8	66.1	58.6
15/F	70	74.4	73	68.8
30/F	70	77.2	73.8	74.5
ST-N11b	Planned landuse			
1/F	70	74.6	74.6	53.8
15/F	70	75.8	75.7	60.2
30/F	70	75.7	75.2	66.2
ST-N11c	Planned landuse			
1/F	70	76.1	76.1	46.9
15/F	70	76.3	76.3	51.4
30/F	70	75.5	75.4	55.9
ST-N11d	Planned landuse			
1/F	70	75.9	75.6	64.3
15/F	70	76.3	73.8	72.8
30/F	70	74.4	72	70.7
ST-N11e	Planned landuse			
1/F	70	74.1	73.9	60.3
15/F	70	75.4	72	72.7
30/F	70	74.1	70.4	71.7
ST-N11f	Planned landuse			
1/F	70	71.2	71	58.9
15/F	70	76.2	71.2	74.6
30/F	70	75.2	70.7	73.3
ST-N11g	Planned landuse			
1/F	70	75	74.8	60.9
15/F	70	75.8	72.4	73
30/F	70	73.8	70.6	71

Table D6	*Predicted Traffic Noise Impact (L10, peak hour dB(A))*					
NSR	**HKPSG criteria**	**No Mitigation**	**Mitigation Option 1**	**Mitigation Option 2**	**Mitigation Option 3**	**Mitigation Option 4**
ST - N1a	Woodcrest Hill					
1/F	70	80.5	80.4	80.4	80.4	80.4
3/F	70	82.4	82.3	82.3	82.3	82.3
ST - N1b	Woodcrest Hill					
1/F	70	79.8	79.8	79.8	79.8	79.8
3/F	70	80.2	80.1	80.1	80.1	80.1
ST - N2a	Keng Hau Road					
G/F	70	75.2	75	75	75	75
3/F	70	76.3	76.1	76.1	76.1	76.1
ST - N2b	Keng Hau Road					
G/F	70	71.8	71.2	71.2	71.2	71.1
3/F	70	73.8	73.4	73.4	73.4	73.3
ST - N3a	Shatin Heights					
1/F	70	71.7	71.5	71.5	71	71
4/F	70	73.3	72.8	72.9	72.3	72.3
8/F	70	74.9	74	74.2	73.5	73.5
ST - N3b	Shatin Heights					
1/F	70	70.8	69.8	70	68.8	68.8
4/F	70	73.6	72.5	72.8	71.5	71.5
8/F	70	75.9	74.3	74.8	73.5	73.5
ST - N3c	Shatin Heights					
1/F	70	76.7	76.7	76.7	76.6	76.6
4/F	70	77.8	77.7	77.8	77.7	77.7
8/F	70	78.6	78.3	78.4	78.2	78.2
ST - N4a	Cheng Wing Chee College					
1/F	65	78.5	78.4	78.3	78.3	78.3
3/F	65	78.6	78.5	78.4	78.4	78.4
6/F	65	79.4	79.1	79	79	79
ST - N5	Carmel Alison Lam Primary					
1/F	65	77.1	76.7	76.2	76.2	76.2
3/F	65	76.8	76.5	75.9	75.9	75.8
6/F	65	77	76.2	75.6	75.5	75.5
ST - N6a	Carado Garden					
1/F	70	74.2	73.5	72.6	72.5	72.4
14/F	70	75.2	74.2	73.1	72.8	72.5
28/F	70	75.4	74.2	73.3	73	72.6
ST - N6b	Carado Garden					
1/F	70	74.3	73.6	72.8	72.6	72.6
14/F	70	75.9	74.8	73.9	73.5	73.2
28/F	70	76	74.8	74.1	73.9	73.5
ST - N7a	Tin Sam Tsuen					
G/F	70	78.3	77.8	77.5	77.4	77.2

NSR	HKPSG criteria	No Mitigation	Mitigation Option 1	Mitigation Option 2	Mitigation Option 3	Mitigation Option 4
3/F	70	80.5	79.4	79.1	78.5	77.8
ST - N7b	Tin Sam Tsuen					
G/F	70	76.8	76.7	76.7	76.7	76.7
3/F	70	77.7	77.6	77.6	77.5	77.5
ST - N8	Tun Kwun Lau Pak Lok College					
1/F	65	77	76.9	77	77	77
3/F	65	77.2	77.1	77.1	77.1	77.1
6/F	65	78.3	78.1	78.1	78.1	78.1
ST - N9	Hin Keng Estate					
1/F	70	76.1	75.7	75.1	75	75
15/F	70	75.2	74.5	73.5	73.4	73.3
30/F	70	75.1	74	72.9	72.6	72.4
ST - N10	Sun Chiu Estate					
1/F	70	78.9	78.9	78.9	78.9	78.9
15/F	70	78.2	78.1	78	78	78
30/F	70	76.9	76.7	76.6	76.6	76.6
ST-N11a	Planned landuse					
1/F	70	78.1	75.8	68.4	67.2	66.8
15/F	70	80.4	78.4	77.1	75.4	74.4
30/F	70	79.4	77.8	77.8	77.6	77.2
ST-N11b	Planned landuse					
1/F	70	76.9	76.1	75	74.6	74.6
15/F	70	77.9	77	76.2	75.9	75.8
30/F	70	77.3	76.5	76.4	76.1	75.7
ST-N11c	Planned landuse					
1/F	70	76.4	76.3	76.1	76.1	76.1
15/F	70	76.7	76.5	76.3	76.3	76.3
30/F	70	75.9	75.7	75.6	75.5	75.5
ST-N11d	Planned landuse					
1/F	70	78.7	77.6	77.6	76.3	75.9
15/F	70	77.8	76.4	76.4	76.4	76.3
30/F	70	75.7	74.5	74.4	74.4	74.4
ST-N11e	Planned landuse					
1/F	70	74.7	74.4	74.4	74.2	74.1
15/F	70	77.8	76.1	76.1	75.9	75.4
30/F	70	75.8	74.1	74.1	74.1	74.1
ST-N11f	Planned landuse					
1/F	70	74.2	73.1	71.7	71.4	71.2
15/F	70	79.5	77.5	77	76.8	76.2
30/F	70	77.7	75.8	75.7	75.5	75.2
ST-N11g	Planned landuse					
1/F	70	76	75.5	75.5	75.1	75
15/F	70	77.5	76	76	75.9	75.8
30/F	70	75.3	73.8	73.8	73.8	73.8

Table D7 Predicted Noise Levels Eligible for Indirect Technical Remedies

NSR		2000 Prevailing	2019 'TOTAL'	2019 "Existing"	2019 "New"	Meet HKPSG	> Noise Criterion	Total ≥ prevailing +1.0	Total ≥ existing +1.0	Eligible for insulation
Haking Wong T T	WK - N1	74.1	76.2	75.9	63.2	no	yes	yes	no	**no**
		74.4	76.5	76.2	64.6	no	yes	yes	no	**no**
Mei Foo Sun Chuen, Ph	WK N2	75.9	77.4	77.4	51.7	no	yes	yes	no	**no**
		79.4	80.7	80.6	54.6	no	yes	yes	no	**no**
		77.8	79.2	79.1	59.9	no	yes	yes	no	**no**
LCK Reception Centre	WK - N3A	82.5	84.9	84.8	63	no	yes	yes	no	**no**
		81.5	83.8	83.8	65.9	no	yes	yes	no	**no**
		79.2	82	81.2	74.1	no	yes	yes	no	**no**
LCK Reception Centre	WK - N3B	84	86.3	86.3	62.1	no	yes	yes	no	**no**
		81.7	84.1	84	66.1	no	yes	yes	no	**no**
		79.7	82.3	81.8	72.7	no	yes	yes	no	**no**
LCK Reception Centre	WK - N3C	83.5	85	85	61.8	no	yes	yes	no	**no**
		82.5	84	84	64	no	yes	yes	no	**no**
		80.9	82.6	82.3	70.9	no	yes	yes	no	**no**
LCK Hospital	WK -N4A	69.4	71.7	71.1	62.9	no	yes	yes	no	**no**
		70.2	72.4	71.8	63.5	no	yes	yes	no	**no**
LCK Hospital	WK - N4B	58.9	61.6	60.7	54.2	yes	no	yes	no	**no**
		61.3	63.8	63	56.2	yes	no	yes	no	**no**
Mei Foo Sun Chuen, Ph	WK - N5	74.5	82.6	82.6	57.4	no	yes	yes	no	**no**
		75.7	80.9	80.8	64	no	yes	yes	no	**no**
		79.3	82.1	81.9	69	no	yes	yes	no	**no**
Mei Foo Sun Chuen, Ph	WK - N6	76.7	85.5	85.5	58.2	no	yes	yes	no	**no**
		76.3	81.4	81.3	64.8	no	yes	yes	no	**no**
		79.1	82	81.8	68.6	no	yes	yes	no	**no**
LCK Reception Centre (	WK - N7A	82.7	84.2	84.1	63.9	no	yes	yes	no	**no**
		82.3	83.8	83.7	65.4	no	yes	yes	no	**no**
		81.3	82.9	82.7	68.4	no	yes	yes	no	**no**
LCK Reception Centre (	WK - N7B	76.8	78.5	78.4	63.8	no	yes	yes	no	**no**
		77.1	78.7	78.5	65.9	no	yes	yes	no	**no**
		76.8	78.7	78.2	69.1	no	yes	yes	no	**no**

Table D7 Predicted Noise Levels Eligible for Indirect Technical Remedies										
NSR		2000 Prevailing	2019 'TOTAL'	2019 "Existing"	2019 "New"	Meet HKPSG	> Noise Criterion	Total ≥ prevailing +1.0	Total ≥ existing+1.0	Eligible for insulation
Woodcrest Hill		ST - N1a								
	1/F	77.3	80.4	80.2	65.8	no	yes	yes	no	**no**
	3/F	79.2	82.3	82.1	68.8	no	yes	yes	no	**no**
Woodcrest Hill		ST - N1b								
	1/F	76.8	79.8	79.7	62.4	no	yes	yes	no	**no**
	3/F	77	80.1	79.9	65.9	no	yes	yes	no	**no**
Keng Hau Road		ST - N2a								
	G/F	71.8	75	74.8	61.3	no	yes	yes	no	**no**
	3/F	72.9	76.1	75.9	63.4	no	yes	yes	no	**no**
Keng Hau Raod		ST - N2b								
	G/F	66.9	71.1	70.3	63.3	no	yes	yes	no	**no**
	3/F	69.6	73.3	72.8	63.8	no	yes	yes	no	**no**
Shatin Heights		ST - N3a								
	1/F	68	71	70.7	58.8	no	yes	yes	no	**no**
	4/F	68.5	72.3	71.9	61.5	no	yes	yes	no	**no**
	8/F	69.6	73.5	73	64.4	no	yes	yes	no	**no**
Shatin Heights		ST - N3b								
	1/F	64.9	68.8	67.9	61.8	yes	no	yes	no	**no**
	4/F	66	71.5	70.1	65.6	no	yes	yes	yes	**yes**
	8/F	67.8	73.5	71.4	69.2	no	yes	yes	yes	**yes**
Shatin Heights		ST - N3c								
	1/F	73.7	76.6	76.6	56.3	no	yes	yes	no	**no**
	4/F	74.6	77.7	77.6	59.9	no	yes	yes	no	**no**
	8/F	75	78.2	78	64.7	no	yes	yes	no	**no**
Cheng Wing Chee College			ST - N4a							
	1/F	71.5	78.3	78.3	58.5	no	yes	yes	no	**no**
	3/F	71.7	78.4	78.3	59.7	no	yes	yes	no	**no**
	6/F	72	79	78.9	62.4	no	yes	yes	no	**no**
Carmel Alison Lam Primary			ST - N5							
	1/F	69.6	76.2	76.1	54.8	no	yes	yes	no	**no**
	3/F	69.5	75.8	75.8	55.2	no	yes	yes	no	**no**
	6/F	69	75.5	75.4	55.8	no	yes	yes	no	**no**
Carado Garden		ST - N6a								
	1/F	68.4	72.4	72.3	54.9	no	yes	yes	no	**no**
	14/F	68.6	72.5	72.3	60.1	no	yes	yes	no	**no**
	28/F	68.5	72.6	71.9	64.4	no	yes	yes	no	**no**
Carado Garden		ST - N6b								
	1/F	69.2	72.6	72.5	56.5	no	yes	yes	no	**no**
	14/F	69.5	73.2	72.8	63.1	no	yes	yes	no	**no**

NSR		2000 Prevailing	2019 'TOTAL'	2019 "Existing"	2019 "New"	Meet HKPSG	> Noise Criterion	Total ≥ prevailing +1.0	Total ≥ existing+1.0	Eligible for insulation
	28/F	69.3	73.4	72.5	66.1	no	yes	yes	no	**no**
Tin Sam Village		ST - N7a								
	G/F	75.8	77.2	77.1	61.8	no	yes	yes	no	**no**
	3/F	75.9	77.8	77.5	67	no	yes	yes	no	**no**
Tin Sam Village		ST - N7b								
	G/F	74.4	76.7	76.6	52.9	no	yes	yes	no	**no**
	3/F	74.8	77.5	77.5	56.5	no	yes	yes	no	**no**
Lau Pak Lok College		ST - N8								
	1/F	70.7	77	76.8	61.4	no	yes	yes	no	**no**
	3/F	72	77.1	77	62.2	no	yes	yes	no	**no**
	6/F	72.3	78.1	78	62.7	no	yes	yes	no	**no**
Hin Keng Estate		ST - N9								
	1/F	68.3	75	75	53.9	no	yes	yes	no	**no**
	15/F	67.7	73.3	73.3	56	no	yes	yes	no	**no**
	30/F	67.6	72.4	72.2	58.8	no	yes	yes	no	**no**
Sun Chui Estate		ST - N10								
	1/F	73.9	78.9	78.9	49.4	no	yes	yes	no	**no**
	15/F	73.2	78	77.9	58.2	no	yes	yes	no	**no**
	30/F	71.8	76.6	76.5	59.4	no	yes	yes	no	**no**

Annex E

Previous EIA: Planning Scenarios for Wai Man Tsuen Re-development

Scenario 1: Industrial Development

Scenario 1 assumes that the development potential of the site will be maximised as much as possible within the development constraints imposed by the route and its connections to/from Ching Cheung Road. This scenario provides for most of the land uses proposed under the current Cheung Sha Wan OZP S/K5/10 and Cheung Sha Wan & Sham Shui Po ODP (Northern Part) D/K5A/1A.

Various possible conceptual layouts have been considered for the subject development site in Butterfly Valley. The layout and access arrangement proposed to provide access to the site are depicted on *Figure A*. Due to the topography of the area, a direct access from Butterfly Valley Road to the development site is not desirable as it lies on an approximate 10% downgrade which would require heavy goods vehicles to brake heavily and turn sharply. It would be preferable to provide a roundabout with direct access to development from Butterfly Valley Road. Access to the development site in the east can be taken from King Lam Street. Access between the two development areas separated by the route will be provided via a road underpass beneath the embankment for the highway maintenance crossover.

The main land use proposed in this scenario is I(A) industry. Industries grouped under this class are mostly light manufacturing industries. They are generally not significantly affected by factors such as proximity to sources of raw materials and market and can be accommodated in ordinary multi-storey flatted factory buildings. Some of these industries may give rise to environmental pollution to adjacent areas. The subject site is suitable for industrial development, being located within an existing industrial estate in Cheung Sha Wan and near the Kwai Chung industrial and port areas. The site is also situated away from the main residential areas and other sensitive land uses such as G/IC uses. The minimum standards for vehicular access and fire protection have also been provided in the layout

According to the HKPSG, the maximum average plot ratio within an industrial zone is 9.5 within the Metroplan area and the range of permissible plot ratios is 5 to 12 subject to airport height restrictions. A worker density of about 25 m^2/worker is normally used as a guide for the planning of infrastructure for I(A) industries.

There is an existing Airport Height Restriction (AHR) of 140 m. There is also an existing technical or design height of 60.96 m P.D. or to the height of the highest natural feature within 90 m of the point concerned (whichever is higher) imposed on the site. WKDS also specified a height band of 40 m to 65 m within the Ching Cheung Road - King Lam Street area. These, however, do not impose a severe constraint on the proposed development.

The maximum gross plot ratio for the I(A) sites in this scenario is 12. The maximum achievable plot ratio has taken into account several factors such as the proposed formation levels of the sites in Butterfly Valley, as shown in Figure 4.5e, typical I(A) factory floor-to-floor heights (5 m for first floor and 4 m for subsequent floors) and average site coverage of about 70%. The development would consist mainly of high density industries. It is estimated that this scenario will generate a total industrial gross floor area of about 244,800 m^2 and provide employment for about 9,800 persons based on I(A) worker density. Given the likely traffic impacts of such an intensive development within the site, a detailed Traffic Impact Assessment (TIA) would have to be carried out in a separate transport assessment study after the main alignment and road connections of Route 16 have been decided to ascertain the capacity of the local road network to accommodate this high level of development.

As an alternative, it is proposed that I(O) industries be considered instead for the proposed I(A) sites. Hong Kong is undergoing a process of structural change from an industrial to a post-industrial economy with particular emphasis on high value-added industries and services. This trend is illustrated by the contemporary establishment of Industrial/Office (I/O) land zonings whereby the redesignation of former industrial uses to those more inclined to Research and Development has been sanctioned by the Town Planning Board. Under the current town planning explanatory notes, the office uses accommodated within an I/O building should be ancillary to manufacturing activities. The Planning Department is, however, concerned with the large amount of approved I(O) uses in Cheung Sha Wan which is about 600,000 m^2 in excess of floor space. It is also concerned with the traffic generation of I(O) uses which is estimated to be about 4 over times that of industrial use. Notwithstanding this, in the event that there would be future demand for the I(O) industries in this area, the I(A) sites could be considered for this purpose subject to a more detailed assessment of the traffic impact assessment.

Amenity areas, 'G' and 'LO' sites are proposed to replace the same land uses proposed under the Cheung Sha Wan & Sham Shui Po ODP. The G site should accommodate a public toilet and cooked food centre for the workers. Besides replacing the open space in the ODP, the proposed LO site also serves as a reprovisioning of the open space affected by the route connections. It is proposed that the existing slopes immediately south of Ching Cheung Road be retained as GB. The GB area can accommodate the two tunnel portals for the route main alignment. The rest of the areas are accounted as amenity areas and roads. The amenity areas will be landscaped. A drainage reserve will be safeguarded beneath the internal roads and connected with the existing mullah beside Kom Tsun Street. A land use budget for the proposed land uses and the preferred planning parameters for the layout in Scenario 1 is depicted in *Table A.*

Table A ***Land Use Budget for Scenario 1***

Proposed Land Use	Land Area (ha)	Permissible Gross Plot Ratio	Remarks
Industry I (A)	2.04	Max. 12	Subject to detailed TIA study
Local Open Space (LO)	0.30	-	-
Government Reservation (G)	0.24	5	-
Amenity Area (A)	0.32	-	-
Green Belt (GB)	1.03	-	-
Roads	1.47	-	-
Total	5.40	-	-

Scenario 2: Industrial Development

Scenario 2 has a different physical layout and access arrangement from Scenario 1. The proposed internal access road loops around the site on the western side of Butterfly Valley, providing direct access to the proposed development. The proposed land uses are depicted on *Figure B.* The main land use proposal under this scenario is industrial use. This proposal envisage the development of I(C) industries. Examples of I(C)

industries include godowns, general warehousing, cold storage, oil storage, sand storage and telephone cable storage. It is proposed that the I(C) uses be located on the western side of the route which is farthest away from existing and proposed uses to avoid adverse environmental effects on surrounding uses. By reserving sites for I(C) development in the future, the existing dangerous goods industries and godowns could be reprovisioned on these sites. This scenario similarly assumes alternative I(O) use on the I(A) sites given its significance in current development trends.

According to the HKPSG, I(C) industries should be located in industrial areas. Locational guidelines for dangerous goods godowns are specified in the HKPSG and should be adhered to in the development of I(C) godowns. Since I(C) industries involve bulk storage which are space-consuming and provide little employment opportunities on site, the worker densities are low. An average gross floor space allocation of about 1,500 m^2/worker is therefore assumed. Plot ratios for I(O) are the same as I(A) industries.

Two I(C) sites are reserved in this scenario. They are located on island sites as emergency access is a requirement for dangerous goods industries/godowns. The same AHR and design height controls apply for the development site as in Scenario 1. Similarly, the height of proposed buildings should not exceed the level of the existing Ching Cheung Road for the reasons cited earlier. The maximum achievable gross plot ratio for the I(C) and I(A) sites is 12. It is estimated that the industries will generate a total industrial gross floor area of 244,800 m^2 and provide employment for about 7,430 persons based on I(A) and I(C) worker densities.

I(A) developments are permitted to go up to plot ratio 12 under the HKPSG and statutory and non-statutory plans and is recommended in this scenario as the maximum limit. In view of the likely impacts of high traffic generation, it is proposed that a detailed TIA study for the area be carried out to ascertain the impacts of high density industrial development.

As in Scenario 1, the 'G', 'LO', amenity areas and 'GB' uses have been retained, and the drainage reserve will be safeguarded beneath the internal roads and connected with the existing mullah beside Kom Tsun Street. *Table B* is the land use budget for Scenario 3.

Table B ***Land Use Budget for Scenario 2***

Proposed Land Use	Land Area (ha)	Permissible Gross Plot Ratio	Remarks
Industry I(A)	1.54	Max. 12	Subject to detailed TIA study
Industry I(C)	0.50	Max. 12	Subject to detailed TIA study
Local Open Space (LO)	0.30	-	-
Government Reservation (G)	0.24	5	-
Amenity area (A)	0.32	-	-
Green Belt (GB)	1.03	-	-
Roads	1.47	-	-
TOTAL	5.4	-	-

Scenario 3: Mixed Use Development

Scenario 3 has the same physical layout and access arrangement as Scenario 1. The proposed land uses, (depicted on *Figure C*) are I(A), Other Specified Use (OU), LO, G, GB and Amenity areas. This proposal has considered introducing OU (lorry parking) which would be appropriate, given the area lies within an existing industrial area which will generate demand for such parking space. It has also been observed that vehicles are currently parked alongside roads such as King Lam Street within the industrial estate which may cause traffic problems.

It is envisaged that I(A) developments can go up to a plot ratio of 12 as permitted under the HKPSG. This will result in an employment population of about 7,300 persons based on I(A) worker density in this scenario. This scenario similarly assumes alternative I(O) use on I(A) sites. Consideration should be given to likely traffic impacts, which should be ascertained by a separate detailed TIA study.

The 'G', 'LO', amenity areas and 'GB' land uses are provided to ensure that there is some landscaping of the area to make it more pleasant visually as it is intended to be a major gateway to West Kowloon. The drainage reserve is also safeguarded underneath the internal road in this proposal. *Table C* is the land use budget for Scenario 3.

Table C ***Land Use Budget for Scenario 3***

Proposed Land Use	Land Area (ha)	Permissible Gross Plot Ratio	Remarks
Industry I(A)	1.52	Max 12	Subject to detailed TIA study
Other Specified Use (OU)	0.57	5	-
Local Open Space(LO)	0.23	-	-
Government Reservation (G)	0.24	5	-
Amenity area (A)	0.34	-	-
Green Belt (GB)	1.03	-	-
Roads	1.47	-	-
TOTAL	5.40		

3.1.1.1 Planning Implications

The study area could accommodate a certain level of development even with the constraints imposed by Route 16 and it's connections. A set of planning parameters have been assumed for the Butterfly Valley Cottage Area under the various development scenarios. Parts of the development site would be sterilised from any possible development because they are located under the elevated structure and as such are not usable. *Table D* is an estimation of the areas of proposed land uses under the current ODP.

Table D ***Estimated Areas of Proposed Land Uses under the Cheung Sha Wan & Sham Shui Po ODP D/K5A/1A***

Land Use	Site Area (ha)	Remarks
Industry I (A)	2.76	-
Local Open Space (LO)	0.23	Incorporates a 9 m D.R. to be constructed beneath the open space
Government Reservation (G)	0.24	To include public toilets & cooked food centre to cater for workers
Green Belt (GB)	1.75	-
Roads	1.56	-
Total	**6.54***	-

* Total area of the Butterfly Valley site is bigger under the ODP than the three scenarios because of the re-alignment of the Butterfly Valley Road and widening of Ching Cheung Road which has been taken into account in the latter planning proposals.

Table E is a summary of the differences in potential land area for development of industries and other uses between the current ODP and the three scenarios.

Table E ***Comparison between Current ODP (D/K5A/1A) and Proposed Scenarios***

Proposed Land Use	ODP	Scenario 1	Scenario 2	Scenario 3
I	2.76	2.04	2.04	1.52
G	0.24	0.24	0.24	0.24
GB	1.75	1.03	1.03	1.03
LO	0.23	0.30	0.30	0.23
A	-	0.32	0.32	0.34
OU	-	-	-	0.57
ROADS	1.56	1.47	1.47	1.47
Total	6.54	5.40	5.40	5.40

There is an apparent 'net loss' in industrial land of about 0.72 ha (Scenarios 1 & 2) and 1.24 ha (Scenario 3) if the ODP layout was used as a comparison with the three scenarios. The loss in development potential for the Butterfly Valley area would not be substantial for Scenarios 1 and 2. The scenarios have made adequate provisions for the G and LO sites earmarked in the current ODP. As evident in the comparison table, the amount of land taken up for roads and amenity areas would be more than the ODP even though the entire planning area is smaller, because of Route 16.

In terms of planning and land use compatibility, the proposed land uses, mainly industrial and other related uses, in the three scenarios would be compatible with the intention to extend existing Cheung Sha Wan industrial estate. The proposed uses would not impose any constraints on other existing uses in the vicinity. The Lai Chi Kok Hospital and Reception Centre would be well buffered from the development site by the existing knoll. The proposed land uses also reflect the planning intentions for the area as apparent in the relevant OZP and ODP. The need to achieve a balanced development given the constraints imposed by the route and the need to plan for an environmentally acceptable development at this location has also been taken into the planning considerations. In this respect, the proposals have taken into account the transportation aspects of the project, current statutory and non-statutory plans and comments of the various government departments.

In terms of transport and traffic aspects, the original intention of the OZP and ODP to develop the site fully for industrial and related uses would mean higher traffic generation than the proposed scenarios as there would be less land available for such development because of the constraints imposed by the route. An assessment of traffic impacts of the various land uses cannot be carried out in great detail at this conceptual design stage. Given the various planning layouts and access arrangements, a more detailed assessment of traffic generation and road capacity would need to be undertaken and refinements made to the layouts and proposed land uses, during the detailed design stage.

The three scenarios would make optimum use of developable land within the valley. Scenario 1 would produce 2.04 ha of industrial land. This scenario has taken most of the proposals of the Cheung Sha Wan & Sham Shui Po ODP (Northern Part) into account. Scenario 2 introduced I(C) use as a possible solution to reprovision the existing dangerous goods industries and godowns in Butterfly Valley. Although this would reduce the amount of land for I(A) development, a better mix of land uses would be achieved that may generate less traffic. Scenario 3 introduced a mix of uses such as OU (lorry parking) and I(A) at the area most affected by the route alignment and connections. Lorry parking may, however, generate more traffic for the area.

Taking into consideration the various planning factors, it is considered that the most preferred choice is Scenario 2. The scenario has taken into account the need to reprovision existing and committed uses and maximisation of development potential given the route alignment and connections. Less traffic impact would be generated as there would be less developable land for I(A) industries which are usually intensive developments with high employment of workers. Furthermore, the mix of uses complement each other and would be compatible to the existing site conditions and surrounding uses.

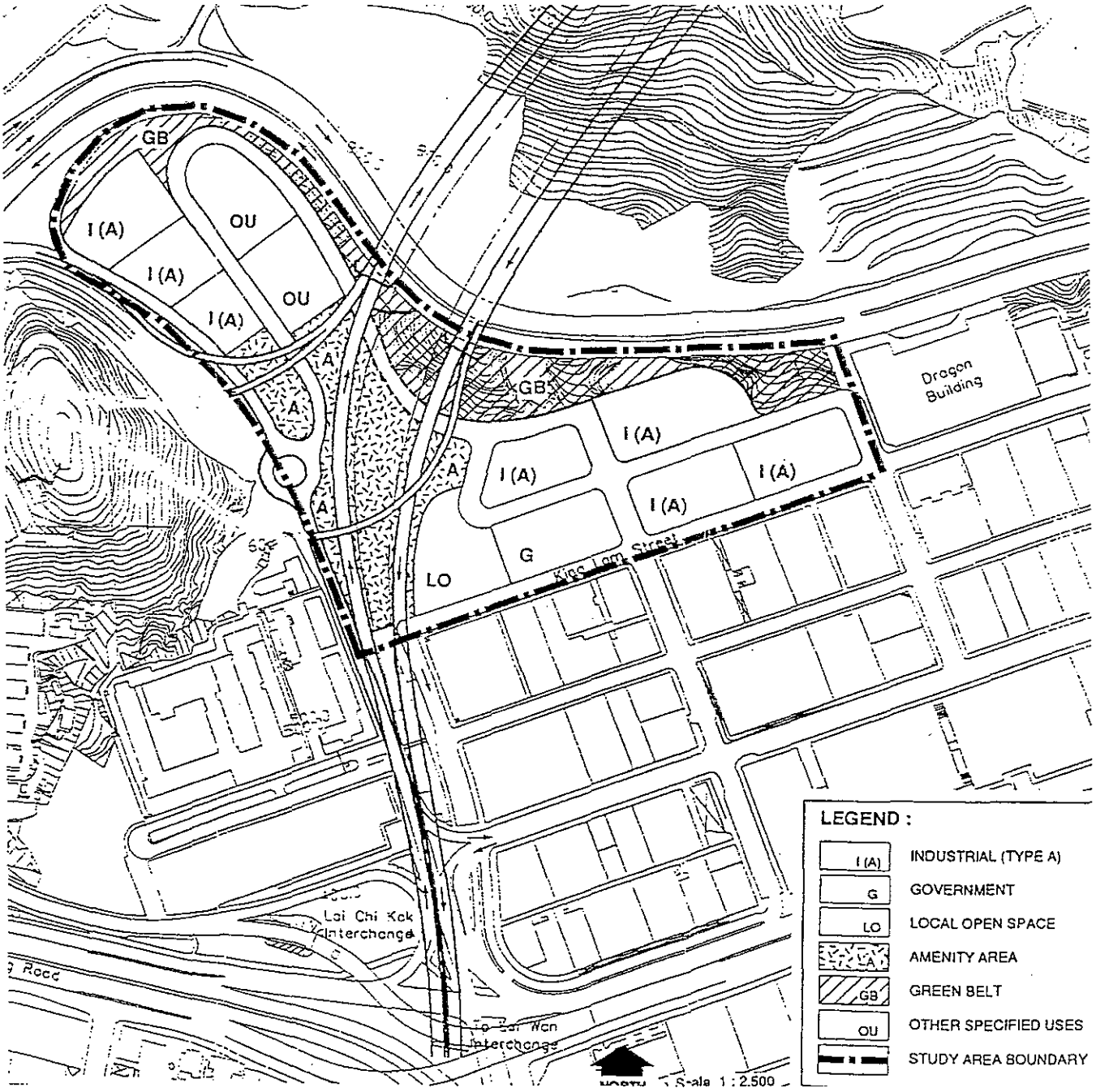

FIGURE A - SCENARIO 3 : MIXED USE DEVELOPMENT

Environmental Resources Management
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong
ERM

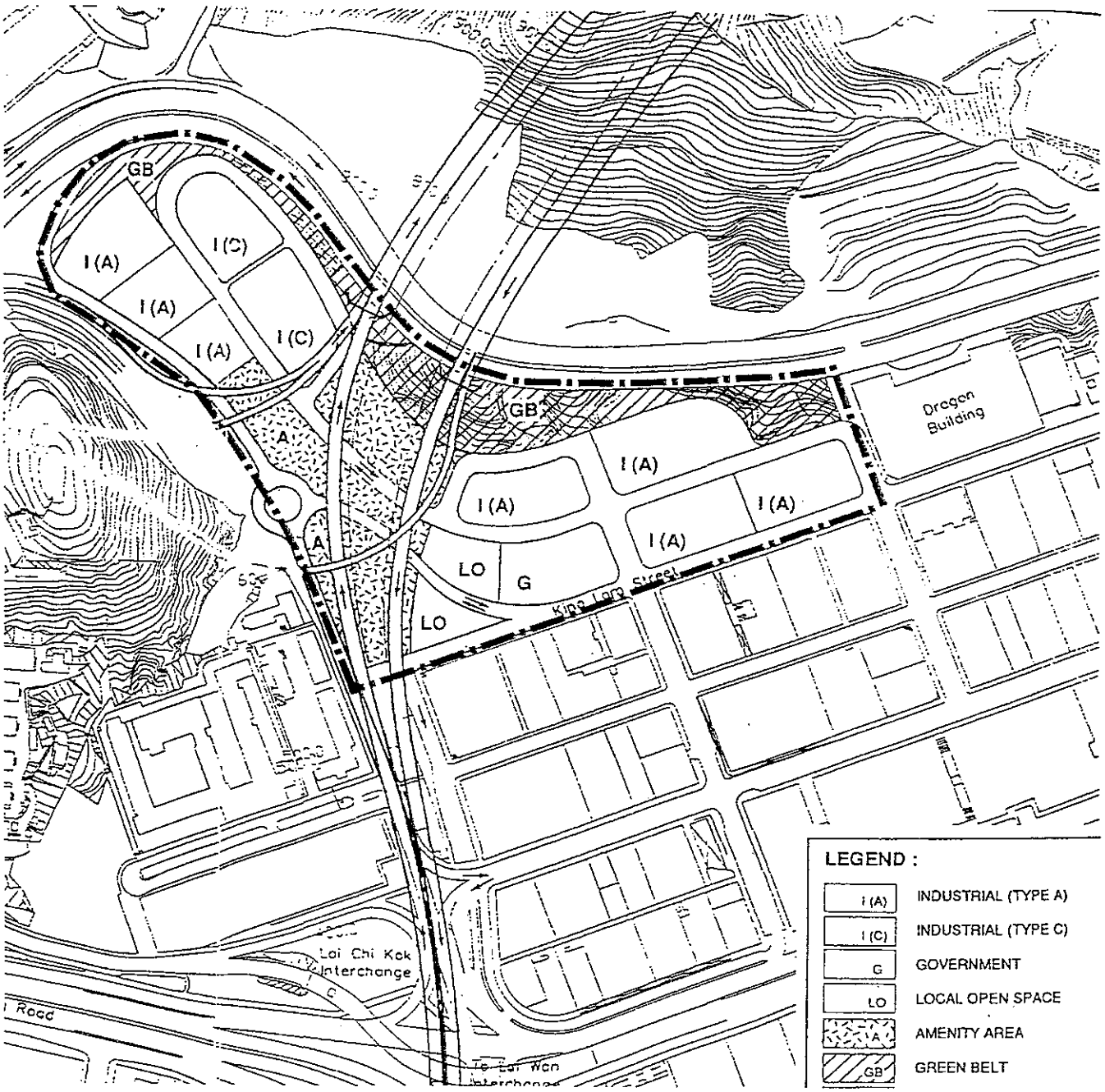

FIGURE B - SCENARIO 2 : INDUSTRIAL (TYPE A & C) DEVELOPMENT

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6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong
ERM

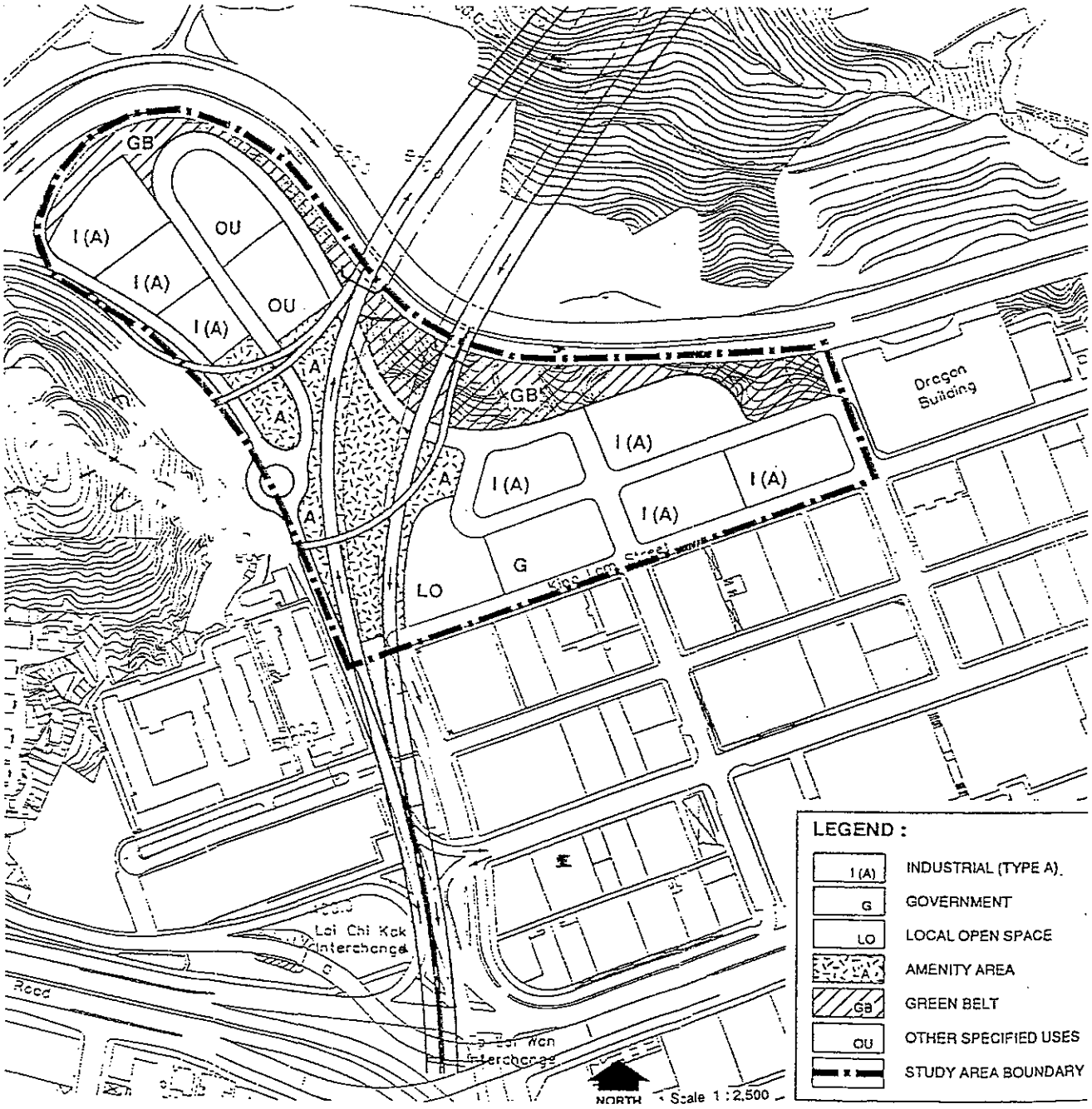
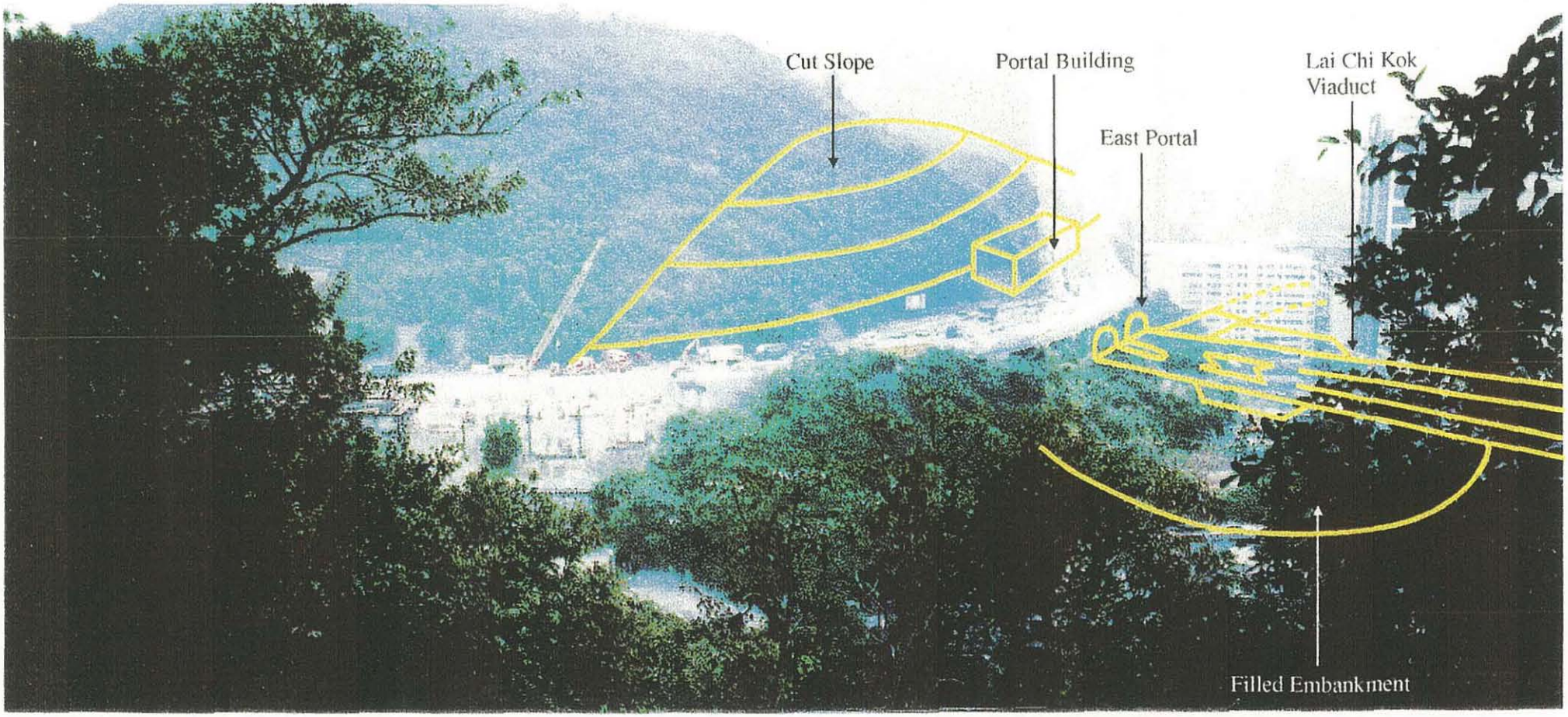


FIGURE C - SCENARIO 1: INDUSTRIAL (TYPE A) DEVELOPMENT

Environmental Resources Management
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong
ERM

Annex F

Illustrations & Landscape Works Drawings



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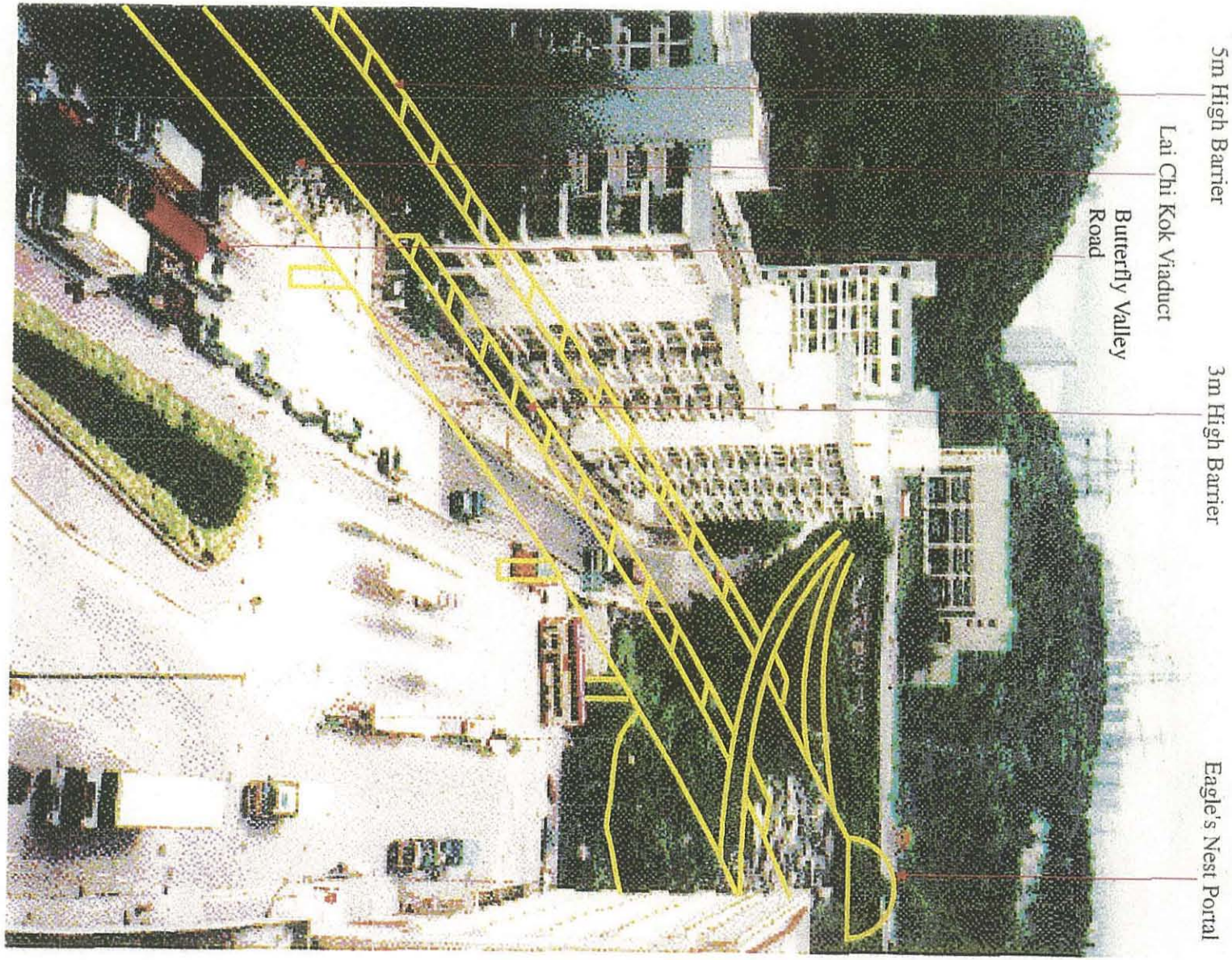
Route 16

AGREEMENT NO. CE 42/96
WEST KOWLOON TO SHATIN

DRAWN	CHECKED	ROUTE 16 FROM WEST KOWLOON TO SHA TIN 16 號幹線由西九龍至沙田段	
DATE		DRG TITLE Photographic Images - Kowloon End Portal	DRG NO Figure 1
SCALE			REV



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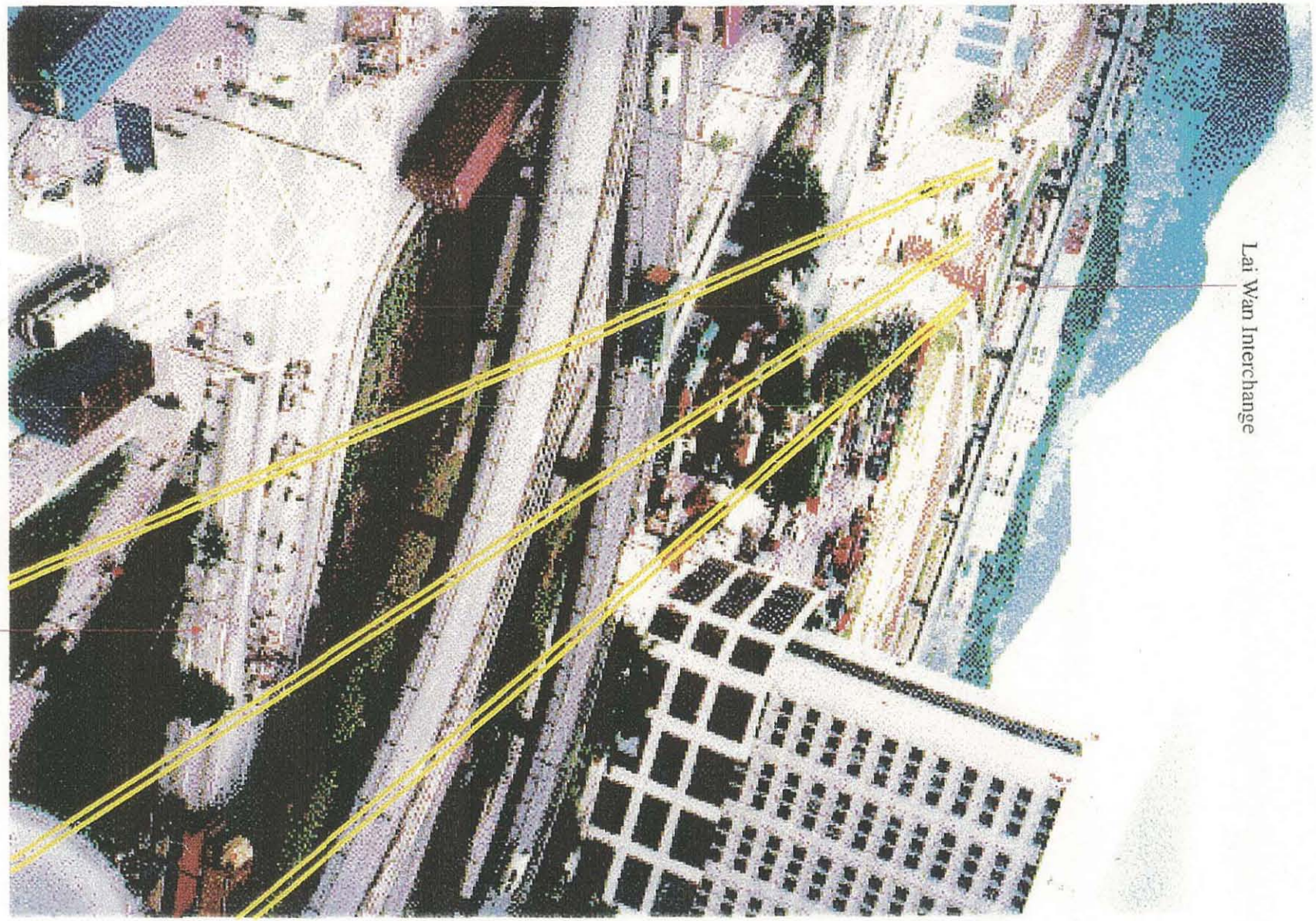
Scott Wilson - Parsons Brinckerhoff In Association with M.V.A. Asia ERM Hong Kong	AGREEMENT NO. CE 42/96 WEST KOWLOON TO SHATIN	DATE SCALE	DRG TITLE: Photographic Images - Lai Chi Kok Viaduct at Butterfly Valley Road	DRG NO: Figure 2 / REV



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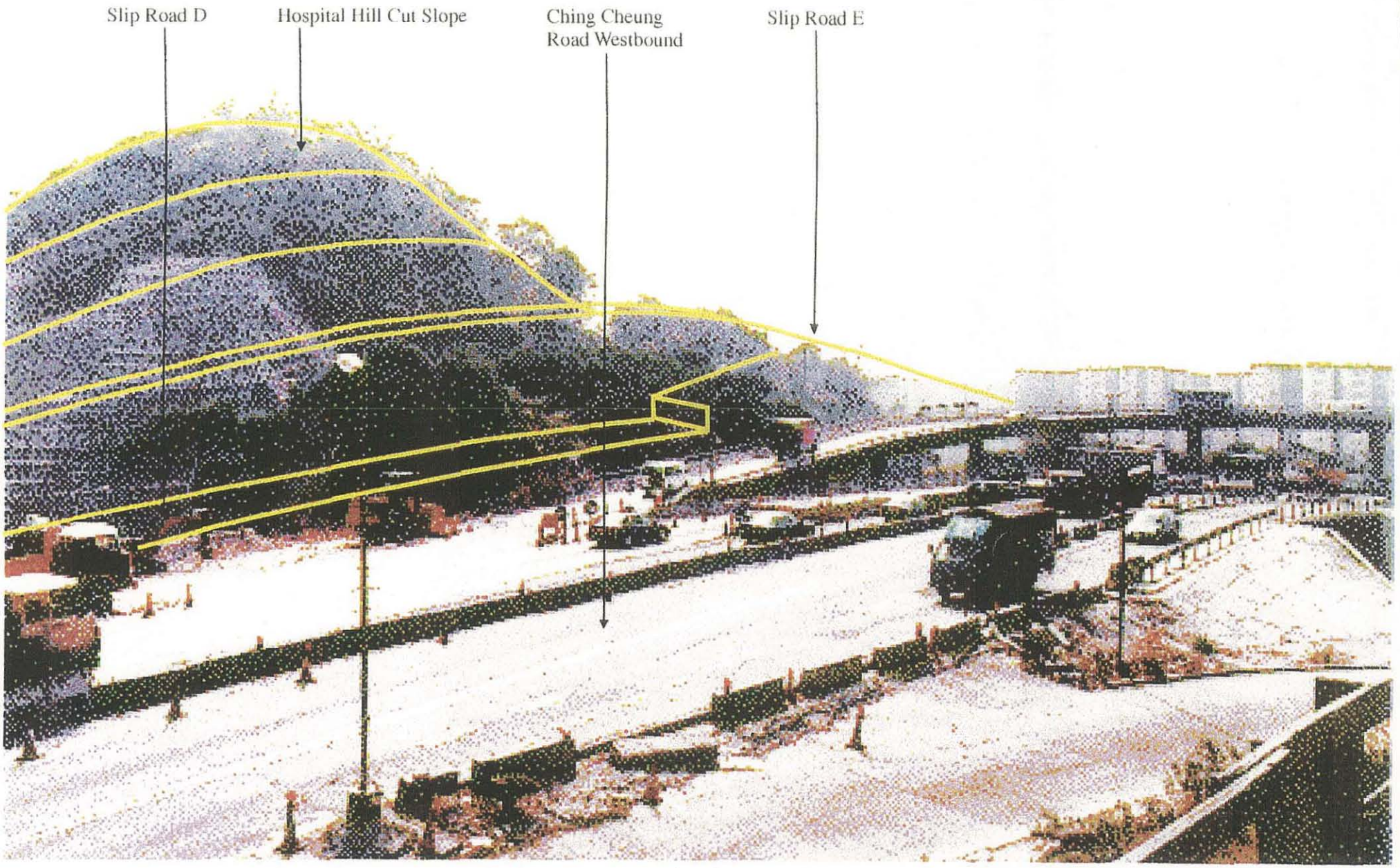
DATE		DRG TITLE Photographic Images - Lai Chi Kok Viaduct Over Cheung Sha Wan Road	DRG NO Figure 3
SCALE			REV



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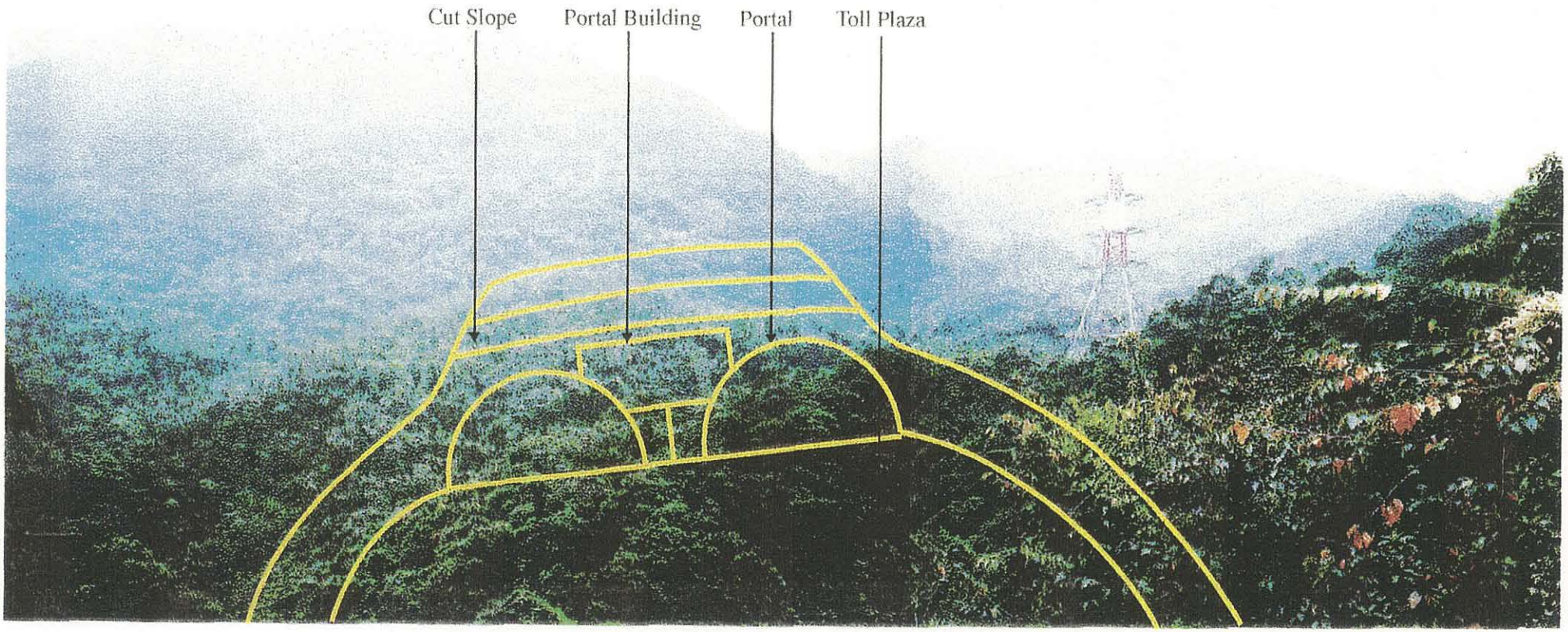
DRAWN	CHECKED	ROUTE 16 FROM WEST KOWLOON TO SHA TIN 16 號幹線由西九龍至沙田段		
DATE		DRG TITLE Photographic Images - Slip Roads D & E near Lai Chi Kok Hospital	DRG NO Figure 4	REV
SCALE				



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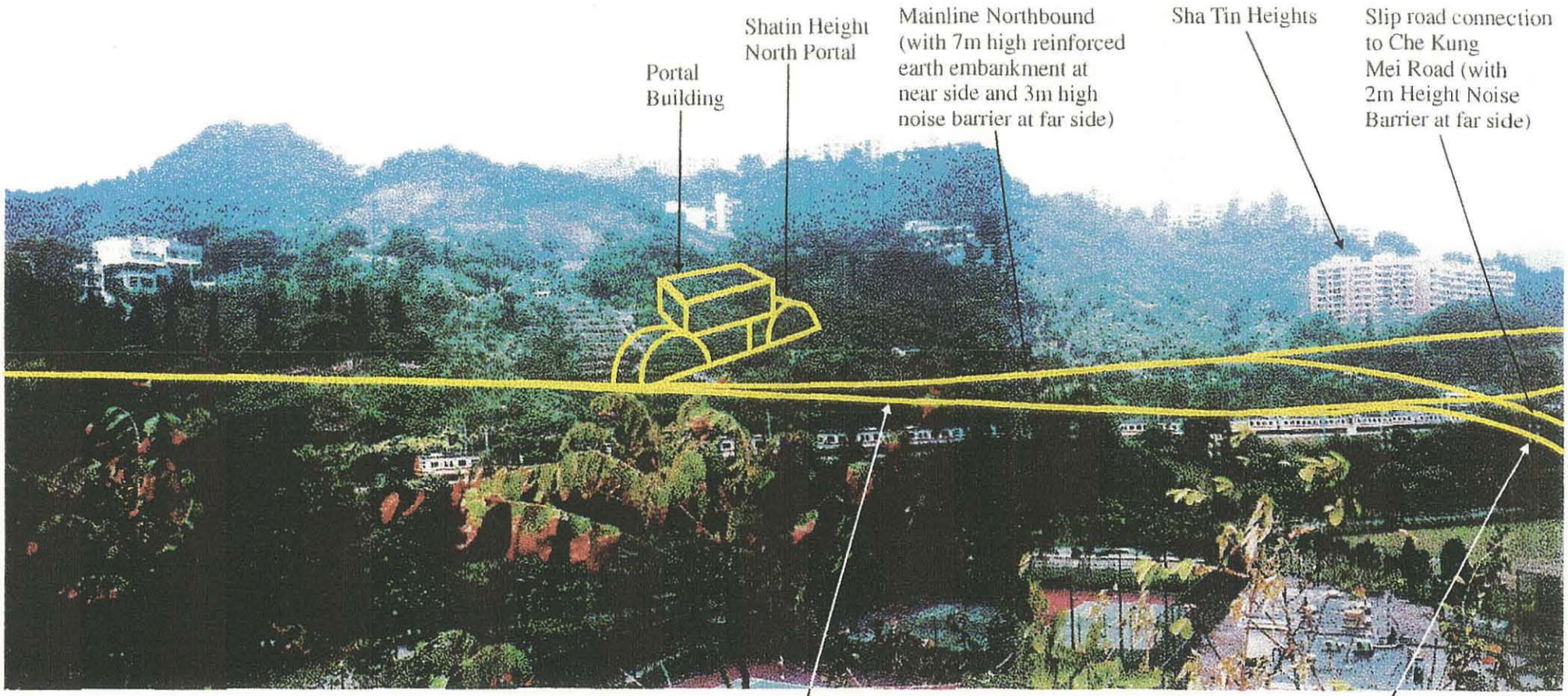
DATE	
SCALE	

ROUTE 16 FROM WEST KOWLOON TO SHA TIN
16 號幹線由西九龍至沙田段

DRG TITLE: Photographic Images - Portal of Eagle's Nest Tunnel at Toll Plaza

DRG NO: Figure 5

REV



The Government of the Hong Kong Special Administrative Region Highways Department	Route 16 AGREEMENT NO. CE 42/96 WEST KOWLOON TO SHATIN	DRAWN / CHECKED	ROUTE 16 FROM WEST KOWLOON TO SHA TIN 16 號幹線由西九龍至沙田段
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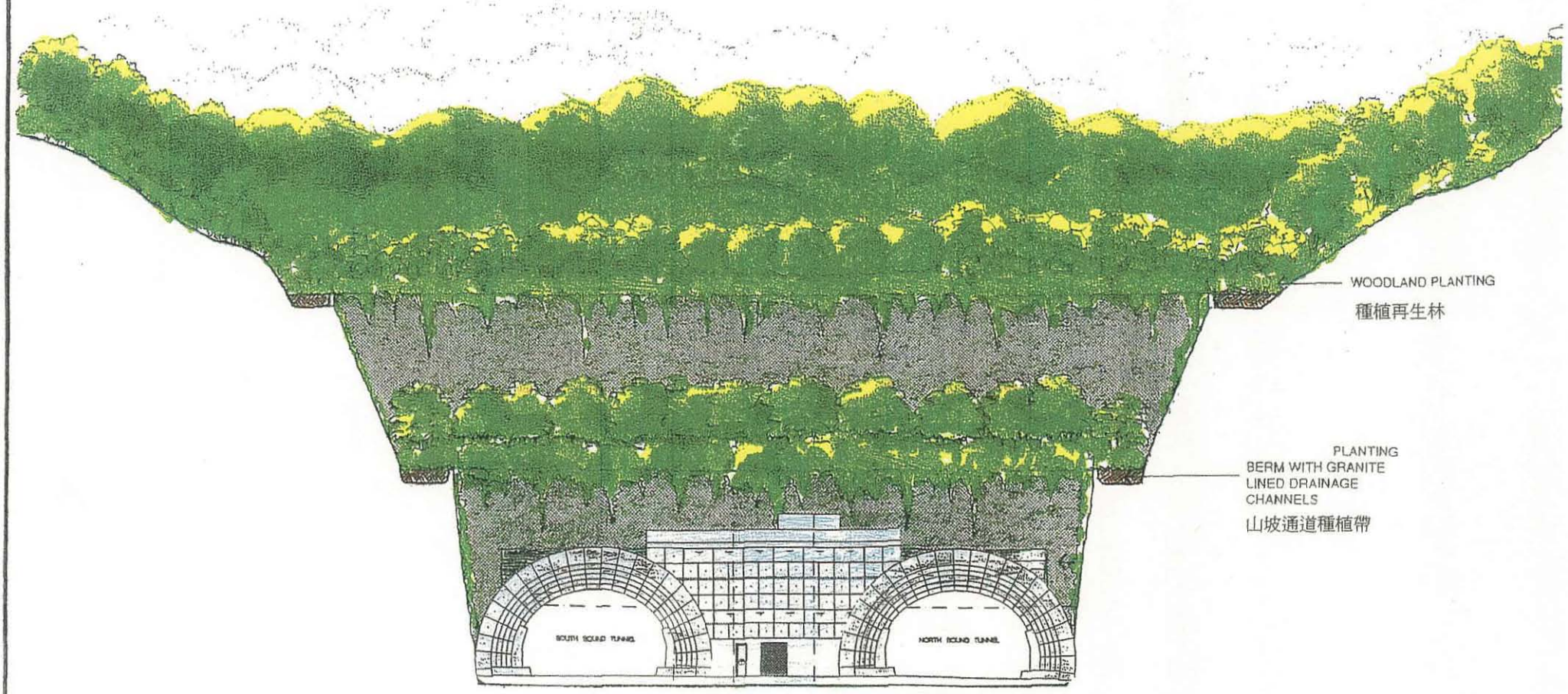
Scott Wilson - Parsons Brinckerhoff In Association with M V A Asia ERM Hong Kong		DATE / SCALE	DRG TITLE: Photographic Images - General View of Shatin End	DRG NO: Figure 7 / REV



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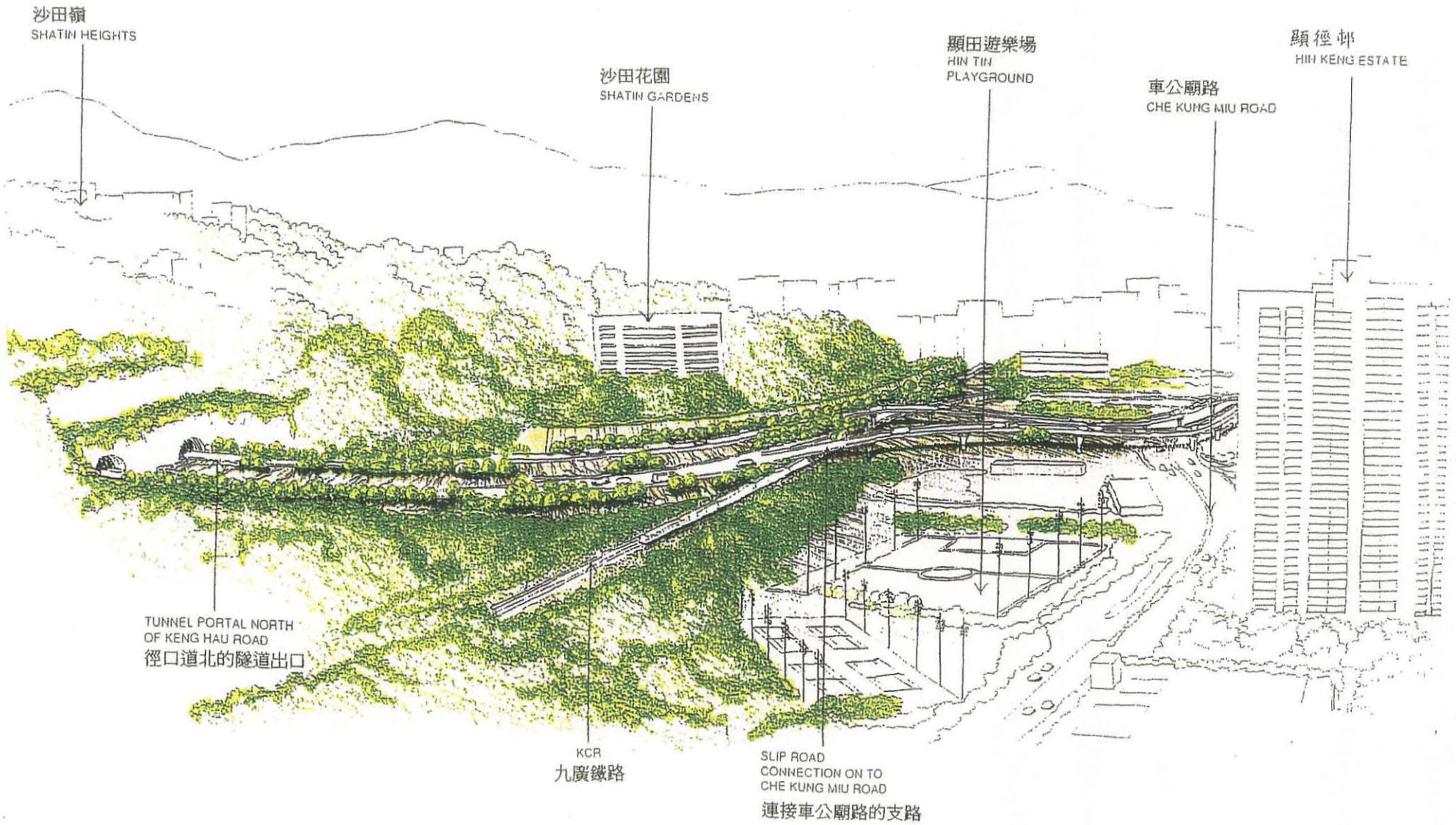
ROUTE 16 FROM WEST KOWLOON TO SHA TIN
16 號幹線由西九龍至沙田段

DRG. TITLE: CROSS SECTION THROUGH TUNNEL TOLL PLAZA PORTAL

DRG. NO.: Figure 8

REV.



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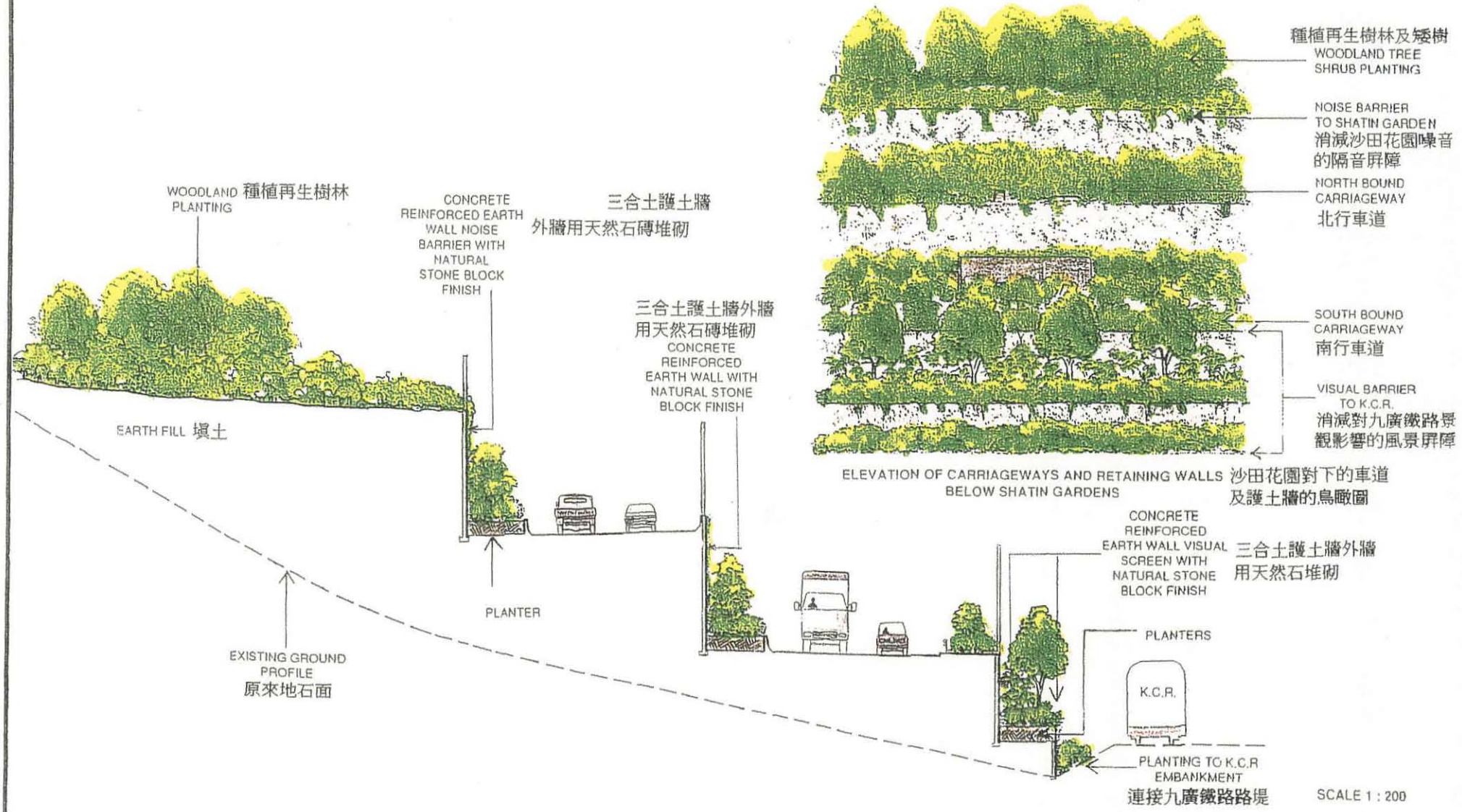
16 號幹線由西九龍至沙田段

DRG. TITLE: SHATIN VALLEY PERSPECTIVE VIEW LOOKING NORTH

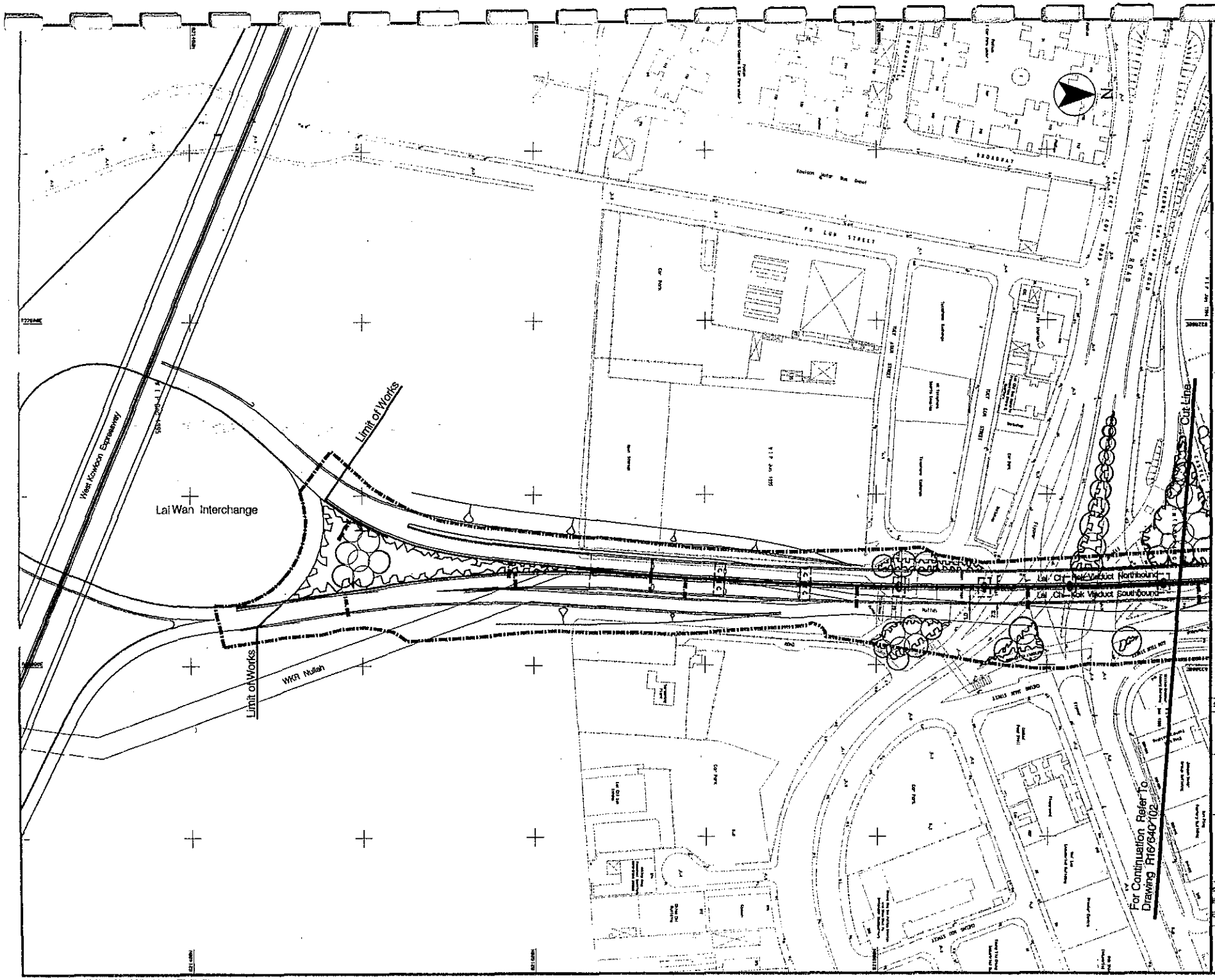
DRG. NO.: Figure 9

REV.



ELEVATION OF CARRIAGEWAYS AND RETAINING WALLS BELOW SHATIN GARDENS 沙田花園對下的車道及護土牆的鳥瞰圖

The Government of the Hong Kong Special Administrative Region Highways Department	Route 16 AGREEMENT NO. CE 42/96 WEST KOWLOON TO SHATIN	DRAWN / CHECKED	ROUTE 16 FROM WEST KOWLOON TO SHA TIN 16 號幹線由西九龍至沙田段
Scott Wilson - Parsons Brinckerhoff In Association with M.V.A. Asia ERM Hong Kong		DATE / SCALE	DRG. TITLE: TYPICAL SECTION OF REINFORCED EARTH RETAINING WALL - SHATIN DRG. NO.: Figure 10 REV.



Legend :

- Existing Vegetation
- Indigenous Revegetation of Hill Slopes
- Ornamental Shrub Planting
- Formal Tree Planting
- Grass

Suffix	Date	Revision	Drawn	Checked

Government of Hong Kong
Highways Department

Route 16

CONTRACT CE 43/96
WEST KOWLOON TO SHATIN
INVESTIGATION ASSIGNMENT

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Drawing No.	R16 / 640 / 101		
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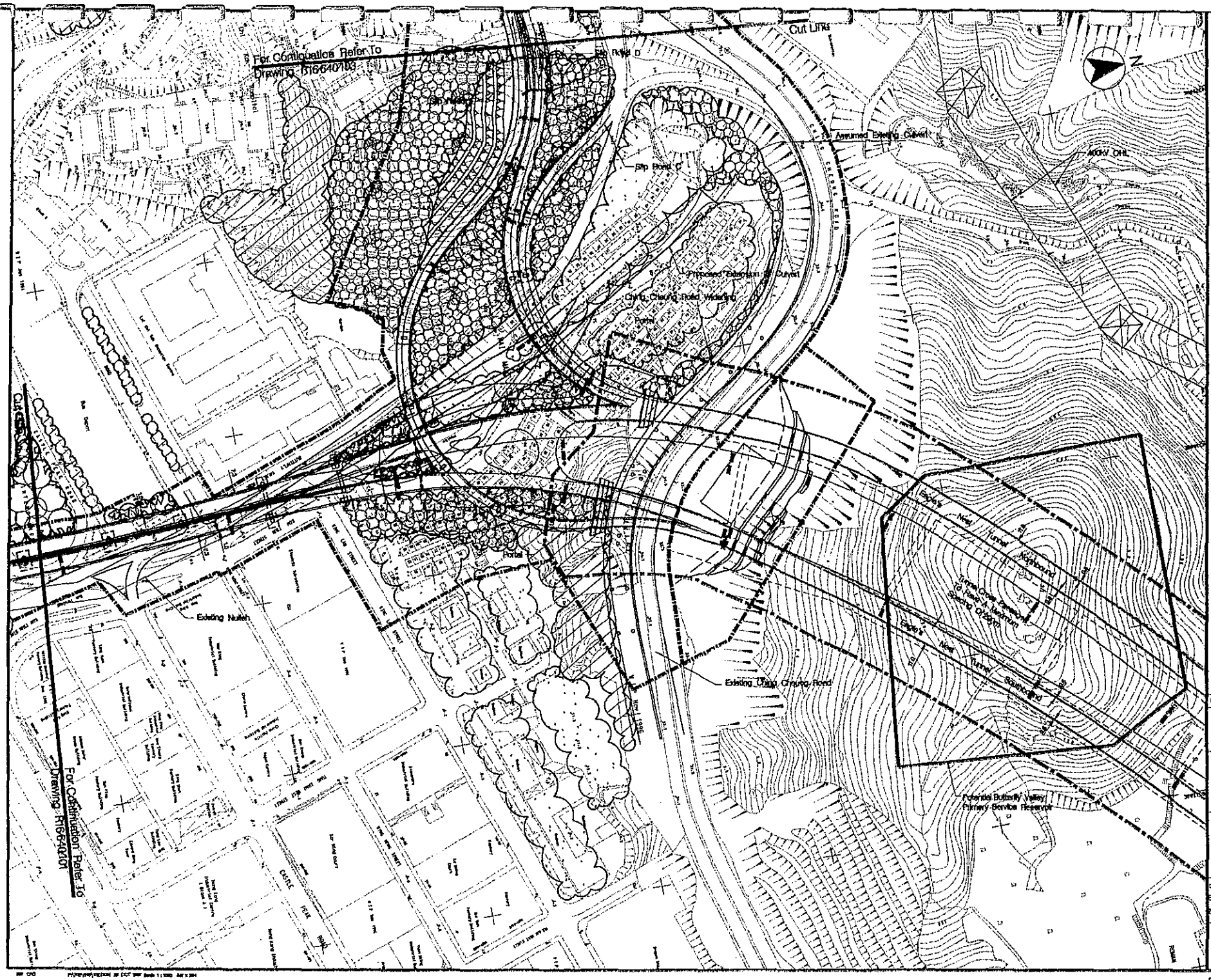

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Route 16

CONTRACT CE 42/98
WEST KOWLOON TO SHATIN
INVESTIGATION ASSIGNMENT

LANDSCAPE WORKS
(SHEET 2 OF 6)

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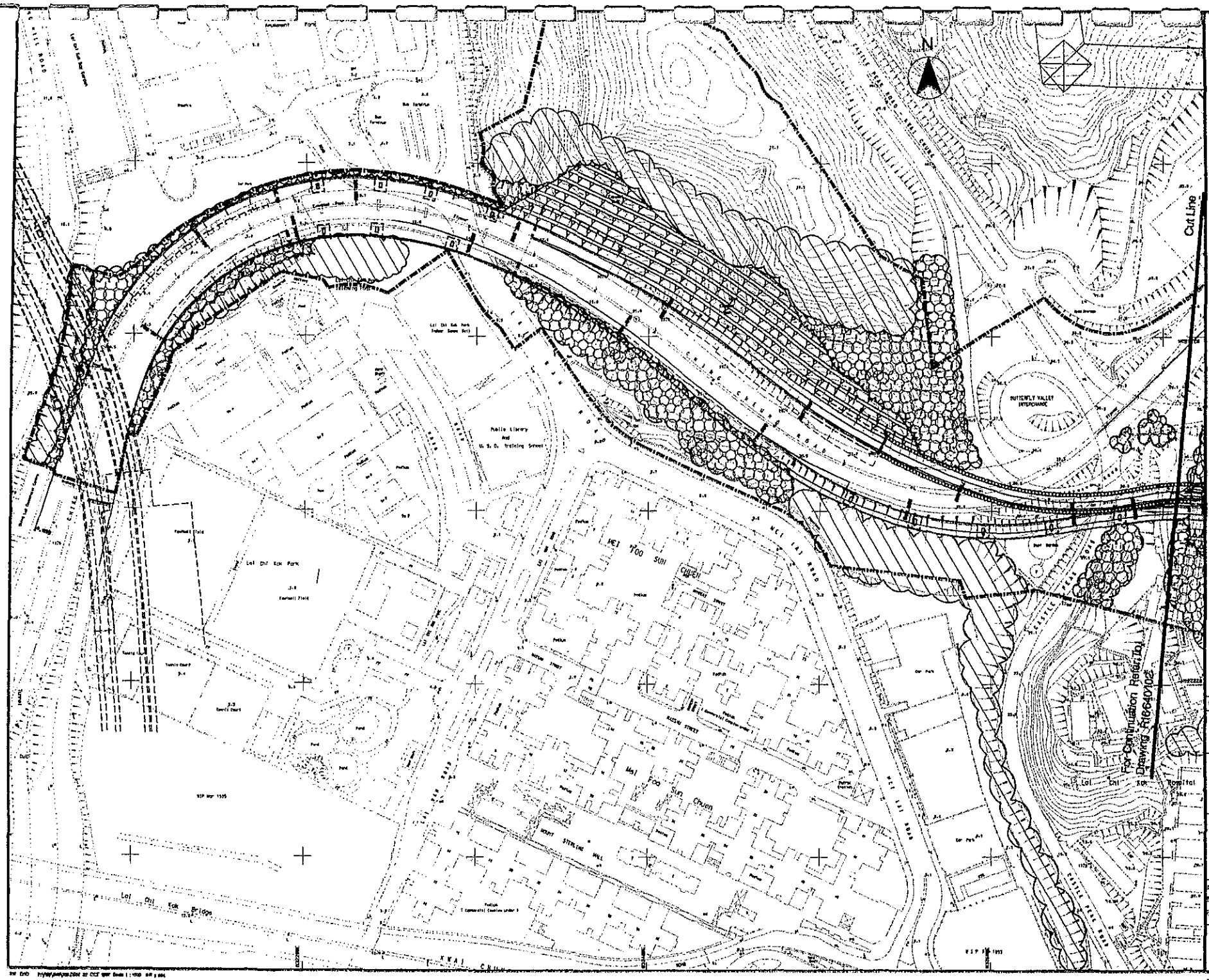

Legend :

- Existing Vegetation
- Indigenous Revegetation of Hill Slopes
- Ornamental Shrub Planting
- Formal Tree Planting
- Grass

Revision	Date	Description	Drawn	Checked

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Highways Department

Route 16

CONTRACT CE 42/98
WEST KOWLOON TO SHATIN
INVESTIGATION ASSIGNMENT

LANDSCAPE WORKS (SHEET 3 OF 6)

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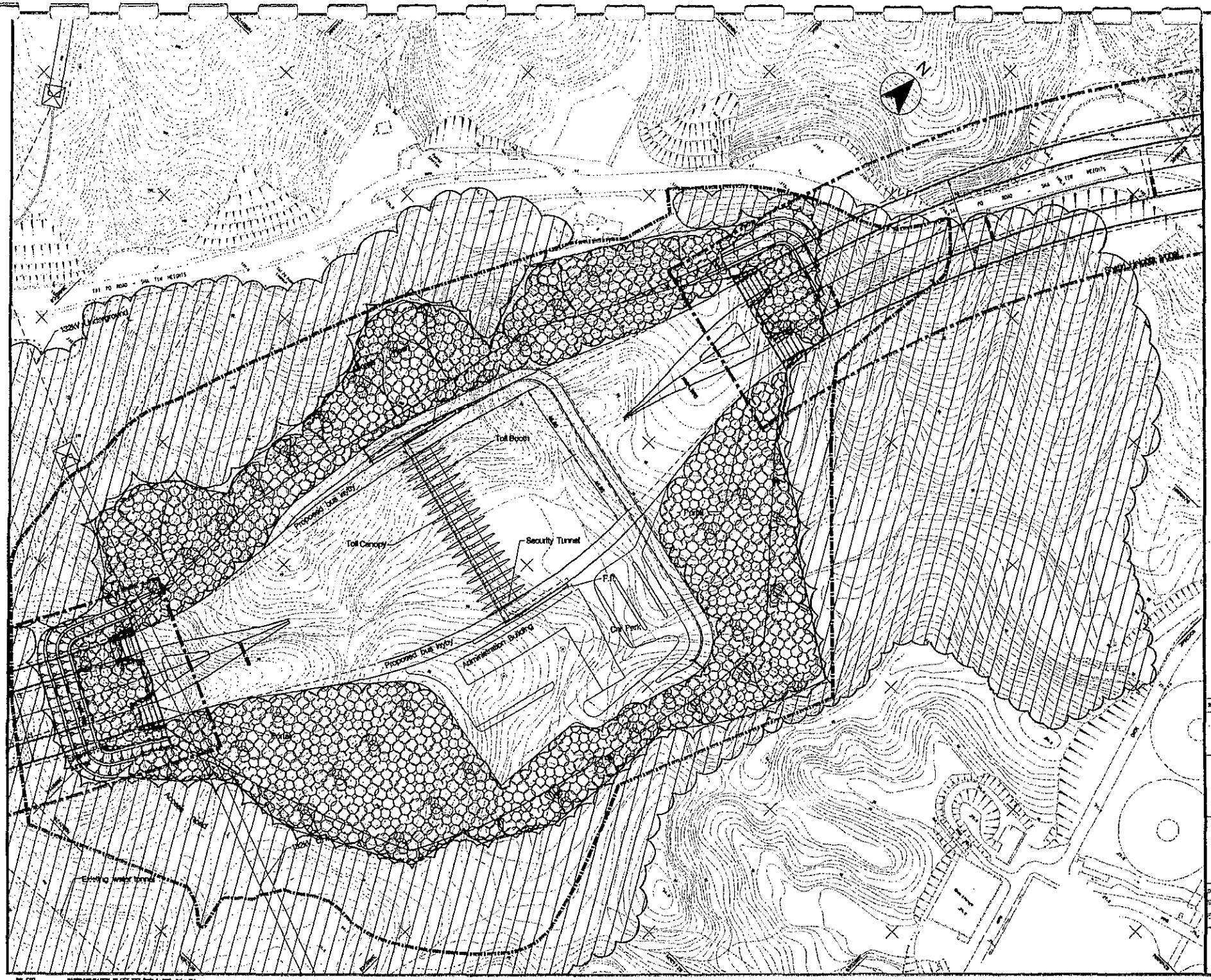

Legend :

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- Indigenous Revegetation of Hill Slopes
- Ornamental Shrub Planting
- Formal Tree Planting
- Grass

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LANDSCAPE WORKS
(SHEET 4 OF 6)

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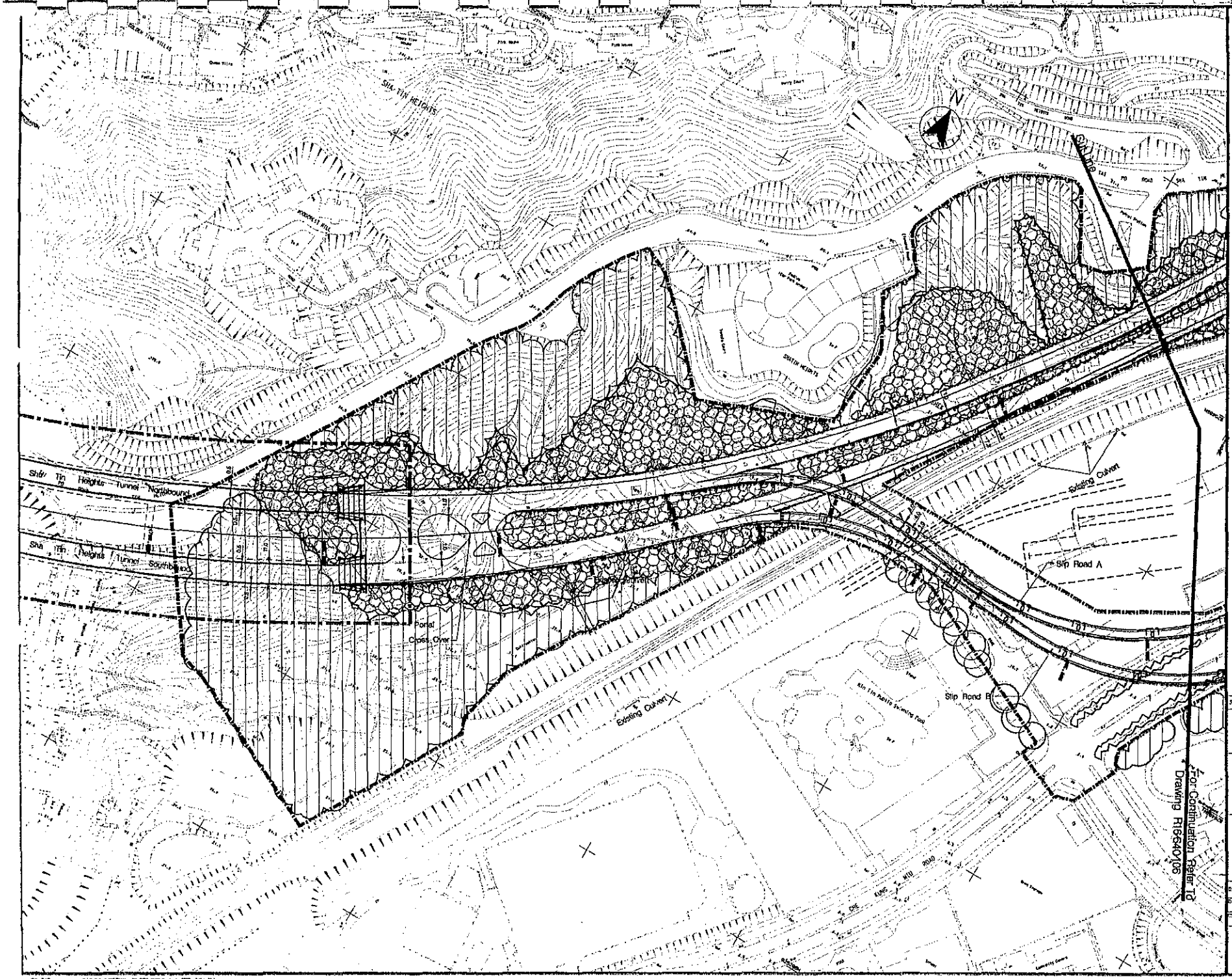
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Indigenous Revegetation of HA Slopes
Ornamental Shrub Planting
Formal Tree Planting
Grass
Shatin Heights Tunnel Northbound
Shatin Heights Tunnel Southbound
Portal
Cross Over
Existing Culvert
Slip Road A
Slip Road B
Existing Culvert
For Continuation Refer To Drawing R16/640/106
Government of Hong Kong
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Route 16
CONTRACT CE 42/96
WEST KOWLOON TO SHATIN
INVESTIGATION ASSIGNMENT
LANDSCAPE WORKS
(SHEET 5 OF 6)
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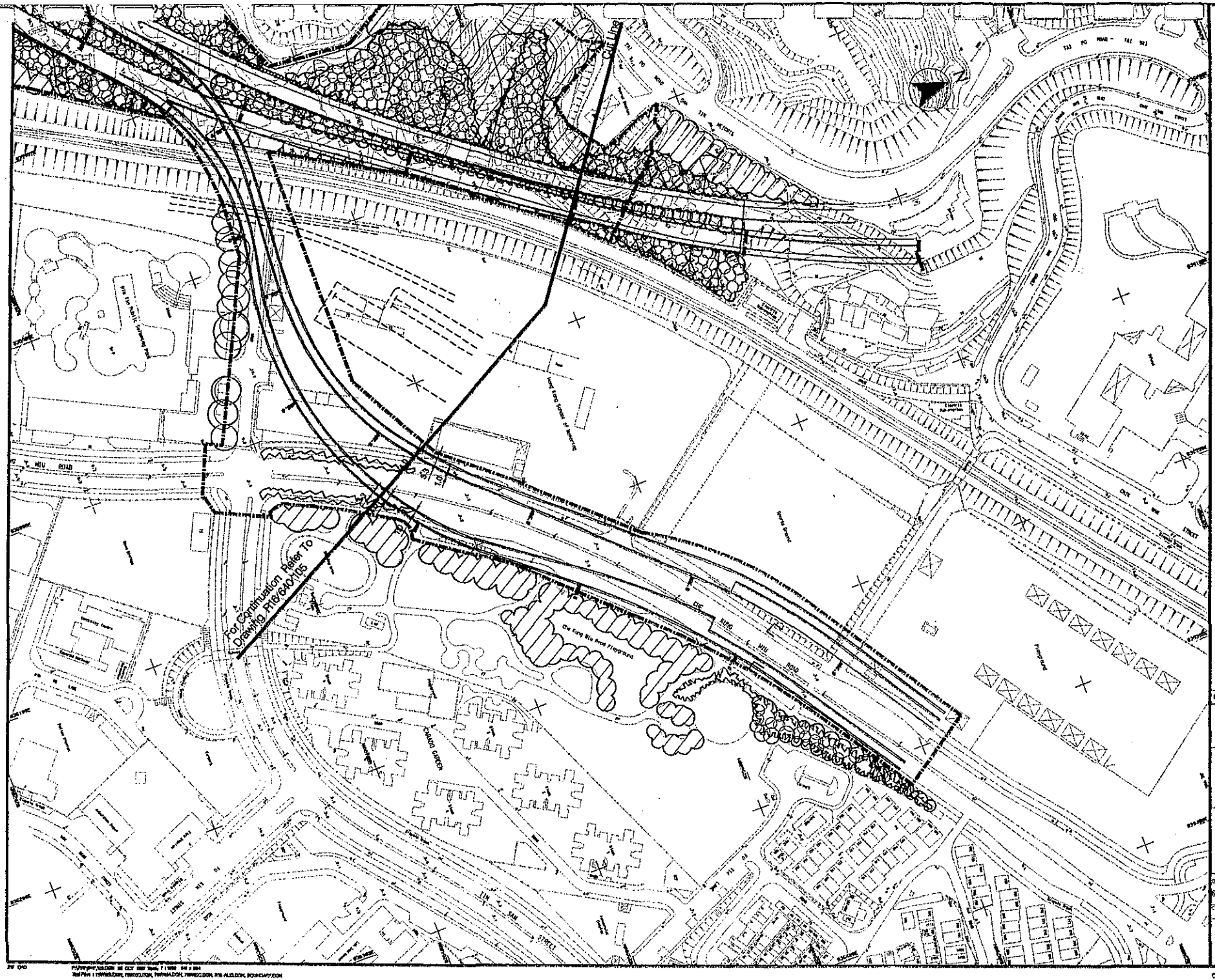

Legend :

- Existing Vegetation
- Indigenous Revegetation of Hillslopes
- Ornamental Shrub Planting
- Formal Tree Planting
- Grass

Suffix	Date	Revision	Drawn	Checked

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Route 16

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WEST KOWLOON TO SHATIN
INVESTIGATION ASSIGNMENT

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(SHEET 6 OF 6)

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38th Floor • Metroplaza Tower 1 • 223 Hing Fong Road • Kwai Fong • Hong Kong
Phone (852) 2428 8866 • Fax (852) 2428 9922 • E-mail swhk@scott-wilson.com.hk
Website www.scott-wilson.com