FINAL REPORT

CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

Highways Department

Agreement No. CE 36/94 Reclamation and Servicing of Tuen Mun Area 38 for Special Industries – Improvement to Roads and Junctions within Tuen Mun Environmental Impact Assessment : *Environmental Impact Assessment Report*

March 1996

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ERM

Agreement No. CE 36/94
Reclamation and Servicing of Tuen Mun Area 38 for Special Industries -
Improvement to Roads and Junctions within Tuen Mun
Environmental Impact Assessment Report
Final Report

ADDENDUM

1. NSR 32

   "St Simon's Child Welfare Centre/School" in Tables 5.2b, 5.4b, 5.4d, 5.5g & 5.5i should read as ***"St Peter Kindergarten"***.

2. Page 58, last paragraph, 5th line

   The sentence should read as: "*...However, as confirmed by Education Department, all the primary and secondary schools within the study area will have insulation installed ...*".

3. Page 67, first paragraph, 7th line

   The sentence should read as: " *...Although all the primary and secondary schools within the study area are scheduled for ....*".

4. Page 67, first paragraph

   The following text should be added to the end of the paragraph: " *At St Peter Kindergarten (NSR 32) the traffic noise levels exceed the HKPSG guideline. However the traffic noise is predominantly contributed by existing roads and the subject road work improvement will not be responsible for the traffic noise at the kindergarten. Unlike primary and secondary schools, kindergartens are not included into the NAMISP for acoustic treatment and there is currently no policy for providing them with noise insulation against existing traffic noise. It should be noted that the St Peter Kindergarten is air-conditioned with gasketted windows which should provide certain extent of noise protection against the existing traffic noisel.* "

5. Tables 5.5g and 5.5i, last columns (Eligible for insulation)

   Text for NSR 32 amended to " *n/a*".

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March 1996

Reference C1304

For and on behalf of ERM-Hong Kong, Ltd

Approved by: _____

Position: Technical Director

Date: 15 March 1996

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1 INTRODUCTION

1.1 BACKGROUND

ERM–Hong Kong, Ltd (ERM), in association with Scott Wilson Kirkpatrick and Townland Consultants Ltd, was commissioned by the Hong Kong Government Highways Department (HyD) to undertake an Environmental Impact Assessment (EIA) for the Improvement to Roads and Junctions within Tuen Mun in relation to the Reclamation and Servicing of Tuen Mun Area 38 for Special Industries Area (hereafter referred to as the Roadworks) as shown in *Figure 1.1a*.

In mid 1990, TDD completed the Expanded Development Study of Tuen Mun Area 38 for Special Industries (EDS) which confirmed the engineering and environmental feasibility of the development. The EDS identified that highways improvement works would be required to overcome the anticipated traffic problems on Lung Mun Road and the junction of Wong Chu Road/Tuen Mun Road which provide the main access for external traffic to and from Area 38. These highways improvement works, which are scheduled to commence in early 1998 for completion by 2001, include:

- construction of a bypass (to be named as the Foothills Bypass) from Tuen Mun Area 45 to Wong Chu Road along the foothills of Castle Peak to divert the traffic and to mitigate the environmental impact on Lung Mun Road;

- improvement to the slip road right turn from Wong Chu Road (P3) to Tuen Mun Road (P1) to provide additional capacity; and

The EDS recommended noise mitigation measures, including the erection of an enclosure, along the primary access route along Wong Chu Road to Tuen Mun west. The EDS also recommended a more detailed EIA study to be carried out to determine areas prone to high noise levels followed by detailed design to remedy the noise problems identified prior to the construction works of the Area 38 development.

Following the recommendation of the EDS, this EIA Study was subsequently undertaken, covering the planned Foothills Bypass Northern Section and the existing Wong Chu Road, mainly to recommend noise control measures for the roads to mitigate the noise impacts from the additional traffic associated with the Tuen Mun Area 38 development. The recommended noise mitigation measures will be implemented as part and parcel of the Area 38 development.

It is expected that the environmental impact due to the construction of the Foothills Bypass Southern Section will be small. Nevertheless, further EIA Study covering the Foothills Bypass southern section will be carried out in mid 1996.

At the commencement of the study, an Inception Report was issued. Subsequently the *Working Paper: Interim Traffic Noise Impact Assessment* was issued in April 1995 to present the interim findings of the traffic noise impact assessment, and to gauge initial comments from the Government on

the likely mitigation measure requirements prior to the submission of the EIA report.

1.2 *PURPOSE OF THE STUDY*

In accordance with the Brief, the main objective of this EIA Study was to assess the potential air quality and noise impacts associated with the construction and operation of the highways improvement works due to the development of Tuen Mun Area 38. Particular attention was drawn to noise sensitive receivers along Wong Chu Road where the residents of On Ting and Yau Oi Estates are already exposed to high road traffic noise. Conceptual noise mitigation measures were developed and evaluated on environmental, engineering, visual and cost grounds. An optimum mitigation package was recommended for implementation to ensure that the proposed development in Tuen Mun would not cause unacceptable additional environmental impacts to sensitive receivers. A review of the potential ecological impact associated with the highway improvement works was also conducted.

Apart from the development of Area 38, the extent and degree of impacts that must be addressed within this Study are also likely to hinge upon the proposed Tuen Mun Port Development (TMPD). Two scenarios, one with the TMPD and the other without it, were therefore assessed within the present Study for the operation phase. With TMPD, there will be additional road works associated with the proposed Southern Relief Road.

The detailed design of the Roadworks is scheduled to commence in April this year, which will take into full account the recommendations from this Study.

1.3 *THE STUDY AREA*

The Study Area covers the areas in central Tuen Mun along Wong Chu Road and its interchanges with Tuen Mun Road and Lung Mun Road (*Figure 1.1a*). The Study Area extends from the section of Tuen Mun Road near Sam Shing Estate in the east to the foothills of Castle Peak in the west. The eastern portion of the Study Area is largely residential, with a large number of public or private housing estates. Scattered villages are found with a number of institutions, such as boys' home, girls' hostel and schools, in the western portion. Within the western portion of the Study Area, a site in Area 18 has already been designated for a proposed housing development under the Private Sector Participation Scheme (PSPS). *Figure 1.3a* shows the landuse zoning of the Study Area.

1.4 *STRUCTURE OF THE REPORT*

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

- *Section* 2 describes the Roadworks and the associated construction programme and design and construction constraints, provides the traffic forecasts of the various scenarios for the impact assessment, and

identifies civil and traffic engineering and visual/landscape constraints to noise mitigation measures;

- *Section 3* assesses the potential construction impacts of the Roadworks and recommends mitigation measures where appropriate to ensure compliance with environmental criteria;

- *Section 4* assesses the potential air quality impact associated with the operation of the Roadworks and where necessary recommends measures to mitigate any unacceptable impact;

- *Section 5* assesses the potential road traffic noise impact associated with the Roadworks, recommends and evaluates mitigation proposals required to meet noise criteria;

- *Section 6* presents the overall conclusion and recommendations of the Study.

The environmental monitoring and audit (EM&A) requirements are presented in the Environmental Schedule in *Annex C*.

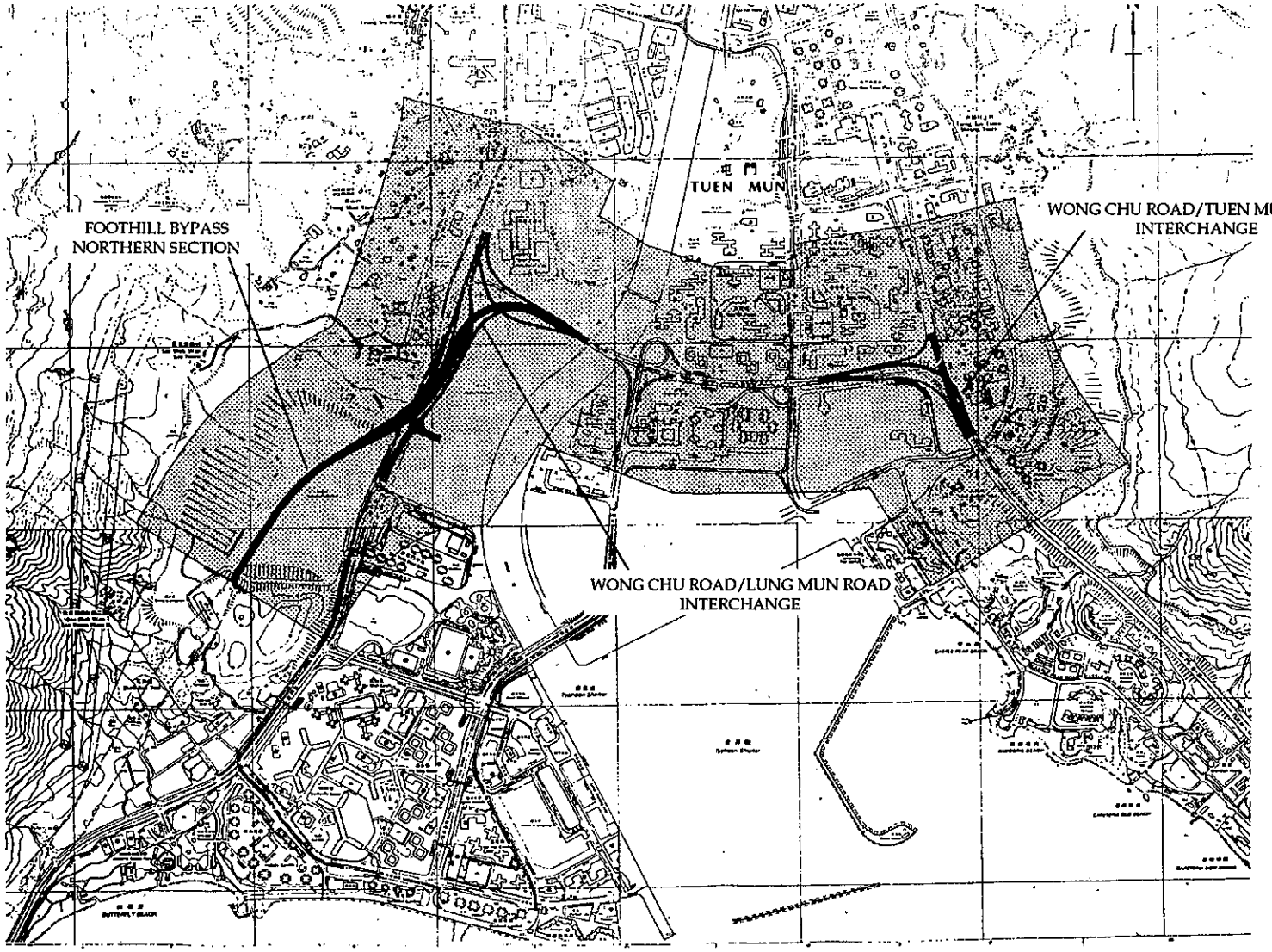

FIGURE 1.1a - ENVIRONMENTAL IMPACT ASSESSMENT STUDY AREA

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Hong Kong

ERM

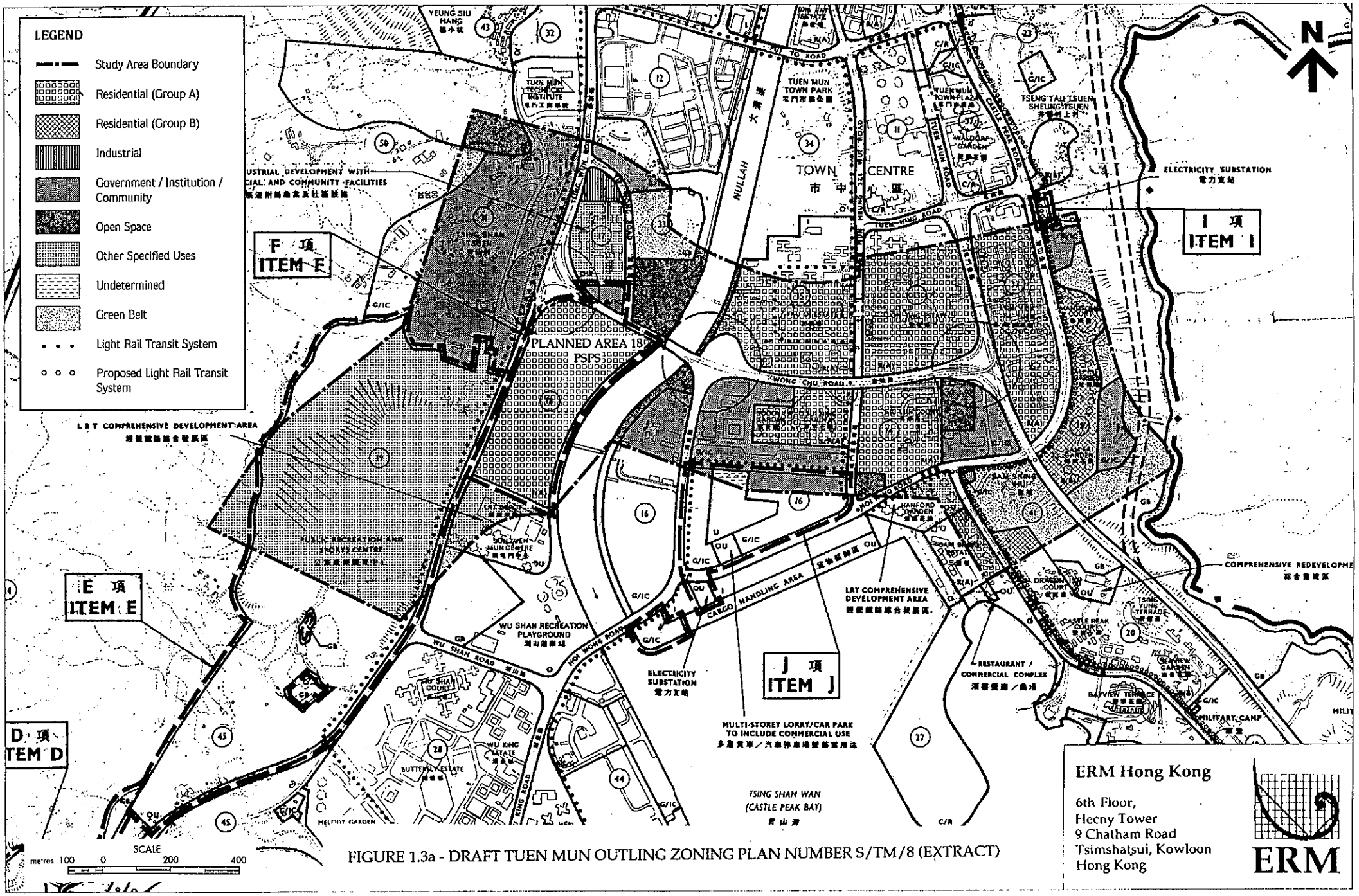

FIGURE 1.3a - DRAFT TUEN MUN OUTLING ZONING PLAN NUMBER S/TM/8 (EXTRACT)

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2 PROJECT DESCRIPTION

2.1 THE ROADWORKS

The Roadworks concerned within this Study involve the Foothill Bypass, and the junctions between Lung Mun Road (D15) and Wong Chu Road (P3), and that between Wong Chu Road (P3) and Tuen Mun Road (P1). Scheme plans of the two junctions were provided by Highways Department as shown in *Figures 2.1a & b*. The Foothill Bypass has not undergone engineering design and an alignment (see *Figure 1.1a*) was given by Territory Development Department (TDD)(NT West) for the purpose of this Study.

2.2 CONSTRUCTION PROGRAMME

A tentative construction programme has been developed and approved by the Government, as shown in *Figure 2.2a*. The programme has been formulated for the purpose of the air quality and noise assessment in this EIA (Phase 1) study. It will be subject to change at the detailed design stage.

2.2.1 *Lung Mun Road/Wong Chu Road Interchange and Foothill Bypass Section*

General

The programme has been prepared using the Start/Finish dates given by TDD.

Due to the proximity of the sites to sensitive receivers including residential buildings and schools pile driving equipment is not preferred, therefore, bored piles have been assumed for the foundations of the elevated structure(s).

An area may be required to be set aside as a precasting area.

No significant excavations are required.

Powered Mechanical Equipment (PME)

Plant has been assumed to consist generally of the following;

Earthworks

- dump trucks of 16 tonne capacity. Where the embankment for the Foothills Bypass is concerned a substantial amount of filling work will be required and it is envisaged 50 tonne capacity dump truck will be used.
- dozer & vibrating drum roller to spread and compact fill material.
- grader to finish final fill layer to the falls & formation levels required before commencing paving works.

Paving

- dump truck (assume 16 tonne capacity) for delivery of subbase.
- mini backhoe to spread sub–base.
- roller to compact layers of sub–base and a grader to trim to levels required.
- hot mix applicator to apply the final road surface.
- roller to finish the road surfacing.

Retaining Walls

- mini backhoe to excavate footings (minimal quantity of excavated material).
- concrete mixer(s) pouring concrete following formwork erection and steel fixing.

Demolition

- backhoe with a breaker to demolish existing rigid or flexible pavements.
- a 16 tonne dump truck has been allowed for to cart away demolished materials.

Elevated Structures (including Foothills Bypass)

- bored piling equipment consisting of a drilling rig and crane to guide/support the drill shaft.
- concrete mixer with a concrete pump. Alternatively, or on occasions when the pump has insufficient reach, a tower crane and tremie will be necessary to carry out pours for the piling and the superstructure.

Footpath & cycle track

- mini backhoe to excavate to foundation and trim.
- concrete mixer.

For the above road sections the overall commencement and completion dates of the programmes are those given by the TDD.

When calculating the periods of time required to construct the various elements these dates appear very generous when minimum plant levels are applied. The durations given in some cases therefore can be reduced without requiring additional resources.

Logic of Programme

The sequence of activities shown in *Figure 2.2a* has been designed to minimise the number of traffic diversions. The road structures below can be seen in the scheme plans shown in *Figure 2.1a & 2.1b.*

North-west bound traffic on Wong Chu Road will be diverted for a period whilst a temporary ramp is built connecting to the existing right hand fork. Once constructed the diversion can be stopped, left hand and right hand forks reopened and Slip Road A constructed.

Opening of Slip Road A allows the left hand fork to be demolished and slip Road G to be constructed. The footpath and cycle track can also then be constructed.

Once Slip Road G is open, the temporary ramp can be disassembled, and the right hand fork demolished. Construction of Slip Road B can then commence. Following this, to minimise simultaneous diversions Wong Chu Road/south-east bound traffic is to be diverted whilst the road works proposed for this section are constructed. Lung Mun Road south bound traffic can then be diverted while the road is realigned as Slip Road D to allow the construction of Slip Road E.

The Lung Mun Road/Foothill Bypass can then be constructed.

2.2.2 *Tuen Mun Road/Wong Chu Road Interchange Section*

The programme activities start and finish dates are those given by Highways Department's own construction programme for this intersection. A temporary bridge is required, the erection of which will possibly require PME consisting of a tower crane and delivery truck. Plant descriptions are the same as for those listed in the P3/D15 Interchange.

2.3 *CONSTRAINTS TO DESIGN AND CONSTRUCTION*

The constraints to the design and construction of the proposed road / junction improvements are identified below, and illustrated where possible in *Figures 2.3a & 2.3b.*

Light Rail Transit (LRT) Stop & Carriageway

Design

- Bridge foundations including piles and piers should be located outside the LRT boundary and allow clearances required by the LRT.

Construction

- The Contractor will have to allow for the LRT to remain operational when formulating his method statement, and may be required by the LRT to carry out construction of this section outside LRT operating hours to ensure passenger safety and reduce the likelihood of unintentional disruptions.

Footbridge

It is proposed to construct a pedestrian footbridge across Lung Mun Road to serve the PSPS development (by others). A pedestrian connection to the LRT stop must be available upon completion of the first phase of the PSPS. This should be completed by the time bridge construction starts.

Design

- The Bypass design will have to provide sufficient clearances around the footbridge.

Design and Construction

- Pedestrian access may be restricted during bridge construction as a consequence.

Utilities

Design and Construction

- Construction activities such as piling, demolition and embankment formation in the vicinity of utilities will require specific approval from utility owners. Implementation of protection measures, re-design of proposed elements or relocation of utilities may be required.

- Utilities presently located underneath the existing emergency vehicle access will have to be diverted/relocated to avoid clashing with the foundations of the proposed elevated Foothills Bypass structure and the proposed road which will run adjacent to the PSPS development area.

- There are numerous utilities located along the existing Lung Mun Road which will require diverting/relocating to avoid the foundations of the elevated structure and associated Slip Roads. These include 132kV cables, a box culvert running across Lung Mun Road, and a trunk sewer along Lung Mun Road. An 800mm diameter watermain runs along the emergency vehicular access (EVA) road extending in between the PSPS site and Lung Mun Road (refer *Figure 2.3c & 2.3d*).

- Lead times and cost implications of utilities and services diversions will affect design and construction and are subject to the agreement of the relevant authority/utility company.

Unstable Slopes

- Slopes in the west of the Study Area, in the plot of empty land where the foothills bypass embankment is proposed, are considered unstable. Measures may need to be taken to stabilise these during construction.

2.4 TRAFFIC MANAGEMENT DURING CONSTRUCTION

Traffic flow will be significantly impeded during construction and activities will need to be planned so as to minimise disruption. In addition vehicular accesses to parking lots and pedestrian accesses will be affected (see *Figures 2.3a & 2.3b*). The traffic management measures required during construction are described below.

2.4.1 *Roads P3/D15 Interchange*

The construction programme (see *Figure 2.2a*) for the reconstruction of this interchange to incorporate the planned Lung Mun Road Bypass involves

one stage where, for a period, all traffic from Wong Chu Road towards Lung Mun Road (southbound) or Tsing Wun Road may need to be diverted or alternative temporary traffic measures implemented.

There is no simple diversion for right turning traffic however. Traffic from the south along Tuen Mun Road would have to be diverted away from Wong Chu Road via Tuen Mun Town Centre. There is likely to be little traffic from the north from Tuen Mun Road, but again this would have to be diverted through Tuen Mun Town Centre. This would likely result in significant additional congestion, especially at the Pui To Road/Tuen Mun Heung Sze Wui Road junction and along the length of Pui To Road. This is unlikely to be acceptable. Similarly, diversion along Hoi Wong Road and Wu Shan Road to join Lung Mun Road further south entails a relatively long extra journey which would be undesirable.

However, an alternative construction programme would be possible (refer *Annex A*). This would involve constructing slip road G first, so that the right turn from Wong Chu Road to Tsing Wun Road can remain in operation throughout the construction period. The left turn from Wong Chu Road towards Lung Mun Road would be affected for a period of around 8 to 10 months however, to enable slip road G to be completed and subsequently the bridge structure for slip road A.

The existing traffic pattern would need to be maintained regardless of which construction sequence is to be adopted with all existing traffic movements and capacities maintained at all times. During detailed design stage investigations will need to be carried out into traffic management during construction and preferred arrangements agreed with relevant departments. The influence on the response of emergency vehicles will be a significant factor in determining the preferred traffic management measures at this interchange.

2.4.2 *Roads P1/P3 Interchange*

The tentative construction programme for the reconstruction of this interchange which has been developed already recognises the importance of retaining all traffic movements at all times. This involves the construction of a temporary bridge to carry traffic from Wong Chu Road to Tuen Mun Road towards Tsuen Wan, while the existing slip road is demolished and rebuilt to the required higher standard. Apart from the brief periods of changeover, this should result in acceptable travel conditions at all times, and clearly the changeover periods should be scheduled at times of low traffic flow.

The works include an extension of the subway between On Ting Estate and Siu Lun Street under Wong Chu Road, which is a busy pedestrian route. Care should be taken during construction that this route is kept open and unobstructed at all times, which should not be difficult to ensure.

2.5 *TRAFFIC FORECASTS DURING OPERATION*

It has been agreed with the Transport Department that the traffic forecasts from the *TMPD Study* is to be adopted for the purpose of this EIA and that the traffic forecasts for the year 2011 AM peak hour represent the worst case traffic situation.

Based on the *TMPD Study*, the main difference between the With and Without TMPD scenarios is that additional road work associated with the construction of the proposed Southern Relief Road is assumed for TMPD only.

Different sets of traffic data including the Worst Case (Year 2011) and Do-Nothing (prevailing traffic by Year 2011) under the With and Without TMPD scenarios were prepared and have been approved by the Government. However subsequent confirmation from the Government requires that the Study should strictly follow the Brief to compare the worst case noise levels with existing noise levels for the purpose of the noise assessment, and therefore the Do-Nothing traffic forecasts have not been used in this report.

Based on the traffic data from the traffic survey undertaken by the Transport Department in mid-1994, the traffic data for the Existing Case (AM peak hour) was generated and has been approved by the Government.

The Existing traffic data and the traffic forecasts for the Worst Case under the With and Without TMPD scenarios are shown schematically in *Figures 2.5a, 2.5b & 2.5c* respectively.

2.6 *CIVIL AND TRAFFIC ENGINEERING CONSTRAINTS TO NOISE MITIGATION MEASURES*

The following constraints to noise mitigation proposals have been identified and have been considered during the generation of the proposals in *Section 5.3.3*.

Bridge Superstructure

- Additional loadings due to the erection of noise barriers over 3m in height will be significant and due allowance should be made for these when calculating the bridge loads.

Footbridges

- Typical noise barrier details will require modification where they are aligned past the footbridge on Wong Chu Road (refer *Figure 2.6b* for location).

Noise Barriers and Enclosures

- The requirements of the Fire Services Department (FSD) should be sought prior to the detailed design of any noise barriers, partial or full noise enclosures. Consideration of adverse effects on fire fighting operations such as access to fire hydrants and radio communication etc should be given. The effect on the structural integrity of the proposed barriers or enclosures in case of fire should also be addressed. The final design will also be subject to FSD's approval.

- Where full enclosures are required they shall allow for the dispersal of heat and smoke, permit maintained radio communication and provide allowable clearances and access to expedite the recovery of vehicles.

- Based on the TMPD Study, Wong Chu Road is identified as a principle route for the transportation of Dangerous Goods. Design measures will need to incorporate FSD requirements to allow the unrestricted passage of Dangerous Goods Vehicles (DGVs). The alternative will require the diversion of DGVs to other minor routes within the surrounding urban areas which is considered unsuitable due to the potentially increased risk to residents.

- In order that full enclosures fulfill all FSD requirements and do not restrict the passage of certain classifications of DGVs, it will be necessary to limit their length to not greater than 230m. In addition openings for natural ventilation with an open area equal to or exceeding 6.25% of the road surface area must be provided. The clear separation between adjacent enclosures must also exceed 15m.

- The contractor will have to allow for undisrupted emergency vehicle access within the sequencing of construction cycles.

- FSD, EPD and HyD should be contacted at the detailed design stage regarding ventilation or additional lighting requirements.

- The Royal Hong Kong Police Force (RHKPF) should be consulted with regards to the effect on the operation of large recovery vehicles.

Traffic

- Noise mitigation proposals such as noise barriers should take into account their proximity to the shoulder of the carriageway and/or effect on line of sight so that design vehicle speeds are maintained. For the purpose of this EIA, the clearance requirements are estimated as shown in *Figures 2.6a, b & c*, which will be subject to change at the detailed design stage.

2.7 *LANDSCAPE AND VISUAL CONSIDERATIONS FOR NOISE MITIGATION MEASURES*

Objectives

The visual and landscape design of the proposed mitigation structures should satisfy the following broad objectives:

- to ensure that the proposed barriers and enclosures are aesthetically compatible with the surrounding structures and environment;

- to avoid a deterioration of the existing environment for the pedestrians due to erection of the proposed mitigation structures; and

- to facilitate proper functioning of the proposed structures.

Design Elements

The major design elements which are relevant to design of the proposed mitigation structures comprise:

- their appearance and construction, such as form, scale, proportion, dimensions, texture, colour and rhythm;

- the impression: harmony, expression of function, visual stability;
- landscape treatment; and
- relation with the adjoining land uses: effect on the natural ventilation, sunlight exposure and ease of passage, etc on the surrounding facilities, such as open space and pedestrian paths.

Design Principles

The following general principles have been observed in the conceptual design:

- The appearance of the proposed mitigation structures should be appropriate to the function and situation of the structures and should facilitate harmonization with the surrounding features;

- A comforting impression of strength and efficiency should be achieved;

- The colour of the structures should take into account the chromatic `mood' of the local environment and the appearance, functions and overall design of the structures themselves.

  The visual context of the proposed Foothill Bypass is dominated by the green backdrop formed by the Castle Peak and golf driving range at Tuen Mun Recreation and Sports Centre. This green backdrop should be respected in selection of the appropriate colour scheme of the design of the noise mitigation structures.

  The other structures are located in a setting of predominantly high-rise residential blocks, the majority of which are public housing estates. Except the Ting Tak House near the junction of Wong Chu Road and Heung Sze Hui Road, which is painted in three different colours (yellow, orange and green), most of the high-rise buildings are characterized with relatively pale colour in simple standardized pattern. Appropriate colour scheme and pattern should be adopted to create visual interest and enhance the chromatic mood of this area.

- There should be no contradiction between external form and internal function of the structures;

- The structures should be visually stable;

- Wherever possible, intensive landscape buffering should be used to humanize the scale of structures, screen any unsightly views, soften the otherwise harsh landscape, provide colour, texture, variety and interest, unify the diverse elements that make up the structures and enhance the visual rhythm of the structures;

- The relevant factors which may affect the sense of comfort of pedestrians should be taken into full account. These factors include, for instances, temperature, sense of security, safety, exposure to sunlight, ease of passage, etc.

- The existing pedestrian way and open spaces should be retained and kept conveniently accessible to users.

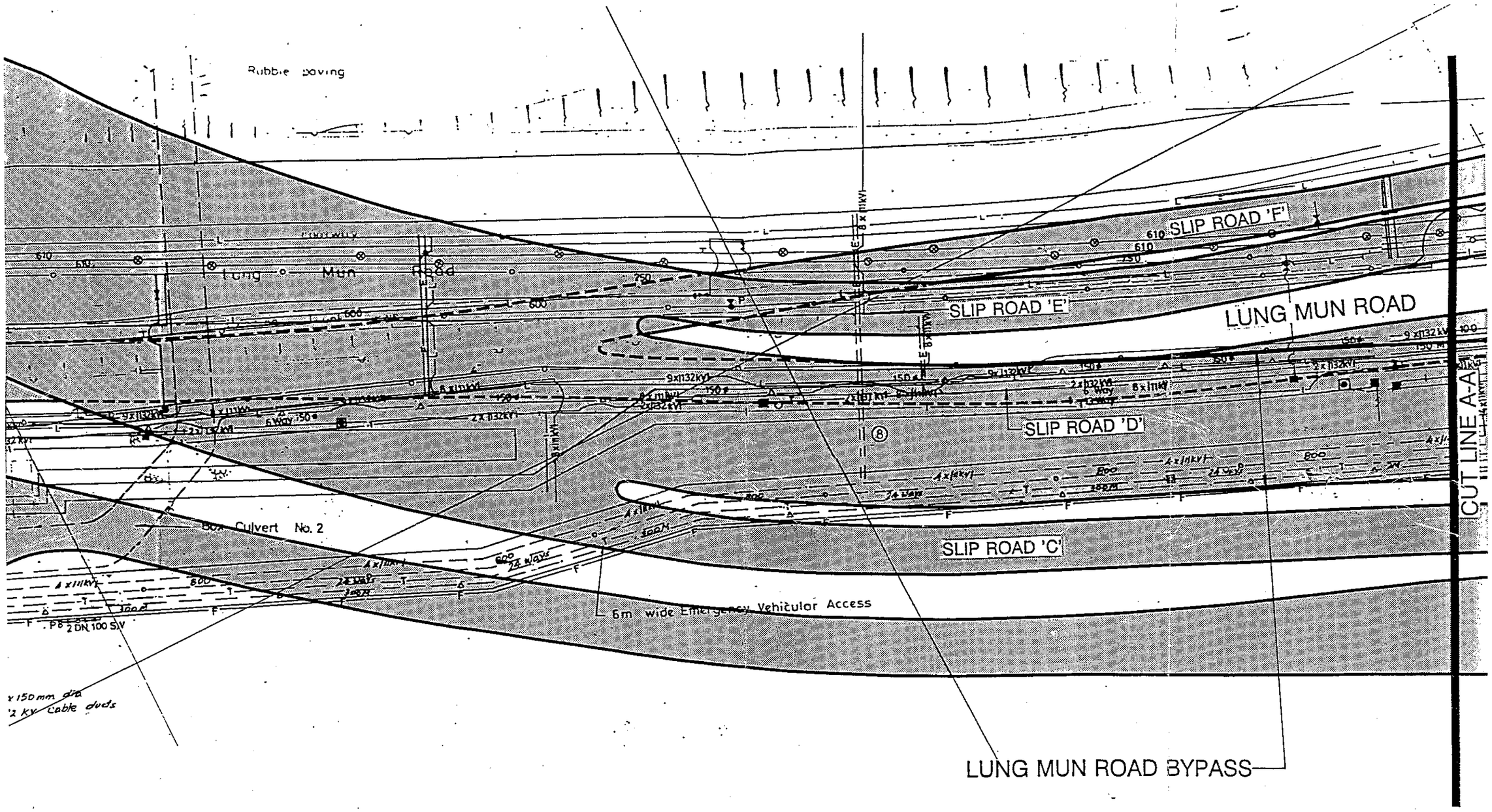

FIGURE 2.3d - UTILITIES ALONG LUNG MUN ROAD - 2

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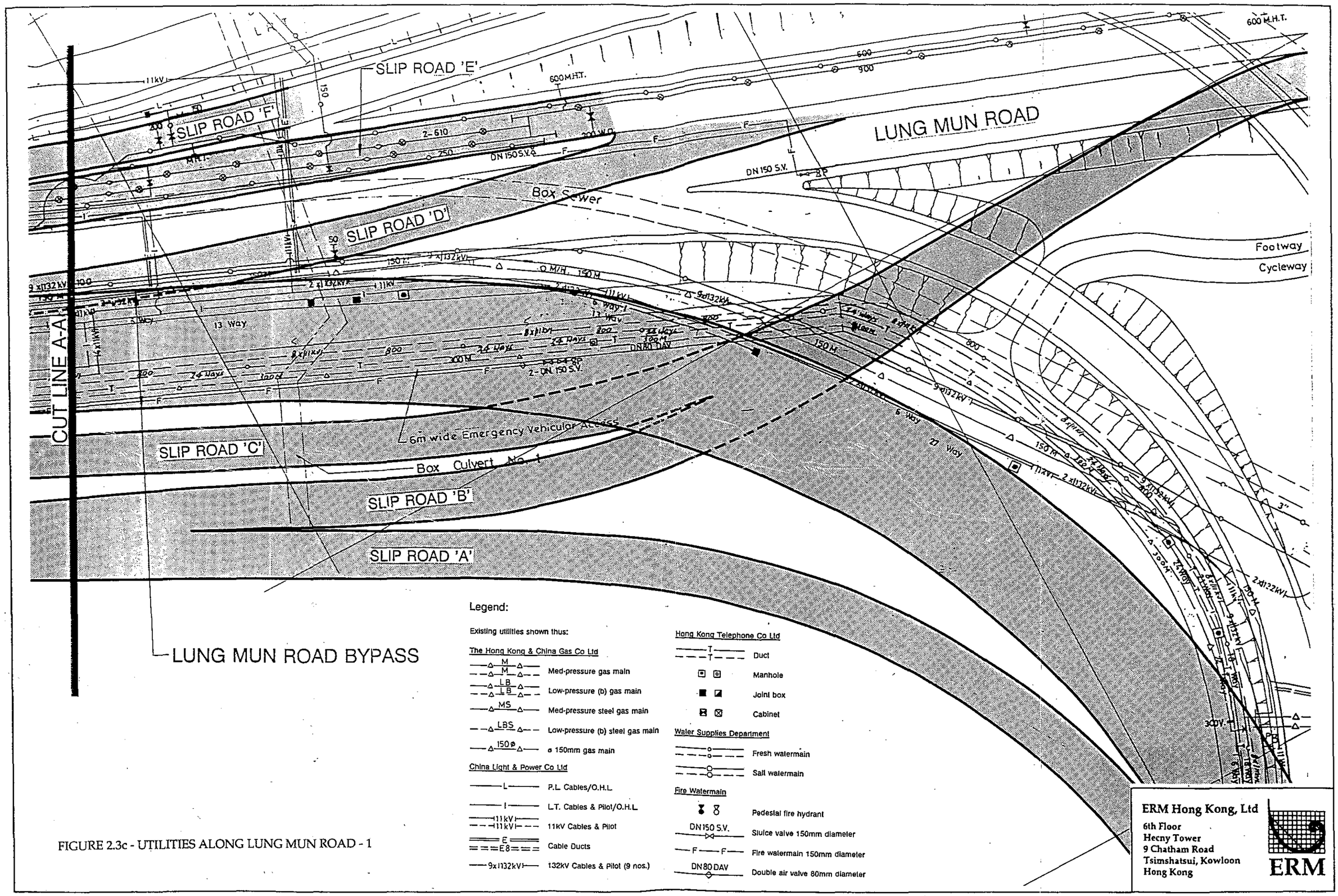

Legend:

Existing utilities shown thus:

The Hong Kong & China Gas Co Ltd

- Med-pressure gas main
- Low-pressure (b) gas main
- Med-pressure steel gas main
- Low-pressure (b) steel gas main
- ø 150mm gas main

China Light & Power Co Ltd

- P.L. Cables/O.H.L.
- L.T. Cables & Pilot/O.H.L.
- 11kV Cables & Pilot
- Cable Ducts
- 132kV Cables & Pilot (9 nos.)

Hong Kong Telephone Co Ltd

- Duct
- Manhole
- Joint box
- Cabinet

Water Supplies Department

- Fresh watermain
- Salt watermain

Fire Watermain

- Pedestal fire hydrant
- Sluice valve 150mm diameter
- Fire watermain 150mm diameter
- Double air valve 80mm diameter

FIGURE 2.3c - UTILITIES ALONG LUNG MUN ROAD - 1

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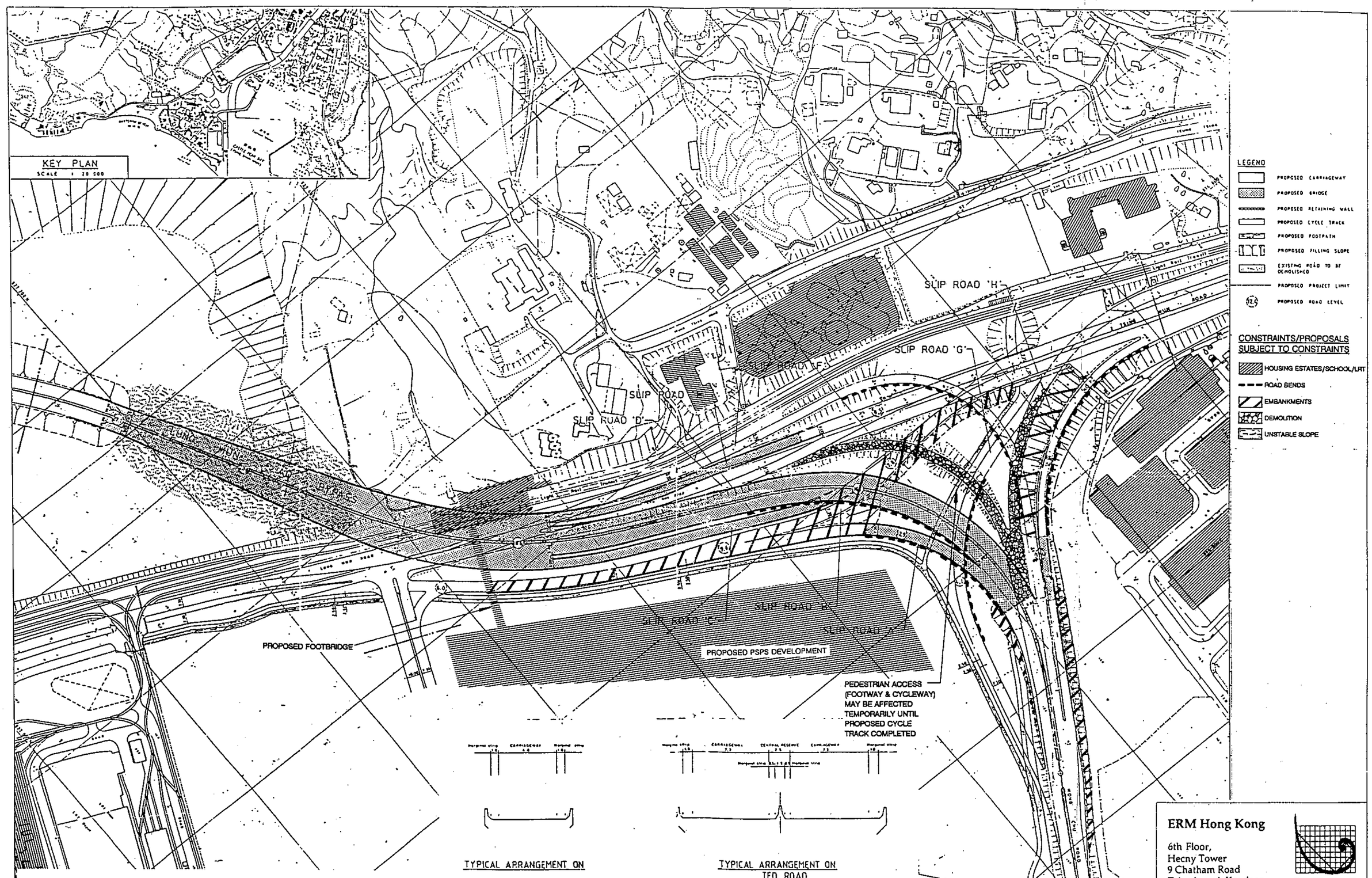

FIGURE 2.3b - CONSTRAINTS TO DESIGN AND CONSTRUCTION (WONG CHU ROAD/LUNG MUN ROAD INTERCHANGE)

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Hong Kong

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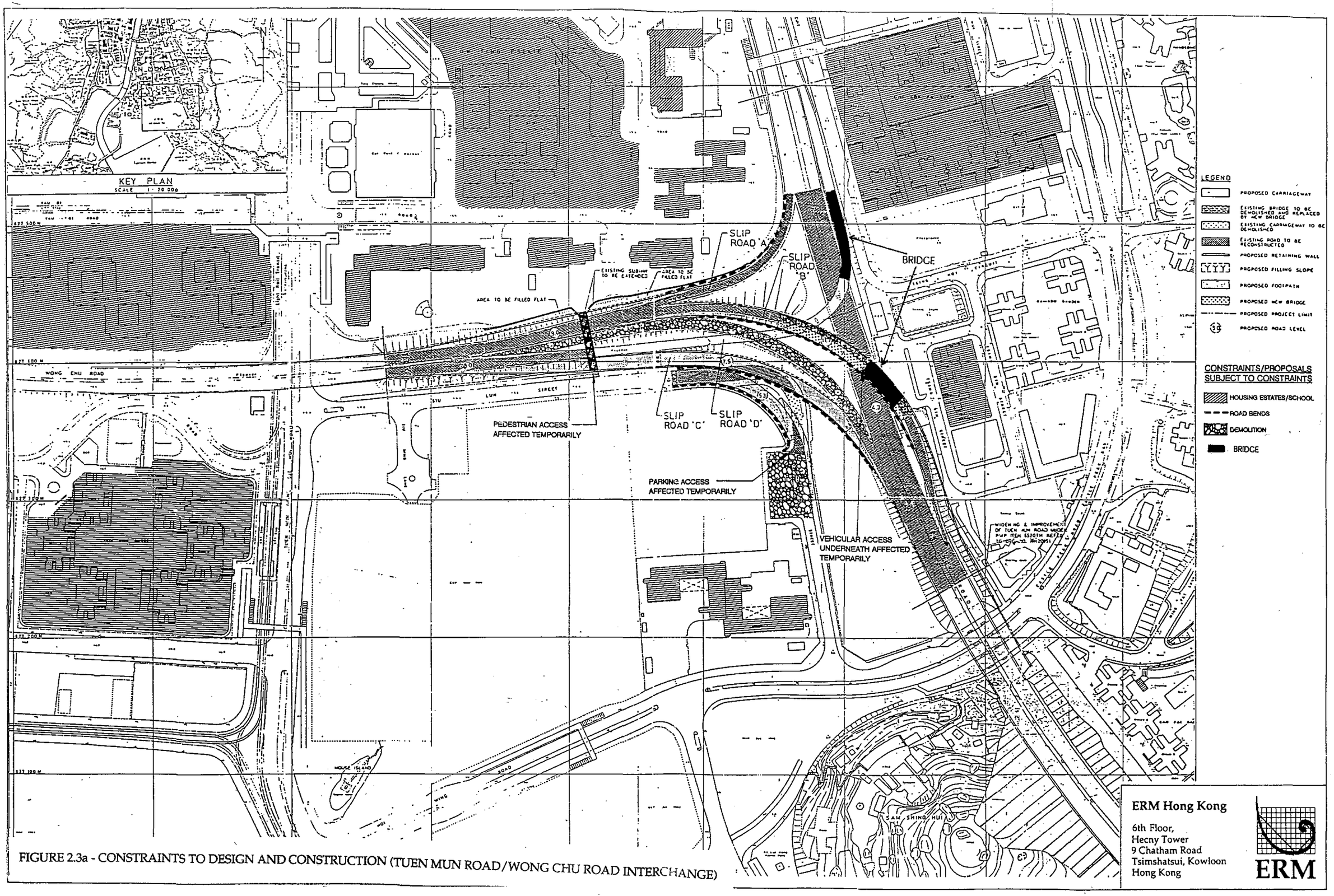

FIGURE 2.3a - CONSTRAINTS TO DESIGN AND CONSTRUCTION (TUEN MUN ROAD/WONG CHU ROAD INTERCHANGE)

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Hong Kong
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	ACTIVITY	DURATION (MONTHS)	1997												1998												1999												2000												2001							PLANT
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	
1.0	**P3/ D15 INTERCHANGE**																																																									
1.1	PRELIMINARIES	3																																																						
1.2	DIVERT NW-BOUND TRAFFIC ON WONG CHU ROAD																																																								
1.3	WIDEN NW-BOUND LANES ON WONG CHU ROAD AND REPAVE	2																																																						DUMP TRUCKS (25 TRIPS/DAY), DOZER, ROLLER (VIBRATING DRUM), GRADER, MINI BACKHOE, DUMP TRUCK (5 TRIPS/DAY), HOT MIX APPLICATOR, ROLLER
1.4	CONSTRUCT TEMPORARY ON-RAMP ONTO EXISTING FORK (TO BE DEMOLISHED) AND RE-OPEN	2																																																					SEE 1.3
1.5	CONSTRUCT SLIP ROAD 'A' INCL. ELEVATED STRUCTURE, RET. WALL AND ABUTMENTS	8																																																					CRANE, DRILLING RIG, CONCRETE TRUCK (20 TRIPS/DAY) PLUS SEE 1.3
1.6	CONSTRUCT SLIP ROAD 'G', MARRYING INTO EXISTING RH FORK AND DEMOLISHING A PART OF THE LH FORK	2																																																					GRADER, MINI BACKHOE, DUMP TRUCK (5 TRIPS/DAY) HOT MIX APPLICATOR, ROLLER, BACKHOE BREAKER
1.7	FOOTPATH & CYCLE TRACK	5																																																						MINI BACKHOE, CONCRETE TRUCK (5 TRIPS/DAY)
1.8	REMOVE TEMPORARY ON-RAMP & DEMOLISH ROAD FORK AS SUITS	3																																																				MINI BACKHOE, BACKHOE BREAKER, DUMP TRUCK (5 TRIPS/DAY)
1.9	CONSTRUCT SLIP ROAD 'B'	4																																																					SEE 1.3
1.10	DIVERT SE-BOUND TRAFFIC ON WONG CHU ROAD																																																							
1.11	CARRY OUT EMBANKMENT WORKS, INCL. SLIP ROAD 'H', BRIDGE, RET. WALL AND REPAVING	6																																																				SEE 1.5
1.12	CONSTRUCT SLIP ROAD 'D'	2																																																			PLANT LISTED UNDER 1.14
1.13	CONSTRUCT SLIP ROAD 'E'	5																																																			PLANT LISTED UNDER 1.14
1.14	FOOTHILLS BYPASS																																																					
1.14.1	PILING	8																																																					
1.14.2	BYPASS SUPERSTRUCTURE	16																																																				CRANE, DRILING RIG
1.14.3	EMBANKMENT FOR NORTH SECTION OF FOOTHILLS BYPASS	14																																																				CONCRETE TRUCK (20 TRIPS/D), CONCRETE PUMP, TOWER CRANE '773' DUMP TRUCKS (125 TRIPS/D), DOZER,
1.14.4	PAVING	24																																																				ROLLER (VIBRATING DRUM)
2.0	**P1/ P3 INTERCHANGE**																																																					GRADER, MINI BACKHOE, DUMP TRUCK (10 TRIPS/D), HOT MIX APPLICATOR
2.1	PRELIMINARIES	6																																																					
2.2	CONSTRUCT SLIP ROAD 'C'	5																																																				MINI BACKHOE, CONCRETE TRUCK (5 TRIPS/D) DUMP TRUCKS (20 TRIPS/D), DOZER, ROLLER, GRADER,HOT MIX APPLICATOR
2.3	CONSTRUCT TEMPORARY BRIDGE	4																																																				TOWER CRANE, TRUCK (5 TRIPS/D)
2.4	DEMOLISH EXISTING BRIDGE	5																																																			CRANE, BREAKER(BACKHOE), TRUCK (5 TRIPS/D)
2.5	CONSTRUCT SLIP ROAD 'B' BRIDGE	26																																																				DRILLING RIG,TOWER CRANE CONCRETE TRUCK (10 TRIPS/D) CONCRETE PUMP , CRANE
2.6	REMOVE TEMPORARY BRIDGE	2																																																				TOWER CRANE, TRUCK (5 TRIPS/DAY)
2.7	RESURFACE WONG CHU ROAD	1																																																			MINI BACKHOE, CONCRETE TRUCK (5 TRIPS/D), DUMP TRUCKS (15 LOADS/D), DOZER, ROLLER, GRADER,HOT MIX APPLICATOR
2.8	RECONSTRUCT TUEN MUN ROAD	6																																																				SEE 1.6

LEGEND

ACTIVITY DURATION

FLOAT

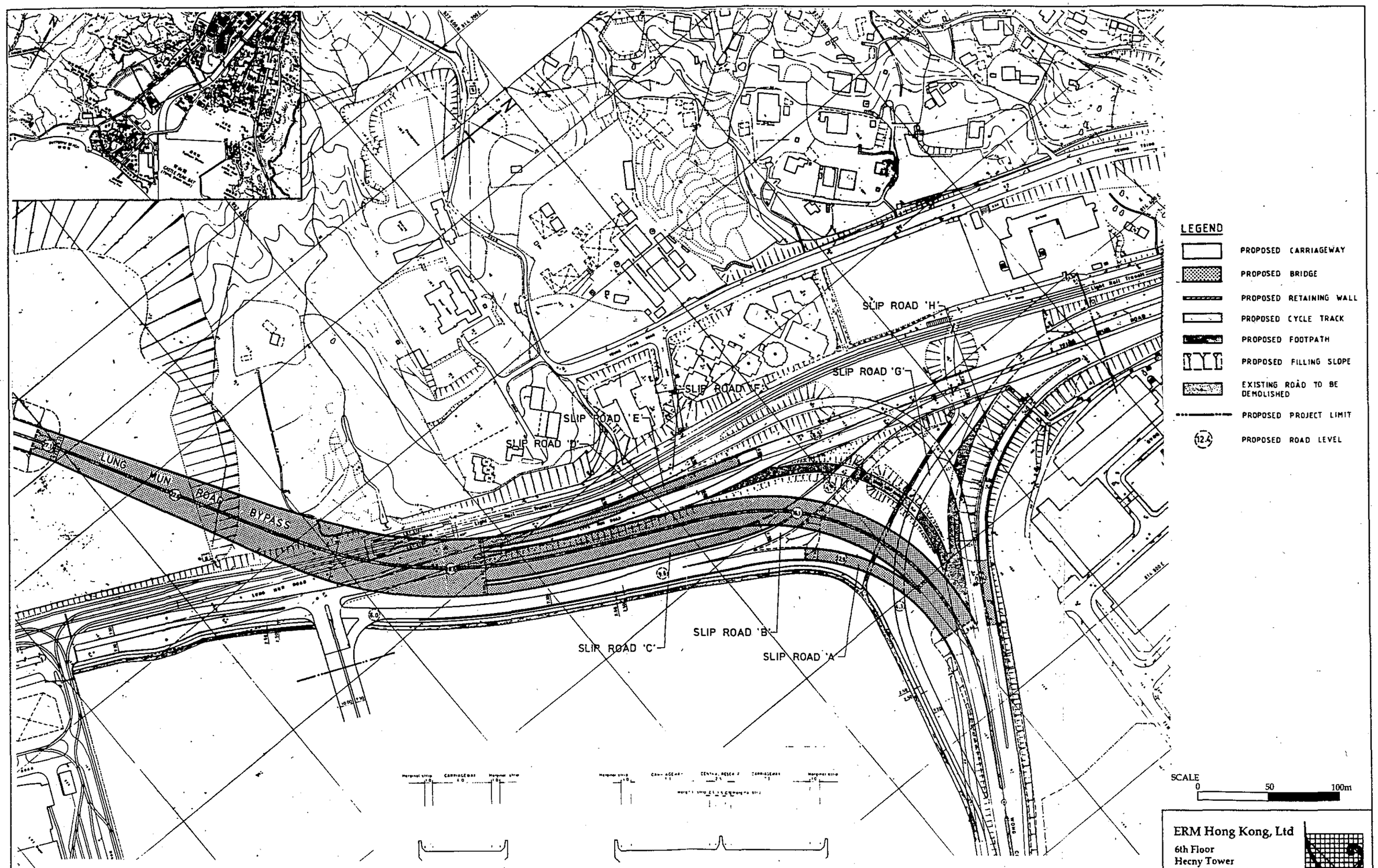
NOTES

1. PRECASTING WORK AREA MAY BE REQUIRED
2. NO SIGNIFICANT EXCAVATION REQUIRED
3. NO CONCRETE BATCHING PLANT , STOCKPILING OR BLASTING OPERATIONS
4. DUMP TRUCK , 16 TONNE CAPACITY, UNLESS INDICATED OTHERWISE

FIGURE 2.2a - TENTATIVE CONSTRUCTION PROGRAMME

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

ERM



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Hong Kong

ERM

FIGURE 2.1b - SCHEME PLAN FOR LUNG MUN ROAD BYPASS - LUNG MUN ROAD/ WONG CHU ROAD INTERCHANGE

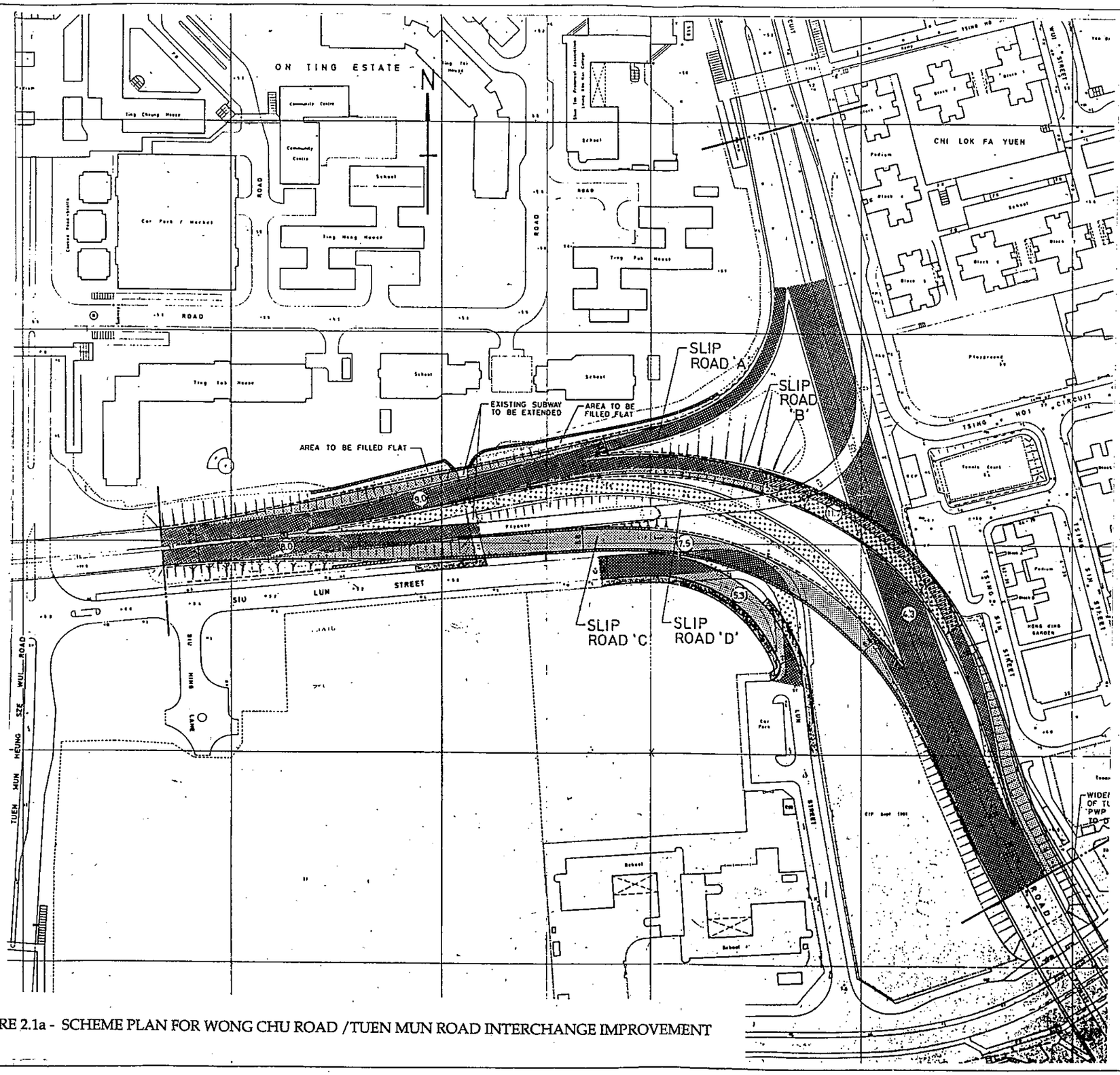

FIGURE 2.1a - SCHEME PLAN FOR WONG CHU ROAD /TUEN MUN ROAD INTERCHANGE IMPROVEMENT

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Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

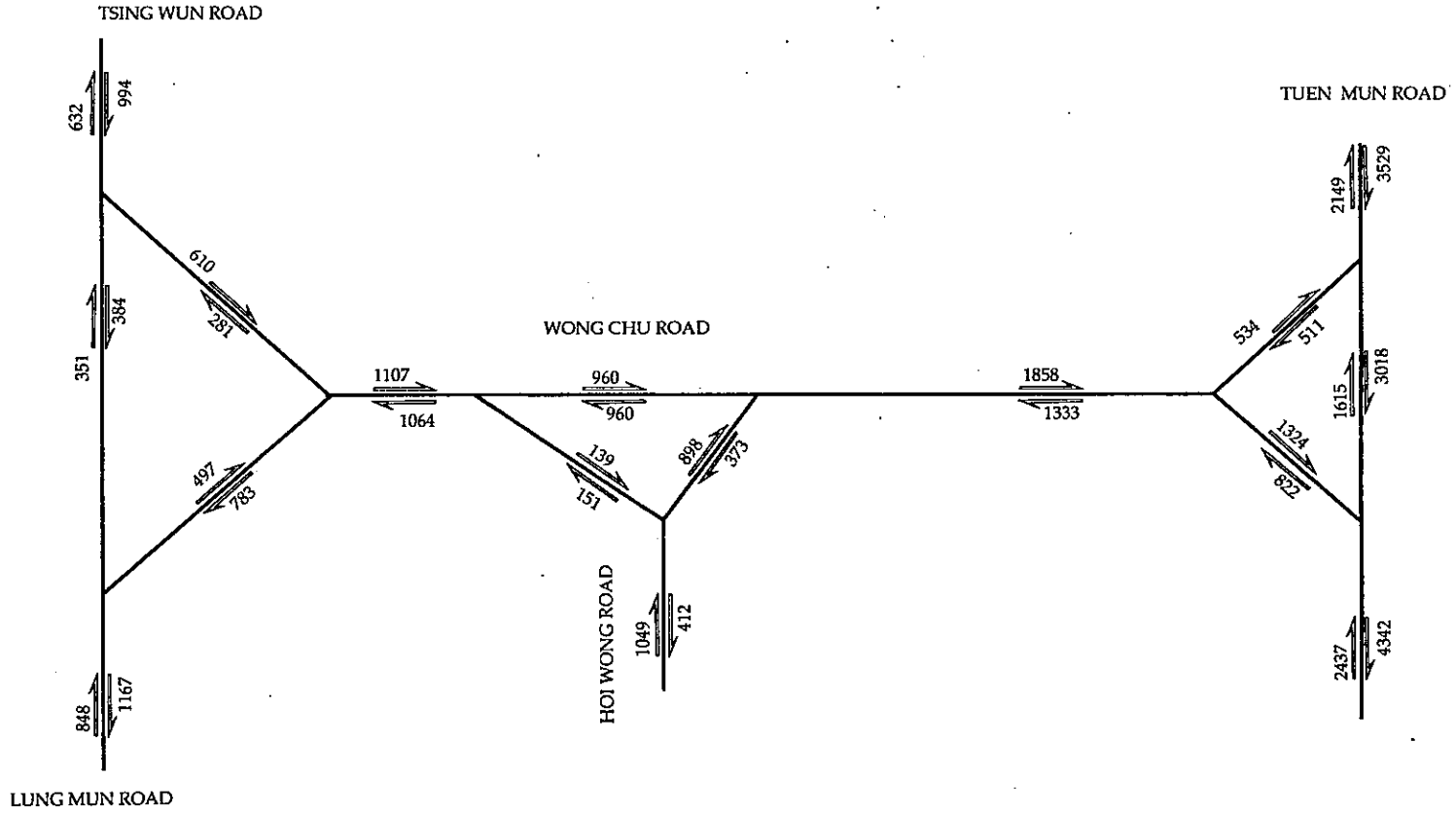

FIGURE 2.5a - EXISTING AM PEAK HOUR TRAFFIC FLOW

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

ERM

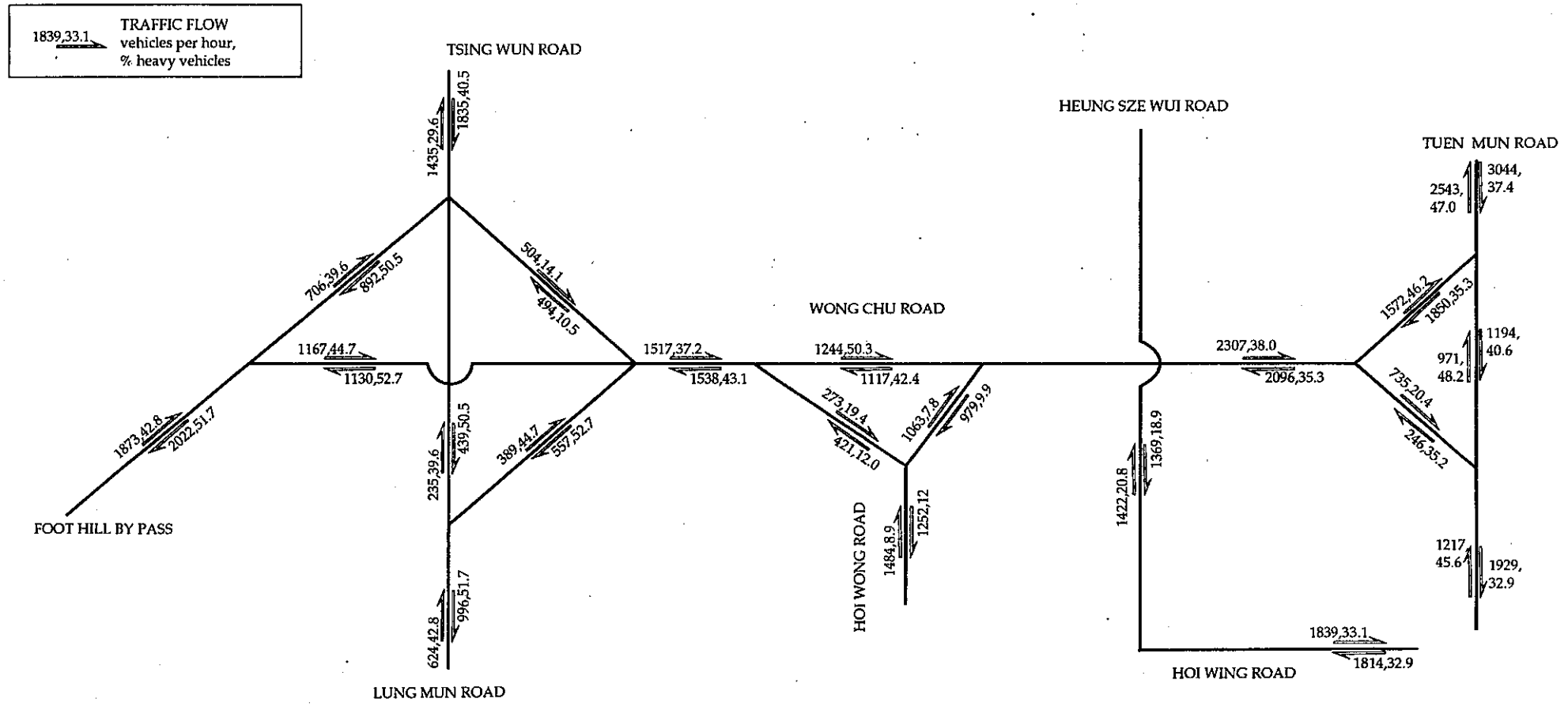

FIGURE 2.5b - WITH TMPD: WORST CASE (2011 AM PEAK HOUR) TRAFFIC FLOW

ERM Hong Kong, Ltd
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Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

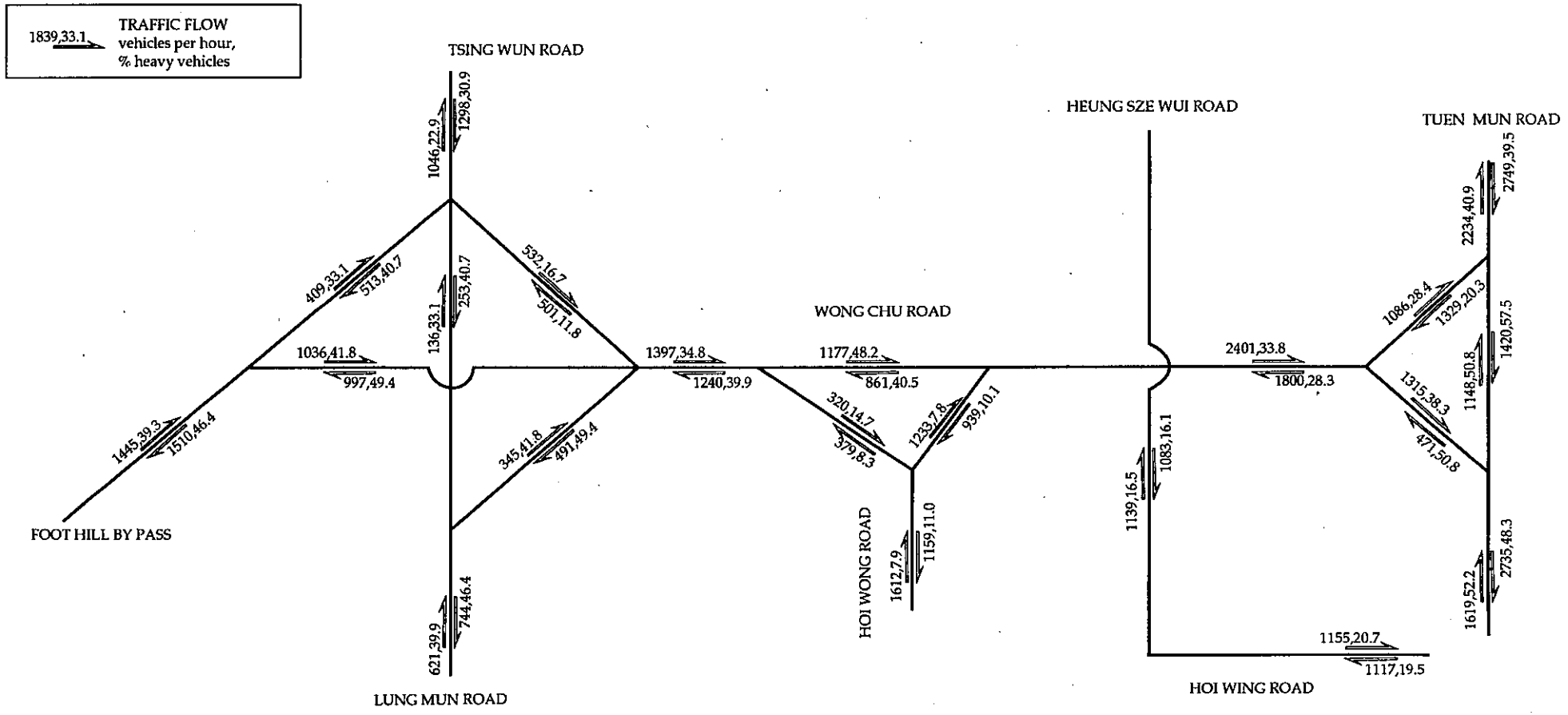

FIGURE 2.5c -WITHOUT TMPD: WORST CASE (2011AM PEAK HOUR) TRAFFIC FLOW

ERM Hong Kong, Ltd
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Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

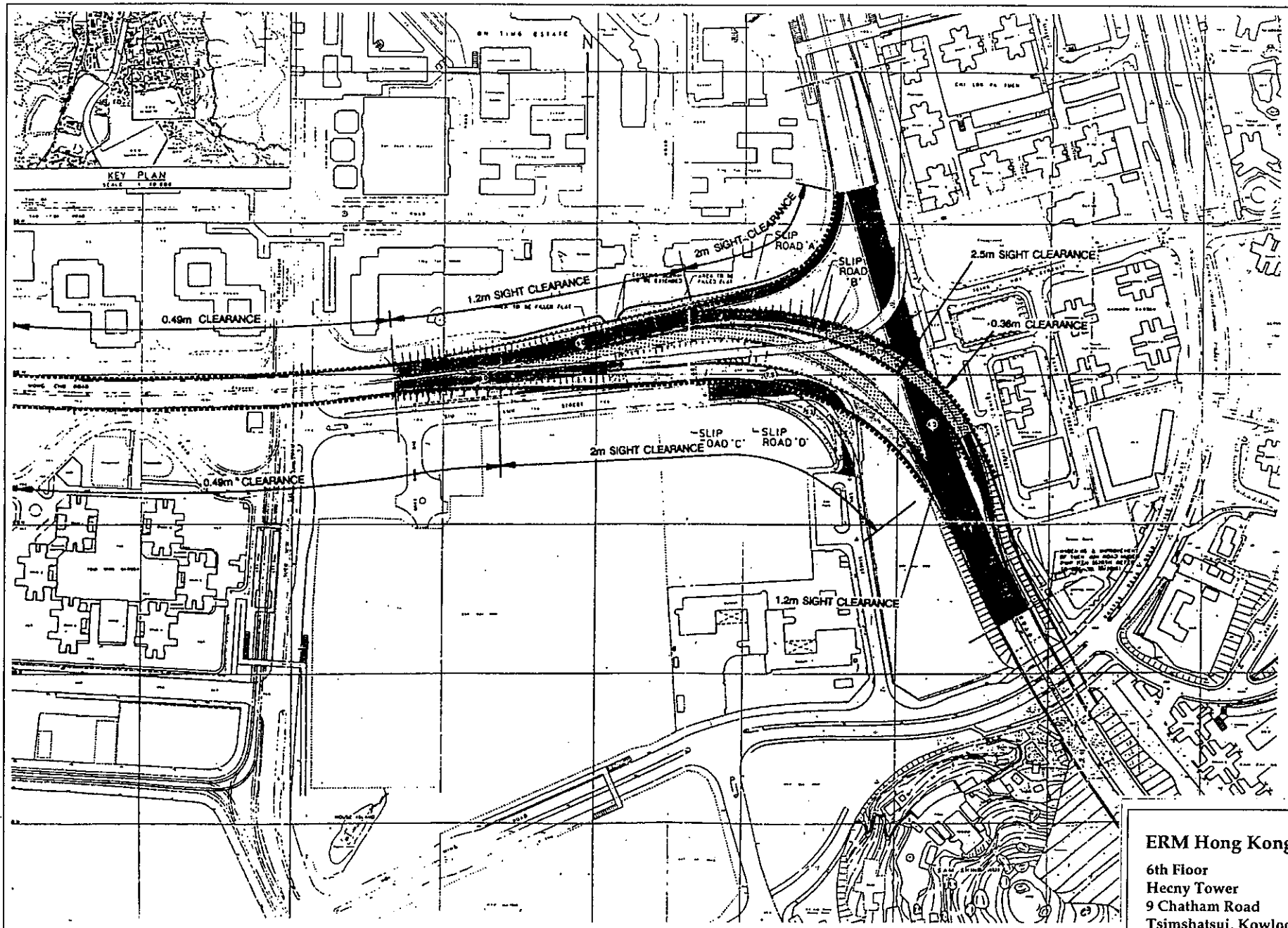

FIGURE2.6a - TRAFFIC CLEARNCE REQUIREMENT - 1

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Hecny Tower
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Tsimshatsui, Kowloon
Hong Kong

ERM

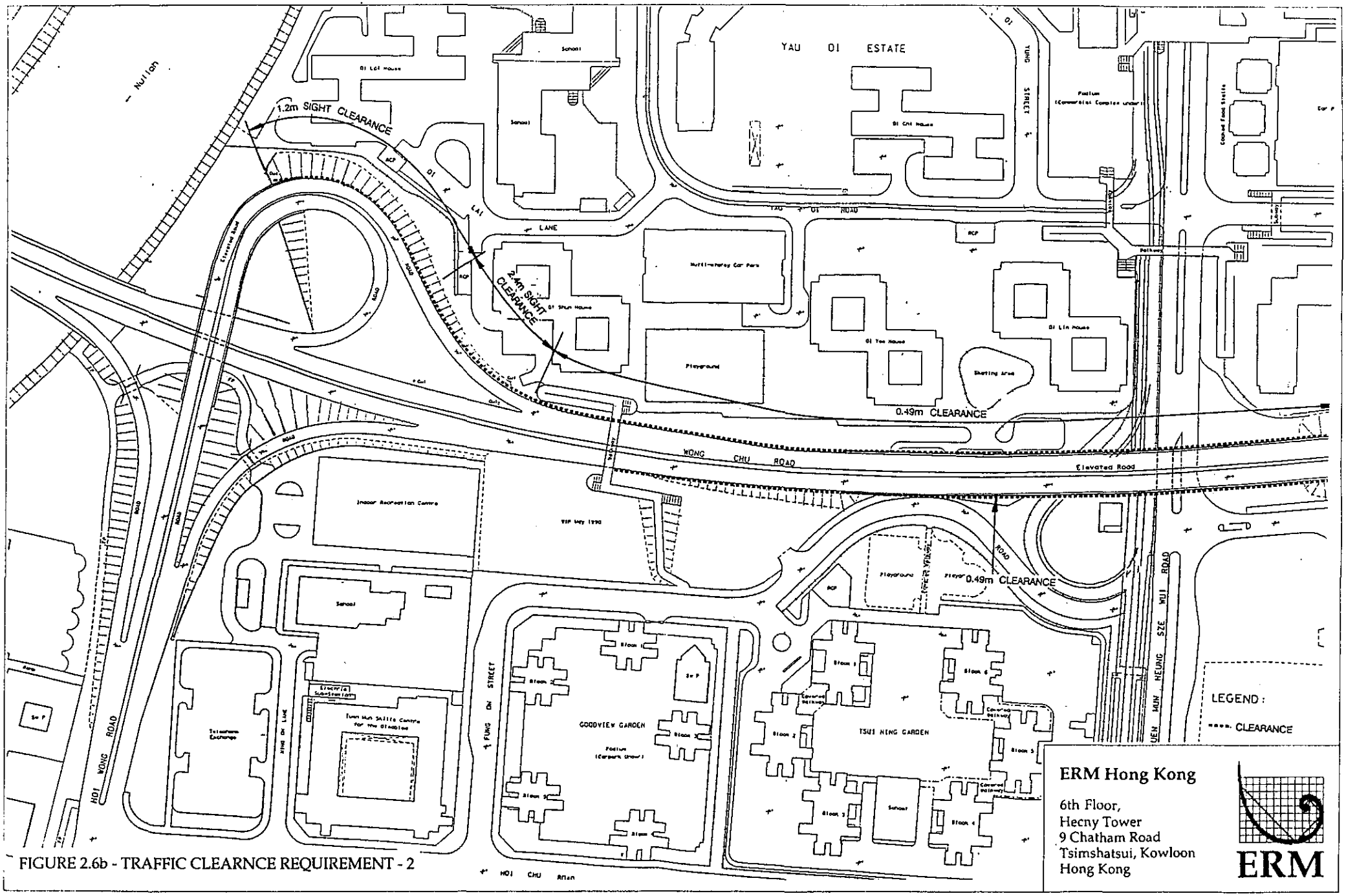

FIGURE 2.6b - TRAFFIC CLEARNCE REQUIREMENT - 2

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

ERM

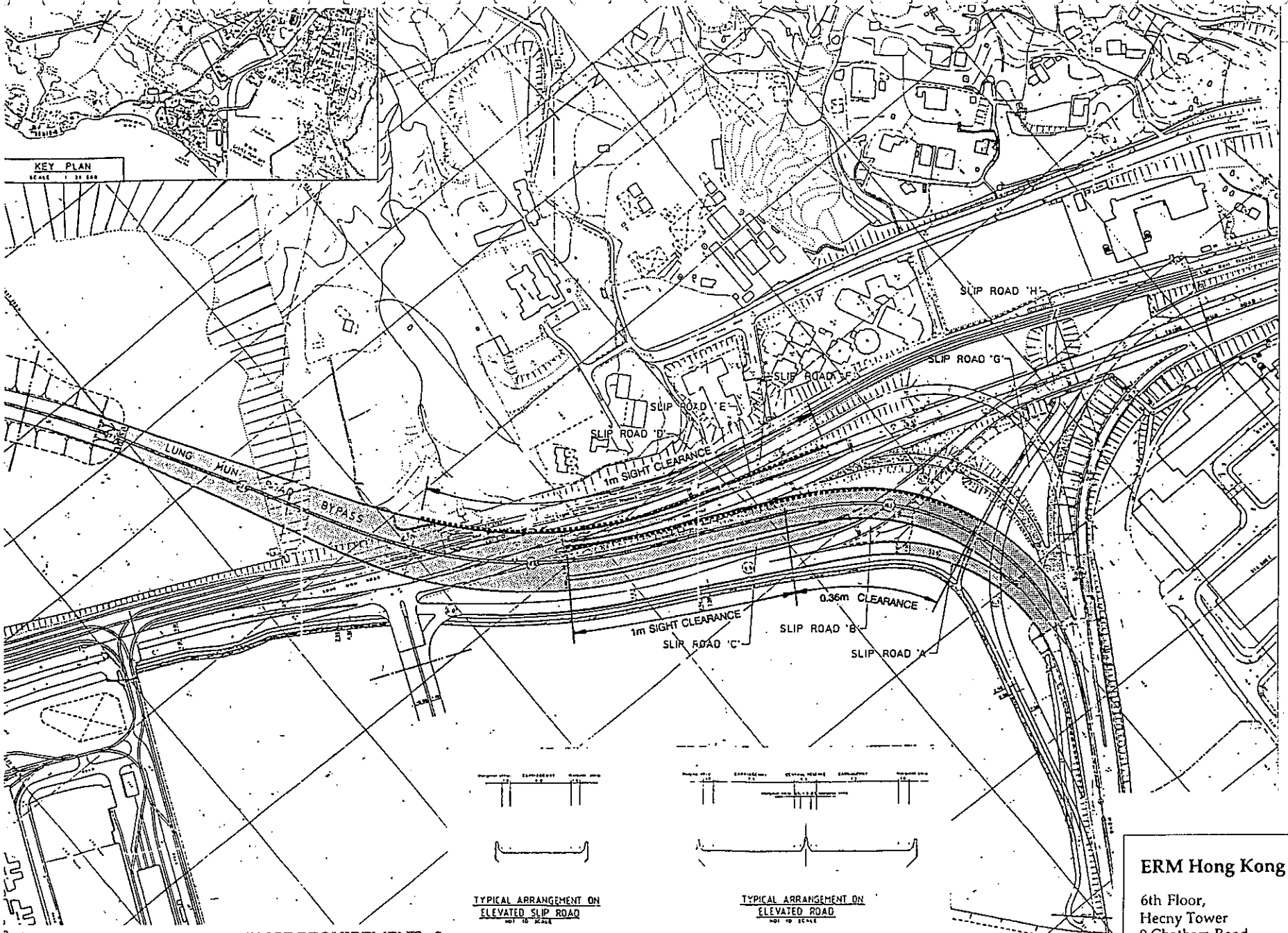

FIGURE 2.6c - TRAFFIC CLEARNCE REQUIREMENT - 3

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Tsimshatsui, Kowloon
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3 CONSTRUCTION IMPACT

3.1 AIR QUALITY

3.1.1 Introduction

This section assesses the air quality impact associated with the construction of the Roadworks upon air sensitive receivers. Worst case impacts on the receivers have been modelled and are presented below.

Dust impact upon the receivers is the major concern during construction. Mitigation measures required to protect the air sensitive receivers are also recommended for any exceedance of environmental criteria.

3.1.2 Government Legislation and Standards

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 (AQO) which stipulate the statutory limits of some typical air pollutants and the maximum allowable numbers of exceedance over specific periods. The AQO are shown in *Table 3.1a* below.

Table 3.1a *Hong Kong Air Quality Objectives*

Pollutant	Concentration in micrograms per cubic metre (i)			
	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
Nitrogen Dioxide (NO_2)	300		150	80
Carbon Monoxide (CO)	30,000	10,000		

Note:

(i) Measured at 298°K (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.

In addition, EPD recommends a maximum level of hourly TSP of 500 $\mu g/m^3$ at the boundary of any construction site.

3.1.3 Baseline Conditions

There are currently no fixed monitoring station near the Study Area. To establish the baseline condition of the Study Area, ambient air quality was monitored on the roof of STFA Wu Siu Kui Memorial Primary School at On

Ting Estate (see *Figure 3.1a* for location). Concentrations of TSP and RSP were continuously monitored at the station for two weeks between 18 March 1995 and 6 March 1995. Results of the baseline monitoring are presented in *Table 3.1b*.

Table 3.1b ***Ambient Air quality of the Study Area***

Pollutant	Daily Average Concentration ($\mu g/m^3$)
Total Suspended Particulates (TSP)	153
Respirable Suspended Particulates (RSP)	78

During the monitoring period, Siu Lun Soccer Pitch, approximately 100m from the station, was being constructed. In addition, construction works of the Tuen Mun Road widening was being carried out near Kam Fai Garden. Fugitive emission from the Siu Lun Soccer Pitch construction site, and overburden or mud from the Tuen Mun Road widening work site carried by haul vehicles and deposited onto the road network around the station, would increase the dust levels at the monitored station and therefore the monitored results would be on the high side. It is likely that the dust levels of the Study Area will be lowered once the construction works are completed.

3.1.4 Air Sensitive Receivers

Representative air sensitive receivers (ASRs) have been identified according to the criteria set out in the Hong Kong Planning Standards and Guidelines (HKPSG) and the Air Pollution Control Ordinance (APCO), and through site inspections and review of landuse plans of the Study Area. The ASRs and their horizontal distances from the kerbside of the nearest alignment are listed in *Table 3.1c* and their locations are shown in *Figures 3.1b & 3.1c*.

A total of 15 ASRs (A1–A15) have been identified for the Tuen Mun Road/ Wong Chu Road Interchange section including the Siu Lun Street Soccer Pitch (A6) which is being constructed. Two new G/IC sites have been planned in Siu Lun Street (A7) and Siu Hing Lane (A15). 10 ASRs (A16–A25) have been selected for the Lung Mun Road/ Wong Chu Road Interchange and Foothill Bypass section. Two sensitive receiver locations (A24 and A25) are located at the site of the planned Tuen Mun Area 18 PSPS development. The PSPS development is scheduled to be completed in phases between May 1998 and March 1999.

Table 3.1c Location of Air Sensitive Receivers

ASR	Locations	Horizontal Distance from nearest Alignment (m)
Tuen Mun Road/Wong Chu Road Interchange Section		
A1	Kam Fai Garden	110
A2	Harvest Garden Building	15
A3	Tung Pui Services Building	15
A4	Hong Kong Garden	25
A5	Chi Lok Fa Yuen	25
A6	Siu Lun St Soccer Pitch (under construction)	10
A7	Planned Siu Lun St G/IC site	5
A8	Wu Chan Kam Chee College	90
A9	Wu Siu Ku Primary School	40
A10	Ting Fuk House	50
A11	Ting Tak House	30
A12	Siu Lun Estate	30
A13	Oi Liu House	50
A14	Tsui Ning Garden	160
A15	Planned Siu Hing Lane G/IC site	40
Lung Mun Road/Wong Chu Road Interchange and Foothill Bypass Section		
A16	Nam Fung Industrial City	30
A17	Yan Chai Hospital No2 Secondary School	40
A18	Ju Ching Chu Secondary School	60
A19	Girl's Hostel	30
A20	Morning Light School	25
A21	Boy's Home	150
A22	Tuen Mun Recreational Sports Centre	10
A23	New Tuen Mun Centre	160
A24	Planned Area 18, PSPS development	20
A25	Planned Area 18, PSPS development	20

3.1.5 *Potential Sources of Impact*

The likely air quality impact arising from the Roadworks is related to dust nuisance, and gaseous emissions from construction plant and vehicles.

SO_2 and NO_2 will be emitted from the diesel-powered equipment used. However, since the amount of such plant required on-site will be limited, their gaseous emissions will be minimal. It is therefore unlikely that the emission from the limited construction plant will breach the AQO. On the other hand, potential dust nuisance will be the major concern from the construction works.

Details of the construction programme are presented in *Section* 2.2. Major sources of dust on site will be from excavation, filling, bulldozing and material handling. Significant excavation is not expected for the road improvement works. It is assumed that there is no concrete batching plant, stockpile or haul road within the work site.

3.1.6 *Evaluation Methodology*

Fugitive Dust Model (FDM) was used to predict the likely dust impacts at the receivers from the Roadworks construction. It was assumed that 80% of particulates are with size equal to 30 μm and the remaining 20% are respirable with size of 10 μm. Average dust density of 2500 kg/m^3 was assumed in this study. Particulate emission rates for the identified potential dusty sources were determined based on the *US EPA* publication *Compilation of Air Pollution Emission Factors (AP–42),* as shown in *Annex B.*

Meterological data (wind speed, wind direction, stability class, temperature and mixing height) have been obtained Royal Observatory's station at Tuen Mun (1993). The data were employed to model dust levels at the sensitive receivers. Both the worst case scenario of 1–hr and 24–hr average TSP concentrations were calculated.

In the assessment, a conservative approach was adopted assuming the worst case scenario that all activities are carried out in parallel. In reality, the activities are of limited duration and could vary in time.

TSP is the main component of dust during the construction of the Roadworks. It is assumed that RSP generation is approximately 20% of the TSP. No specific assessment was undertaken to calculate RSP concentrations at the ASRs.

3.1.7 *Impacts Assessment*

Wong Chu Road/Tuen Mun Road Interchange Section

The construction programme shown in *Figure 2.2a* indicates that 1998 is the peak year for the construction of Wong Chu Road/Tuen Mun Road Interchange. Major construction activities for the year will be:

- construction of slip road 'C';
- construction of temporary bridge and demolishing of existing bridge; and
- construction of slip road 'B' bridge.

The modelled 1–hour and 24–hour average dust levels at the sensitive receivers for the road improvement works of the Wong Chu Road/Tuen Mun Road Interchange are shown in *Table 3.1d.*

Table 3.1d *Predicted TSP Levels at Air Sensitive Receivers (Wong Chu Road /Tuen Mun Road Interchange)*

ASR	Locations	Concentration of TSP ($\mu g/m^3$)	
		1-hr Average	24-hr Average
A1	Kam Fai Garden	190	157
A2	Harvest Garden Building	207	158
A3	Tung Pui Services Building	399	160
A4	Hong Kong Garden	476	165
A5	Chi Lok Fa Yuen	292	178
A6	Siu Lun St Soccer Pitch	514	296
A7	Siu Lun St G/IC	543	307
A8	Wu Chan Kam Chee College	314	217
A9	Wu Siu Ku Primary School	315	217
A10	Ting Fuk House	325	186
A11	Ting Tak House	353	178
A12	Siu Lun Estate	315	187
A13	Oi Liu House	273	165
A14	Tsui Ning Garden	221	159
A15	Siu Hing Lane G/IC	335	170

Note: Background included in the TSP levels

The predicted hourly dust levels at the ASRs range from 207 $\mu g/m^3$ to 543 $\mu g/m^3$. Both the 1-hour and 24 hour TSP criteria will be exceeded at Siu Lun Street Soccer Pitch (A6) and the planned Siu Lun Street G/IC (A7). Mitigation measures will be required to reduce the air impact upon these two receivers.

Wong Chu Road/Lung Mun Road Interchange Section

For the road improvement works of the Wong Chu Road/ Lung Mun Road Interchange, the peak construction year is 1999 (see *Figure 2.2a)*. The following activities will be carried out in the year:

- demolishing of temporary on-ramp and road fork;
- construction of slip roads 'B', 'D' and 'E';
- carrying out embankment works of slip road 'H' bridge and retaining wall; and
- construction of the Foothill Bypass including superstructure, embankment and paving.

The predicted 1-hour and 24-hour average dust levels at the sensitive receivers are shown in *Table 3.1e.*

Table 3.1e *Predicted TSP Levels at Air Sensitive Receivers (Wong Chu Road /Lung Mun Road Interchange)*

ASR	Location	Concentration of TSP (ug/m3)	
		1-hr average	24-hr average
A16	Nam Fung Industrial Building	771	274
A17	Yan Chai hospital No2 Secondary School	390	202
A18	Ju Ching Chu Secondary School	403	216
A19	Girl's Hostel	406	226
A20	Morning Light School	427	220
A21	Boy's Home	341	197
A22	Tuen Mun Recreational Sports Centre	299	200
A23	Tuen Mun Centre	239	173
A24	Area 18 PSPS Development	756	266
A25	Area 18 PSPS Development	770	246

Note: Background included in the TSP results

Predicted hourly TSP averages at the ASRs from 300 ug/m^3 to 800 ug/m^3. The TSP criteria will be exceeded at Nam Fung Industrial Building (A16) and Tuen Mun Area 18 PSPS development (A24 & A25). Mitigation measures will be required to reduce the air impact upon these receivers.

3.1.8 Mitigation Measures

As presented above, the construction work is likely to cause unacceptable dust impact on the Siu Lun Street Soccer Pitch, the planned Siu Lun Street G/IC, Nam Fung Industrial City, and the planned Tuen Mun Area 18 PSPS development. The following dust control measures as part of good construction practice should be incorporated in the Contract Specifications and implemented to minimise dust nuisance to within the acceptable levels.

- where breaking of oversize rock/concrete is required, watering should be implemented to control dust. Water spray should be used during the handling of fill material at the site and at active cuts, excavation and fill sites where dust is likely to be created;
- 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;
- wheel washing trough should be provided at the exit of work sites;
- all stockpiles of aggregate or spoil should be enclosed or covered and water applied in dry or windy condition; and

- effective water sprays should be used on the site at potential dust emission sources such as unpaved area.

With a proper control system, dust emission of material handling and drilling would be reduced by 70%, as stated in AP-42. Bulldozing could also be reduced by 60%. *Tables 3.1f and 3.1g* present both the mitigated hourly and daily averages at the receivers.

Table 3.1f ***Mitigated TSP Levels at Air Sensitive Receivers (Wong Chu Road /Tuen Mun Road Interchange)***

ASR	Locations	Concentration of TSP ($\mu g/m^3$)	
		1-hr Average	24-hr Average
A1	Kam Fai Garden	168	154
A2	Harvest Garden Building	174	155
A3	Tung Pui Services Building	250	156
A4	Hong Kong Garden	281	158
A5	Chi Lok Fa Yuen	208	163
A6	Siu Lun St Soccer Pitch	296	179
A7	Siu Lun St G/IC	307	166
A8	Wu Chan Kam Chee College	217	163
A9	Wu Siu Ku Primary School	217	164
A10	Ting Fuk House	221	166
A11	Ting Tak House	232	163
A12	Siu Lun Estate	217	166
A13	Oi Liu House	200	158
A14	Tsui Ning Garden	180	155
A15	Siu Hing Lane G/IC	225	160

Table 3.1g ***Mitigated TSP Levels at Air Sensitive Receivers (Wong Chu Road /Lung Mun Road Interchange)***

ASR	Location	Concentration of TSP ($\mu g/m3$)	
		1-hr average	24-hr average
A16	Nam Fung Ind Building	392	199
A17	Yan Chai hospital No2 Secondary School	246	171
A18	Ju Ching Chu Secondary School	250	175
A19	Girl's Hostel	245	179
A20	Morning Light School	257	177
A21	Boy's Home	225	167
A22	Tuen Mun Recreational Sports Center	206	168
A23	Tuen Mun Centre	185	160
A24	Area 18 PSPS Development	382	194
A25	Area 18 PSPS Development	394	188

It can be seen that the mitigated dust levels at the receivers would be considerably reduced and will comply with the dust criteria.

Environmental monitoring and audit (EM&A) of construction dust should be undertaken at Siu Lun Street Soccer Pitch and Area 18 PSPS to ensure the efficiency of the dust control measures and that the dust criteria will not be exceeded during construction. The EM&A requirements are presented in the Environment Schedule in *Annex C.*

3.1.9 *Conclusions*

Total suspended particulate is the major pollutant during the Roadworks construction. Air dispersion model were employed to predict the dust impact upon receivers. The dust criteria will be satisfied at most ASRs. Exceedance of the criteria is expected at the planned Siu Lun Street G/IC and soccer pitch, Nam Fung Industrial City and the planned Area 18 PSPS development. Mitigation measures have been recommended to minimize the dust impacts on the receivers, which should be incorporated into the Contract Specifications. The dust criteria will be satisfied with the incorporation of the mitigation measures, and will be checked by EM&A procedures.

3.2 *NOISE IMPACT*

3.2.1 *Introduction*

This section assesses the potential noise impact associated with the construction of the Roadworks. In addition this section recommends measures to mitigate any unacceptable impact.

3.2.2 *Environmental Legislation and Guidelines*

In Hong Kong the control of construction noise other than Percussive Piling outside of daytime, weekday working hours (0700–1900, Monday through Saturday) is governed by the NCO and the subsidiary technical memoranda namely *Technical Memorandum on Noise From Construction Work Other Than Percussive Piling (TM1),* and 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. Since no percussive piling is proposed on this project, *TM2* will not be referenced again in this assessment.

The NCO criteria for the control of noise from powered mechanical equipment (PME) are dependant upon the type of area containing the NSR rather than the measured background noise level. The NCO requires that noise levels from construction at affected NSRs be less than a specified *Acceptable Noise Level* (ANL) which depends on the *Area Sensitivity Rating* (ASR).

It is intended that the construction activities of the proposed works should be planned and controlled in accordance with the NCO. Works requiring the use of PME during restricted hours (i.e. outside of 0700–1900 Monday through Saturday, and during public holidays) and particularly at night, will

require a *Construction Noise Permit* (CNP) and will need to achieve the applicable ANL. The ANL is derived from the *Basic Noise Levels* (BNL) by applying corrections for the duration of the works and the effect of any other nearby sites operating under a CNP. For this assessment these corrections are negligible and so have been set to zero.

For the installation of horizontal panels of the recommended noise enclosure along Wong Chu Road (see *Section 5.8*), the work are proposed to be carried out during non-peak hours at evening and night time (i.e. 1900 to 2300 & 2300-0700 hours respectively), and hence a CNP will be required and will need to achieve the respective ANL of 70 dB(A) and 55 dB(A).

Although the NCO does not provide for the control of construction activities during normal working hours, a limit of $L_{Aeq,\,30\,min}$ 75 dB(A) is proposed in the "*Practice Note For Professional Persons, PN2/93*" issued by the *Professional Persons Environmental Consultative Committee* (ProPECC) in June 1993. This limit has been applied on major construction projects, and is now generally accepted in Hong Kong, and will therefore be adopted in this study in order to protect residential NSRs to an appropriate extent. The noise impact criteria have been specified in *Tables 3.2b* and *3.2c*.

For schools , (of which there are four in the study area) the recommended noise level during normal school days is $L_{Aeq,\,30\,min}$ 70 dB(A), this is lowered to $L_{Aeq,\,30\,min}$ 65 dB(A) during student examination periods. The mitigation measures that are recommended later in this section aim to lower noise levels to below the normal level for schools ($L_{Aeq,\,30\,min}$ 70 dB(A)), additional measures such as reducing the number of plants in use would therefore be required during examination periods, if these occur within noisy construction phases.

3.2.3 *Baseline Conditions and Noise Sensitive Receivers*

Existing Conditions

The existing ambient noise levels in the Study Area were measured between 0800 to 0900 for two typical days on 23 and 24 March 1995 at 4 representative NSR locations as shown in *Figure 3.1a*. Predominant existing noise sources at these locations were traffic on Tuen Mun Road, Wong Chu Road, Lung Mun Road, other neighbouring roads serving the surrounding area and the light rail trains.

The survey was chosen for the hours 0800 to 0900 as the recent traffic survey from the Transport Department indicated that traffic flow was highest between these hours for the roads being investigated. Equipment used for the measurement consisted of a Bruel & Kjaer Type 2236 sound level meter with a Type 4188 microphone. This equipment was calibrated using a Type 4231 calibrator before and after each measurement, and no significant drift was detected. The weather conditions during the measurement periods were fine with only light wind and no rain.

Noise measurements were made in A-weighting and fast response settings, and $L_{10(15\,min)}$, $L_{eq(15\,min)}$ and $L_{90(15\,min)}$ noise levels at 1m from the facade of the monitoring locations and 1.2m above ground were recorded. These measurements are summarised in *Table 3.2a*. 15-minute sampling periods were used. Standard acoustical principles and practices were followed in the measurement and analysis of the measured noise data.

Table 3.2a *Measured Baseline Noise Levels in the Study Area*

Monitoring Locations		Measured Noise Level dB(A)			Sources of Noise
		$L_{10(15\ min)}$	$L_{eq(15\ min)}$	$L_{90(15\ min)}$	
M1	Kam Fai Garden (Ground)	79.6	76.4	69.1	– vehicles – nearby general construction noise from Tuen Mun Road widening work
M2	Wu Shiu Kui Primary School (Roof)	72.1	70.9	68.4	– vehicles
M3	Oi Yee House (Ground)	72.7	70.2	66.1	– vehicles
M4	Morning Light School (Roof)	76.1	71.8	62.1	– vehicles – light rails

These measurements indicate that the existing environment around the study area is already noisy, with peak hour noise levels at all the representative NSRs above the $L_{A10,\ peak\ hour}$ 70 and 65 dB(A) criteria for residences and schools respectively.

Noise Sensitive Receivers

Noise Sensitive Receivers (NSRs), as defined by Hong Kong Planning Standard and Guideline (HKPSG) and the Noise Control Ordinance (NCO), were identified.

The construction noise impacts at the worst impacted representative NSRs have been considered, these NSRs and their respective noise impact criteria have been listed in *Tables 3.2b* to *d* (P1/D15 Interchange & Foothill Bypass, P1/P3 Interchange and installation of noise enclosure respectively) . The location of the NSRs are marked on *Figures 3.2a, 3.2b.* and *3.2c.*

Table 3.2b ***Construction Noise Criteria for NSRs impacted by the P1/D15 Interchange & Foothill Bypass***

NSR number	NSR name and type	Noise impact criteria (*Daytime* $L_{Aeq,\ 30\ min}$ *dB(A)*)
36	Yan Chai Hospital No. 2 Secondary School	70 normally 65 during exams
39	Girls' Hostel	75
40	Morning Light School	70 normally 65 during exams
42	Boy's Hostel	75
57	Area 18 PSPS Housing Development	75

The single aspect building blocks along the north and west site boundaries of the Area 18 PSPS housing development (to be completed by 1999) for mitigating traffic noise impact, as required in the Planning Brief, suggest that there will be no noise sensitive rooms facing directly to the Roadworks' construction site and hence, the housing development should not be subject to high levels of construction noise. A worst case representative NSR (with

a direct line of sight to the construction site) at the development has been considered in this assessment for reference.

Table 3.2c *Construction Noise Criteria for NSRs impacted by the P1/P3 Interchange*

NSR number	NSR name and type	Noise impact criteria (*Daytime $_{LAEQ,\ 30MIN}$ dB(A)*)
8	Ting Tak House – residential	75
9	Shun Tak Fraternal Association Wu Siu Kut Memorial Primary School	NA*
10	Lui Cheung Kwok Lutheran Primary School	NA*
12	Ting Fuk House – residential	75
20	Chi Lok Fa Yuen Block 5 – residential	75
46	Hong King Garden Blocks A & B – residential	75

* NSRs 9 and 10 are insulated and therefore do not follow the same criteria recommended for schools. They have however been included in this section to show the noise levels at the facade of the buildings.

Table 3.2d *Construction Noise Criteria for NSRs impacted by the Installation of Noise Enclosure*

NSR number	NSR name and type	Noise impact criteria	
		Evening	Night time
2	Oi Yee House	70	55
3	Oi Shun House	70	55
8	Ting Tak House	70	55
26	Goodview Garden	70	55
30	Tsui Ning Garden	70	55
56	Siu Lun Court Block 2	70	55

3.2.4 Evaluation Methodology

A methodology for assessing noise from the project has been developed based on the TM1. In general, the methodology is as follows:

- locate NSRs that may be affected by the worksite;
- calculate distance attenuation to NSRs from worksite notional noise source point;
- calculate maximum total site sound power level (SWL) for construction activities using the plant list and SWL for each plant given in the technical Memoranda (TM1 and TM2).
- predict construction noise levels at NSRs in the absence of any mitigation measures; and,

If the noise impact criteria at NSRs are exceeded, mitigation measures must be considered. A revaluation of the total SWL for activities must be made assuming the use of tangible mitigation measures such as super quiet plants and barriers. If the criteria are still exceeded, further mitigation measures, such as reduction in noisy plants working simultaneously would need to be recommended.

3.2.5 *Impact Assessment*

Roadworks Construction

The day time construction activities will be carried out in two main construction areas. These areas are as follows:

- P1/D15 Interchange & Foothill Bypass construction area; and
- P1/P3 Interchange construction area.

The nature, plant list and duration of construction activities, and programme are presented in *Section 2.2*. The plant list and the corresponding sound power levels are given in *Tables 3.2e* and *3.2f*. The number of dump trucks used by each activity was estimated from the trip frequencies given in *Figure 2.2a* Tentative Construction Programme. A limit of three trucks visiting a particular work area within a half hour period was estimated.

Table 3.2e *P1/D15 Interchange & Foothill Bypass Construction Area*

Activity		Noise Source	TM Reference Number	No	Sound Power Level (dB(A))
1.3	Widen Northwest – Bound lanes on Wong Chu Road and repave	Dozer	CNP030	1	115
		Dump Tracks	CNP067	3	117 + 5
		Grader	CNP104	1	113
		Hot Mix Applicator	CNP004	1	109
		Mini Backhoe	CNP081	1	112
		Roller	CNP185	1	108
		Roller (vibrating drum)	CNP186	1	108
					Total 124
1.4	Construct Temporary on–Ramp onto Existing Fork (to be demolished) and re–opened	Plant list is identical that of activity 1.3			**Total 124**
1.5	Construct slip road 'A' including elevated structure, ret wall and abutments	Concrete Trucks	CNP044	2	109 + 3
		Crane	CNP048	1	112
		Dozer	CNP030	1	115
		Drilling Rig	CNP166	1	100
		Dump Trucks	CNP067	3	117 + 5
		Grader	CNP104	1	113
		Hot Mix Applicator	CNP004	1	109
		Mini Backhoe	CNP081	1	112
		Roller	CNP185	1	108
		Roller (vibrating drum)	CNP186	1	108
					Total 124
1.6	Construct slip road 'G' marrying into existing RH fork and demolishing a part of the LH fork	Backhoe Breaker	CNP027	1	122
		Dump Trucks	CNP067	1	117
		Grader	CNP104	1	113
		Hot Mix Applicator	CNP004	1	109
		Mini Backhoe	CNP081	1	112
		Roller	CNP185	1	108
					Total 124

Activity		Noise Source	TM Reference Number	No	Sound Power Level (dB(A))
1.7	Footpath and cycle track	Concrete Trucks	CNP044	2	109 + 3
		Mini Backhoe	CNP081	1	112
					Total 114
1.8	Remove temporary on-ramp onto existing fork (to be demolished) and re-open	Backhoe Breaker	CNP027	1	112
		Dump Trucks	CNP067	1	117
		Mini Backhoe	CNP081	1	112
					Total 124
1.9	Construct slip road 'B'	Plant list is identical to that of activity 1.3			**Total 124**
1.11	Carry out embankment works incl slip road 'H' bridge, ret wall and repave	Plant list is identical to that of activity 1.5			**Total 124**
1.12	Construct slip road 'D'	Plant list is the sum of plants listed under 1.14.1 to 1.14.4, inclusive			**Total 124**
1.13	Construct slip road 'E'	Plant list is the sum of plants listed under 1.14.1 to 1.14.4, inclusive			**Total 124**
1.14.1	Piling on Foothills Bypass	Crane	CNP048	1	112
		Drilling Rig	CNP166	1	100
					Total 112
1.14.2	Foothills Bypass Superstructure	Concrete Pump	CNP047	1	109
		Concrete Trucks	CNP044	2	109 + 3
		Tower Crane	CNP049	1	95
					Total 114
1.14.3	Embankment for north section of Foothills Bypass	Dozer	CNP030	1	115
		Dump Trucks	CNP067	2	117 + 3
		Roller (vibrating drum)	CNP186	1	108
					Total 121
1.14.4	Paving of Foothills Bypass	Dump Trucks	CNP067	2	117 + 3
		Grader	CNP104	1	113
		Hot Mix Applicator	CNP004	1	109
		Mini Backhoe	CNP081	1	112
					Total 122

Table 3.2f *P1/P3 Interchange Construction Area*

Activity		Noise Source	TM Reference Number	No	Sound Power Level (dB(A))
2.2	Construction of slip road 'C'	Concrete Trucks	CNP044	1	109
		Dozer	CNP030	1	115
		Dump Trucks	CNP067	2	117 +3
		Grader	CNP104	1	113
		Hot Mix Applicator	CNP004	1	109
		Mini Backhoe	CNP081	1	112
					Total 123
2.3	Construct Temporary Bridge	Tower Crane	CNP049	1	95
		Trucks (5 trips/day)	CNP141	1	112
					Total 112
2.4	Demolish existing bridge	Backhoe Breaker	CNP027	1	122
		Crane	CNP048	1	112
		Trucks (5 trips/day)	CNP141	1	112
					Total 123
2.5	Construction of slip road 'B' Bridge	Concrete Pump	CNP047	1	109
		Concrete Trucks	CNP044	2	109+3
		Crane	CNP048	1	112
		Drilling Rig	CNP166	1	100
		Tower Crane	CNP049	1	95
					Total 116
2.6	Remove temporary bridge incl. reconstruction	Plant list is identical to that of activity 2.3			**Total 112**
2.7	Complete resurfacing of Wong Chu Road	Plant list is identical to that of activity 2.2			**Total 123**
2.8	Complete reconstruction of Tuen Mun Road	Plant list is identical to that of activity 1.6			**Total 124**

Tables 3.2g to *h* below indicates the distance between NSRs and the worst case notional sound source of each activity. The Activity/NSR combinations that are marked NA represent distances greater than 180m. A 180m distance corresponds to a distance correction factor of 53 dB(A), as a result the noise level from the activity at the NSR will be lower than the assessment criterion, therefore the Activity/NSR combination does not need to be considered further. Additional screening is also likely for more distant noise sources.

Table 3.2g *Distance Between NSRs and P1/D15 Interchange Activities (m)*

Activity	NSR				
	36	39	40	42	57
1.3	90	68	NA	NA	NA
1.4	NA	NA	NA	NA	NA
1.5	NA	131	110	NA	40
1.6	160	144	NA	NA	NA
1.7	160	134	126	NA	30
1.8	160	75	81	NA	NA
1.9	150	95	110	NA	110
1.11	90	175	NA	NA	NA
1.12	NA	68	71	167	90
1.13	NA	60	55	156	110
1.14.1	NA	100	82	171	70
1.14.2	NA	100	82	171	70
1.14.3	NA	100	82	171	70
1.14.4	NA	100	82	171	70

Table 3.2h *Distance Between NSRs and P1/P3 Interchange Activities (m)*

Activity	NSR					
	8	9	10	12	20	46
2.2	92	72	66	NA	NA	71
2.3	NA	NA	35	NA	92	NA
2.4	NA	58	41	NA	NA	65
2.5	NA	90	30	NA	105	31
2.6	NA	NA	35	NA	92	NA
2.7	52	46	20	73	65	NA
2.8	NA	NA	106	101	49	53

Tables 3.2i and *3.2j* give the cumulative noise levels at the NSRs that result from concurrent construction activities. Possible concurrent activities have been identified from the tentative construction programme (see *Section* 2.2). The total noise levels that are highlighted in the tables indicate exceedance of the criteria at the NSR.

Table 3.2i *Noise Levels for Worst Case Concurrent Activity–P3/D15 Interchange*

NSR	Activity	Duration (m/yr) – dates are inclusive	Noise Levels – including distance and facade correction ($L_{Aeq,\ 30\ minute}$ dB(A))	Total Noise Level ($L_{Aeq,\ 30\ minute}$ dB(A))
36	1.3, 1.4;	10/97–11/97	80, NA	*80*
	1.5, 1.7, 1.14.2;	8/98–9/98	NA, 65, NA	65
	1.6, 1.7, 1.14.2;	10/98–11/98	75, 65, NA	*75*
	1.7, 1.8, 1.9, 1.14.2;	12/98	65, 74, 75, NA	*78*
	1.8, 1.9, 1.14.2, 1.14.3;	1/99–2/99	74, 75, NA, NA	*78*
	1.9, 1.14.2, 1.14.3;	3/99–5/99	75, NA, NA, NA	75
	1.11, 1.14.2, 1.14.3;	6/99–7/99	80, NA, NA	*80*
	1.11, 1.14.2, 1.14.3, 1.14.4;	8/99–11/99	80, NA, NA, NA	*80*
39	1.3, 1.4;	10/97–11/97	82, NA	*82*
	1.5, 1.14.1;	12/97–4/98	77, 67	*77*
	1.5, 1.14.1, 1.14.2;	5/98–7/98	77, 67, 69	*78*
	1.5, 1.7, 1.14.2;	8/98–9/98	77, 66, 69	*78*
	1.6, 1.7, 1.14.2;	10/98–11/98	76, 66, 69	*77*
	1.7, 1.8, 1.9, 1.14.2;	12/98	66, 81, 79, 69	*83*
	1.8, 1.9, 1.14.2, 1.14.3;	1/99–2/99	81, 79, 69, 76	*84*
	1.9, 1.14.2, 1.14.3;	3/99–5/99	79, 69, 76	*81*
	1.11, 1.14.2, 1.14.3;	6/99–7/99	75, 69, 76	*79*
	1.11, 1.14.2, 1.14.3, 1.14.4;	8/99–11/99	75, 69, 76, 77	*81*
	1.12, 1.14.2, 1.14.3, 1.14.4;	12/99–1/00	MAX (83, SUM(69, 76, 77))*	*83*
	1.13, 1.14.2, 1.14.3, 1.14.4;	2/00–4/00	MAX (84, SUM(69, 76, 77))*	*84*
	1.13, 1.14.2, 1.14.4;	5/00–6/00	MAX (84, SUM(69, 77))*	*84*
	1.14.2, 1.14.4;	7/00–2/01	69, 77	*77*
	1.14.4;	3/01–7/01	77	*77*
40	1.5, 1.14.1;	12/97–4/98	78, 69	*79*
	1.5, 1.14.1, 1.14.2;	5/98–7/98	78, 69, 71	*80*
	1.5, 1.7, 1.14.2;	8/98–9/98	78, 67, 71	*79*
	1.6, 1.7, 1.14.2;	10/98–11/98	NA, 67, 71	72
	1.7, 1.8, 1.9, 1.14.2;	12/98	67, 80, 78, 71	*83*
	1.8, 1.9, 1.14.2, 1.14.3;	1/99–2/99	80, 78, 71, 78	*84*
	1.9, 1.14.2, 1.14.3;	3/99–5/99	78, 71, 78	*81*
	1.11, 1.14.2, 1.14.3;	6/99–7/99	NA, 71, 78	*79*
	1.11, 1.14.2, 1.14.3, 1.14.4;	8/99–11/99	NA, 71, 78, 78	*82*
	1.12, 1.14.2, 1.14.3, 1.14.4;	12/99–1/00	MAX (82, SUM(71, 78, 78))*	*82*
	1.13, 1.14.2, 1.14.3, 1.14.4;	2/00–4/00	MAX (85, SUM(71, 78, 78))*	*85*
	1.13, 1.14.2, 1.14.4;	5/00–6/00	MAX (85, SUM(71, 78))*	*85*
	1.14.2, 1.14.4;	7/00–2/01	71, 78	*79*
	1.14.4;	3/01–7/01	78	*78*
42	1.5, 1.14.1;	12/97–4/98	NA, 63	63
	1.5, 1.14.1, 1.14.2;	5/98–7/98	NA, 63, 64	67
	1.5, 1.7, 1.14.2;	8/98–9/98	NA, NA, 64	64
	1.6, 1.7, 1.14.2;	10/98–11/98	NA, NA, 64	64
	1.7, 1.8, 1.9, 1.14.2;	12/98	NA, NA, NA, 64	64
	1.8, 1.9, 1.14.2, 1.14.3;	1/99–2/99	NA, NA, 64, 72	73
	1.9, 1.14.2, 1.14.3;	3/99–5/99	NA, 64, 72	73
	1.11, 1.14.2, 1.14.3;	6/99–7/99	NA, 64, 72	73
	1.11, 1.14.2, 1.14.3, 1.14.4;	8/99–11/99	NA, 64, 72, 72	75
	1.12, 1.14.2, 1.14.3, 1.14.4;	12/99–1/00	MAX (75, SUM(64, 72, 72))*	75
	1.13, 1.14.2, 1.14.3, 1.14.4;	2/00–4/00	MAX (76, SUM(64, 72, 72))*	*76*
	1.13, 1.14.2, 1.14.4;	5/00–6/00	MAX (76, SUM(64, 72))*	*76*
	1.14.2, 1.14.4;	7/00–2/01	64, 72	73
	1.14.4;	3/01–7/01	72	72

NSR	Activity	Duration (m/yr) – dates are inclusive	Noise Levels – including distance and facade correction ($L_{Aeq, 30\ minute}$ dB(A))	Total Noise Level ($L_{Aeq, 30\ minute}$ dB(A))
57	1.5, 1.14.1;	12/97–4/98	87, 70	*87*
	1.5, 1.14.1, 1.14.2;	5/98–7/98	87, 70, 72	*87*
	1.5, 1.7, 1.14.2;	8/98–9/98	87, 79, 72	*88*
	1.6, 1.7, 1.14.2;	10/98–11/98	NA, 79, 72	*80*
	1.7, 1.8, 1.9, 1.14.2;	12/98	79, NA, 78, 72	*82*
	1.8, 1.9, 1.14.2, 1.14.3;	1/99–2/99	NA, 78, 72, 79	*82*
	1.9, 1.14.2, 1.14.3;	3/99–5/99	78, 72, 79	*82*
	1.11, 1.14.2, 1.14.3;	6/99–7/99	NA, 72, 79	*80*
	1.11, 1.14.2, 1.14.3, 1.14.4;	8/99–11/99	NA, 72, 79, 80	*82*
	1.12, 1.14.2, 1.14.3, 1.14.4;	12/99–1/00	MAX (80, SUM(72, 79, 80))*	*83*
	1.13, 1.14.2, 1.14.3, 1.14.4;	2/00–4/00	MAX (78, SUM(72, 79, 80))*	*83*
	1.13, 1.14.2, 1.14.4;	5/00–6/00	MAX (78, SUM(72, 80))*	*78*
	1.14.2, 1.14.4;	7/00–2/01	72, 80	*81*
	1.14.4;	3/01–7/01	80	*80*

* The noise generated by activity 1.12 (or 1.13) can not be added to 1.14.x activities since they share the same plants (i.e. both 1.12 (or 1.13) and the 1.14.x activities can not produce noise concurrently). The maximum possible noise level for each NSR is calculated accordingly.

Table 3.2j Noise Levels for Worst Case Concurrent Activity–P1/P3 Interchange

NSR	Activity	Duration (m/yr) – dates are inclusive	Noise Levels – including distance and facade correction ($L_{Aeq, 30\ minute}$ dB(A))	Total Noise Level ($L_{Aeq, 30\ minute}$ dB(A))
8	2.2;	9/97–12/97	79	*79*
	2.2, 2.3;	1/98	79, NA	*79*
	2.7, 2.8;	1/01	84, NA	*84*
9*	2.2;	9/97–12/97	81	*81*
	2.2, 2.3;	1/98	81, NA	*81*
	2.4;	5/98–7/98	83	*83*
	2.4, 2.5;	8/98–9/98	83, 72	*83*
	2.5;	10/98–9/00	72	*72*
	2.7, 2.8;	1/01	85, NA	*85*
10*	2.2;	9/97–12/97	81	*81*
	2.2, 2.3;	1/98	81, 76	*83*
	2.3;	2/98–4/98	76	*76*
	2.4;	5/98–7/98	86	*86*
	2.4, 2.5;	8/98–9/98	86, 82	*87*
	2.5;	10/98–9/00	82	*82*
	2.6;	10/00–11/00	76	*76*
	2.7, 2.8;	1/01	92, 79	*92*
	2.8;	2/01–6/01	79	*79*
12	2.7, 2.8;	1/01	81, 79	*83*
	2.8;	2/01–6/01	79	*79*
20	2.2, 2.3;	1/98	NA, 68	68
	2.3;	2/98–4/98	68	68
	2.4, 2.5;	8/98–9/98	NA, 71	71
	2.5;	10/98–9/00	71	71
	2.6;	10/00–11/00	68	68
	2.7, 2.8;	1/01	82, 85	*87*
	2.8;	2/01–6/01	86	*86*

NSR	Activity	Duration (m/yr) - dates are inclusive	Noise Levels - including distance and facade correction ($L_{Aeq, 30\ minute}$ dB(A))	Total Noise Level ($L_{Aeq, 30\ minute}$ dB(A))
46	2.2;	9/97-12/97	81	*81*
	2.2, 2.3;	1/98	81, NA	*81*
	2.4;	5/98-7/98	82	*82*
	2.4, 2.5;	8/98-9/98	82, 81	*84*
	2.5;	10/98-9/00	81	*81*
	2.7, 2.8;	1/01	NA, 85	*85*
	2.8;	2/01-6/01	85	*85*

* NSR 9 and 10 are insulated and do not follow the noise criteria recommended for schools, therefore the noise levels are not in exceedance.

Enclosure Installation

In *Section 5.8*, a full enclosure along Wong Chu Road for noise mitigation is recommended. The installation of horizontal panels covering the road will need to be carried out during non-peak hours to minimise traffic disturbance (see *Section 5.6*). Therefore the potential noise impacts from the installation during restricted hours is discussed below. A list of the PME possiby required and the corresponding SWL are given in *Table 3.2k* below.

Table 3.2k *Installation of Horizontal Panels of Noise Enclosure*

PME	TM Reference	No.	SWL (dB(A))
Mobile Crane	CNP048	1	112
Saw, circular, wood	CNP201	1	108
Generator	CNP101	1	108
		Total	115

It has been assumed that there will be no other construction activities of the Roadworks operating during the installation of the noise enclosure. PME that are required for other installation activities are envisaged to be operated during the day. *Table 3.2l* shows the distances between the noise source (noise enclosure) and NSRs. Potential noise levels at the NSRs from the installation of horizontal panels is shown in *Table 3.2m*.

Table 3.2l *Respective Distance between NSRs and Noise Source (Noise Enclosure)*

Number	NSR name	Distance (m)
2	Oi Yee House	20
3	Oi Shun House	17
8	Ting Tak House	20
26	Goodview Garden	66
30	Tsui Ning Garden	57
56	Siu Lun Court Block 2	70

Table 3.2m Predicted Noise Levels – Noise Enclosure

NSR		Predicted Noise Levels – including distance and facade correction ($L_{Aeq, 30\ mins}$ dB(A))
2	Oi Yee House	84
3	Oi Shun House	85
8	Ting Tak House	84
26	Goodview Garden	74
30	Tsui Ning Garden	75
56	Siu Lun Court Block 2	73

3.2.6 *Impact Evaluation and Mitigation Measures Recommendation*

Roadworks Construction

It can be seen from *Tables 3.2i* to *j* above, that construction noise has the potential for exceeding the daytime noise criteria at most NSRs, with noise levels of up to 87 dB(A) predicted for some combinations of concurrent operations. Therefore mitigation measures are required, and the following forms of mitigation are recommended and should be incorporated into the Contract Specifications.

1) good site practice to limit noise emissions at source;
2) selection of quiet plant and working methods;
3) construction of mobile noise barriers;
4) avoidance of simultaneous noisy activities;
5) reduction in the numbers of plant operating in critical areas close to NSRs;

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 adequate.

Good site practice

Good site practice and noise management can considerably reduce the impact of the construction sites' activities on nearby NSRs. The following 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 programme;
- machines and plant (such as trucks) 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 programme;

- mobile plant should be sited as far away from NSRs as possible; and
- material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

The noise benefits of these techniques are difficult to quantify, and whilst they would provide some attenuation, they cannot be assumed to guarantee a high level of noise mitigation.

Selecting quiet 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 contractors 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 sound power level is less than the value 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:

Concrete Pumps:	105 dB(A) max;
Dozer:	110 dB(A) max;
Dump Truck:	110 dB(A) max;
Mobile Crane:	105 dB(A) max; and
Generators:	100 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.

Referring the above list to the plant inventories given in *Table 3.2 e* to *f*, calculation indicates that the PNL derived from TM data can be reduced by up to 5 dB(A). It is therefore recommended that quiet plants be employed.

Reducing the numbers of plant operating in critical areas close to NSRs

In general the numbers of plant should be left to the choice of the Contractor so that in combination with the selection of quiet plant, any further reduction in the total plant noise level, or the site specific maximum site sound power levels, as described above, can be achieved. This method could be more effective for the protection of NSRs close to the worksite such as Oi Yee House, Oi Shun House and Ting Tak House.

Constructing mobile noise barriers

In general, mobile noise barriers of between 3 and 5 m high, located close to particular types of plants, as listed below, could give up to a 5 dB(A) reduction from screening at all NSRs (estimated in accordance with TM1). It

should be possible for the Contractor to provide a number of these mobile barriers to achieve this level of reduction, providing the barriers have no openings or gaps and have a superficial surface density of at least 10 kg m^{-2}. Site perimeter barriers would generally be ineffective in reducing noise levels at NSRs since many NSRs are too close to activity work sites.

Plants that could benefit from mobile noise barriers:

- Backhoe Breaker;
- Crane;
- Drilling Rig;
- mini Backhoe;
- Generators; and
- Circular saw.

The reductions in total sound power levels for each activity as listed in *Table 3.2n* will result in a lowering of noise levels at the NSRs as indicated in *Tables 3.2o* and *3.2p* below.

Table 3.2n *Noise reduction as a result of using Quiet Plants and Mobile Barriers*

Activity	With Normal Plants	With Quiet Plants & Mobile Barriers
1.3	124	119
1.4	124	119
1.5	124	120
1.6	124	120
1.7	114	111
1.8	124	118
1.9	124	119
1.11	124	120
1.12	124	120
1.13	124	120
1.14.1	112	107
1.14.2	114	113
1.14.3	121	116
1.14.4	122	117
2.2	123	119
2.3	112	112
2.4	123	119
2.5	116	114
2.6	112	112
2.7	123	119
2.8	124	120

Table 3.2o *Noise Levels for Worst Case Concurrent Activity– P3/D15 Interchange – assuming use of quiet plants and mobile barriers*

NSR	Activity	Duration (m/yr) – dates are inclusive	Noise Levels – including distance and facade correction ($L_{Aeq,\ 30\ minute}$ dB(A))	Total Noise Level ($L_{Aeq,\ 30\ minute}$ dB(A))
36	1.3, 1.4;	10/97–11/97	75, NA	*75*
	1.5, 1.7, 1.14.2;	8/98–9/98	NA, 62, NA	62
	1.6, 1.7, 1.14.2;	10/98–11/98	71, 62, NA	*71*
	1.7, 1.8, 1.9, 1.14.2;	12/98	62, 69, 71, NA	*73*
	1.8, 1.9, 1.14.2, 1.14.3;	1/99–2/99	69, 71, NA, NA	*73*
	1.9, 1.14.2, 1.14.3;	3/99–5/99	71, NA, NA, NA	*71*
	1.11, 1.14.2, 1.14.3;	6/99–7/99	76, NA, NA	*76*
	1.11, 1.14.2, 1.14.3, 1.14.4;	8/99–11/99	76, NA, NA, NA	*76*
39	1.3, 1.4;	10/97–11/97	78, NA	*78*
	1.5, 1.14.1;	12/97–4/98	73, 62	73
	1.5, 1.14.1, 1.14.2;	5/98–7/98	73, 62, 68	74
	1.5, 1.7, 1.14.2;	8/98–9/98	73, 64, 68	75
	1.6, 1.7, 1.14.2;	10/98–11/98	72, 64, 68	74
	1.7, 1.8, 1.9, 1.14.2;	12/98	64, 76, 75, 68	*79*
	1.8, 1.9, 1.14.2, 1.14.3;	1/99–2/99	76, 75, 68, 71	*79*
	1.9, 1.14.2, 1.14.3;	3/99–5/99	75, 68, 71	*77*
	1.11, 1.14.2, 1.14.3;	6/99–7/99	70, 68, 71	75
	1.11, 1.14.2, 1.14.3, 1.14.4;	8/99–11/99	70, 68, 71, 72	*77*
	1.12, 1.14.2, 1.14.3, 1.14.4;	12/99–1/00	MAX (79, SUM(68, 71, 72))*	*79*
	1.13, 1.14.2, 1.14.3, 1.14.4;	2/00–4/00	MAX (80, SUM(68, 71, 72))*	*80*
	1.13, 1.14.2, 1.14.4;	5/00–6/00	MAX (80, SUM(68, 72))*	*80*
	1.14.2, 1.14.4;	7/00–2/01	68, 72	74
	1.14.4;	3/01–7/01	72	72
40	1.5, 1.14.1;	12/97–4/98	74, 64	75
	1.5, 1.14.1, 1.14.2;	5/98–7/98	74, 64, 70	*76*
	1.5, 1.7, 1.14.2;	8/98–9/98	74, 64, 70	*76*
	1.6, 1.7, 1.14.2;	10/98–11/98	NA, 64, 70	71
	1.7, 1.8, 1.9, 1.14.2;	12/98	64, 75, 73, 70	*78*
	1.8, 1.9, 1.14.2, 1.14.3;	1/99–2/99	75, 73, 70, 72	*79*
	1.9, 1.14.2, 1.14.3;	3/99–5/99	73, 70, 72	*77*
	1.11, 1.14.2, 1.14.3;	6/99–7/99	NA, 70, 72	74
	1.11, 1.14.2, 1.14.3, 1.14.4;	8/99–11/99	NA, 70, 72, 74	*77*
	1.12, 1.14.2, 1.14.3, 1.14.4;	12/99–1/00	MAX (78, SUM(70, 72, 74))*	*78*
	1.13, 1.14.2, 1.14.3, 1.14.4;	2/00–4/00	MAX (80, SUM(70, 72, 74))*	*80*
	1.13, 1.14.2, 1.14.4;	5/00–6/00	MAX (80, SUM(70, 74))*	*80*
	1.14.2, 1.14.4;	7/00–2/01	70, 74	75
	1.14.4;	3/01–7/01	74	74
42	1.5, 1.14.1;	12/97–4/98	NA, 58	58
	1.5, 1.14.1, 1.14.2;	5/98–7/98	NA, 58, 63	64
	1.5, 1.7, 1.14.2;	8/98–9/98	NA, NA, 63	63
	1.6, 1.7, 1.14.2;	10/98–11/98	NA, NA, 63	63
	1.7, 1.8, 1.9, 1.14.2;	12/98	NA, NA, NA, 63	63
	1.8, 1.9, 1.14.2, 1.14.3;	1/99–2/99	NA, NA, 63, 66	68
	1.9, 1.14.2, 1.14.3;	3/99–5/99	NA, 63, 66	68
	1.11, 1.14.2, 1.14.3;	6/99–7/99	NA, 63, 66	68
	1.11, 1.14.2, 1.14.3, 1.14.4;	8/99–11/99	NA, 63, 66, 68	71
	1.12, 1.14.2, 1.14.3, 1.14.4;	12/99–1/00	MAX (71, SUM(63, 66, 68))*	71
	1.13, 1.14.2, 1.14.3, 1.14.4;	2/00–4/00	MAX (71, SUM(63, 66, 68))*	71
	1.13, 1.14.2, 1.14.4;	5/00–6/00	MAX (71, SUM(63, 68))*	71
	1.14.2, 1.14.4;	7/00–2/01	63, 68	69
	1.14.4;	3/01–7/01	68	68

NSR	Activity	Duration (m/yr) – dates are inclusive	Noise Levels – including distance and facade correction ($L_{Aeq,\ 30\ minute}$ dB(A))	Total Noise Level ($L_{Aeq,\ 30\ minute}$ dB(A))
57	1.5, 1.14.1;	12/97–4/98	83, 65	*83*
	1.5, 1.14.1, 1.14.2;	5/98–7/98	83, 65, 71	*83*
	1.5, 1.7, 1.14.2;	8/98–9/98	83, 76. 71	*84*
	1.6, 1.7, 1.14.2;	10/98–11/98	NA, 76, 71	*77*
	1.7, 1.8, 1.9, 1.14.2;	12/98	76, NA, 73, 71	*79*
	1.8, 1.9, 1.14.2, 1.14.3;	1/99–2/99	NA, 73, 71, 74	*78*
	1.9, 1.14.2, 1.14.3;	3/99–5/99	73, 71, 74	*78*
	1.11, 1.14.2, 1.14.3;	6/99–7/99	NA, 71, 74	*76*
	1.11, 1.14.2, 1.14.3, 1.14.4;	8/99–11/99	NA, 71, 74, 75	*78*
	1.12, 1.14.2, 1.14.3, 1.14.4;	12/99–1/00	MAX (76, SUM(71, 74, 75))*	*78*
	1.13, 1.14.2, 1.14.3, 1.14.4;	2/00–4/00	MAX (74, SUM(71, 74, 75))*	*78*
	1.13, 1.14.2, 1.14.4;	5/00–6/00	MAX (74, SUM(71, 75))*	*76*
	1.14.2, 1.14.4;	7/00–2/01	71, 75	*76*
	1.14.4;	3/01–7/01	75	75

* The noise generated by activity 1.12 (or 1.13) can not be added to 1.14.x activities since they share the same plants (i.e. both 1.12 (or 1.13) and the 1.14.x activities can not produce noise concurrently). The maximum possible noise level for each NSR is calculated accordingly.

Table 3.2p *Noise Levels for Worst Case Concurrent Activity– P1/P3 Interchange – assuming use of quiet plants and mobile barriers*

NSR	Activity	Duration (m/yr) – dates are inclusive	Noise Levels – including distance and facade correction ($L_{Aeq,\ 30\ minute}$ dB(A))	Total Noise Level ($L_{Aeq,\ 30\ minute}$ dB(A))
8	2.2;	9/97–12/97	75	75
	2.2, 2.3;	1/98	75, NA	75
	2.7, 2.8;	1/01	80, NA	*80*
9*	2.2;	9/97–12/97	77	*77*
	2.2, 2.3;	1/98	77, NA	*77*
	2.4;	5/98–7/98	78	*78*
	2.4, 2.5;	8/98–9/98	78, 70	*79*
	2.5;	10/98–9/00	70	70
	2.7, 2.8;	1/01	81, NA	*81*
10*	2.2;	9/97–12/97	78	*78*
	2.2, 2.3;	1/98	78, 76	*80*
	2.3;	2/98–4/98	76	*76*
	2.4;	5/98–7/98	81	*81*
	2.4, 2.5;	8/98–9/98	81, 79	*83*
	2.5;	10/98–9/00	79	*79*
	2.6;	10/00–11/00	76	*76*
	2.7, 2.8;	1/01	88, 74	*88*
	2.8;	2/01–6/01	74	74
12	2.7, 2.8;	1/01	77, 75	*79*
	2.8;	2/01–6/01	75	75
20	2.2, 2.3;	1/98	NA, 68	68
	2.3;	2/98–4/98	68	68
	2.4, 2.5;	8/98–9/98	NA, 69	69
	2.5;	10/98–9/00	69	69
	2.6;	10/00–11/00	68	68
	2.7, 2.8;	1/01	78, 81	*83*
	2.8;	2/01–6/01	81	*81*

NSR	Activity	Duration (m/yr) – dates are inclusive	Noise Levels – including distance and facade correction ($L_{Aeq, 30\ minute}$ dB(A))	Total Noise Level ($L_{Aeq, 30\ minute}$ dB(A))
46	2.2;	9/97–12/97	77	*77*
	2.2, 2.3;	1/98	77, NA	*77*
	2.4;	5/98–7/98	77	*77*
	2.4, 2.5;	8/98–9/98	77, 79	*81*
	2.5;	10/98–9/00	79	*79*
	2.7, 2.8;	1/01	NA, 81	*81*
	2.8;	2/01–6/01	81	*81*

* NSR 9 and 10 are insulated and do not follow the noise criteria recommended for schools, therefore the noise levels are not in exceedance.

As can be seen from the *Tables 3.2o* and *3.2p* above, using quiet plant and mobile barriers is insufficient to lower noise levels at the NSRs to below the assessment criteria for the worst case possible concurrent noisy activities. These predictions however, represent the worst possible cases which theoretically could occur, but are in fact unlikely since it would require all noisy plant to be operating concurrently, at the nearest notional point of each works area (most works areas are long and thin) to the NSR, and to all be fully active at exactly the same time. However, it is possible that these levels of impact, or impacts approaching these, could occur at the same time, albeit for a short duration.

Therefore additional mitigation measures such as avoidance of simultaneous noisy activities and a reduction in the numbers of plants operating in critical areas close to NSRs may be required from time to time. Since it is difficult to provide quantitative predictions of the effect these further mitigation measures will have on noise levels, and it is not possible to identify when they will occur, regular monitoring of noise at the NSRs reported in *Tables 3.2o* and *3.2p* (with the exception of NSRs 9 and 10, which are insulated) will be required during the construction phase of the Tuen Mun Interchanges. This will enable the contractor to react if the assessment criteria are approached, to reduce noise emission at specific areas. For NSR 57, the predicted noise levels shown in *Table 3.2o* is considered to represent the worst case scenario. It has been assumed that no noise sensitive room will be facing the construction site, and hence it has been considered that NSR 57 will not be exposed to unacceptable day time construction noise levels.

For NSRs 9 & 10 (STFA Wu Siu Kut Memorial Primary School & Lui Cheung Kwong Primary School), these schools are expected to be insulated before Easter 1996 (i.e. prior to the start of Construction Works). As confirmed by Education Department (ED), 24 classrooms will be insulated for STFA Wu Siu Kut Memorial Primary School and 24 classrooms, 3 special rooms and 2 staff rooms will be insulated for Lui Cheung Kwong Primary School. Since ED has not indicated which façade will be insulated. It has been assumed the classrooms and other sensitive rooms facing Wong Chu Road and Tuen Mun Road will be insulated. However, since the schools will be exposed to high levels of construction noise, it is recommended that Type II insulation should be provided for all sensitive rooms facing onto the Construction Site at Lui Cheung Kwong Primary School (as the highest construction noise levels predicted at the school is 88 dB(A)), and Type I insulation should be provide for all sensitive rooms facing onto the Construction Site at STFA Wu Siu Kut Memorial Primary School (i.e. the southern façade of the schools).

For NSRs 36 and 40, ED confirmed that these two schools are expected to be insulated in the summer of 1996 and are expected to be completed before 1999. However, since the construction work of the Roadworks are expected to be commenced in October 1997, it is recommended that these schools' insulation programme should be pushed forward so that the insulation for these schools are completed before the construction works.

NSR 40 are predicted to be exposed to construction noise levels of 80 dB(A). It is recommended that all the noise sensitive rooms facing onto the construction site should be installed with Type II insulation. For NSR 36, the highest construction noise predicted at the facade is 76 dB(A) and hence, Type I insulation are recommended for all the sensitive rooms facing onto the construction site (i.e. the eastern facade of the school).

Enclosure Installation

As shown in Table 3.2m, the assessment indicates that unmitigated enclosure installation activities along Wong Chu Road would cause exceedances during restricted hours (all hours outside of 0900–1900 Monday through Saturday, as well as all day on Sunday and Public Holiday). Thus adequate mitigation measures will be necessary for installation work to meet the criteria. Such work will require the granting of a CNP by the EPD, an the Contractor will be required to demonstrate that compliance with the $L_{Aeq,30\ min}$ 70 or 55 for evening and night-time operations, respectively.

It is considered that the installation of adequate mitigation measures for the abatement of the potential construction noise (maximum 30 dB(A)) predicted at the NSRs for the night time (2300–0700 hours) noise enclosure installation work would not be so effective. Therefore it is recommended that the enclosure installation work should be restricted to the evening time (1900–2300 hours). The allowable noise limit is 70 dB(A) during this period.

Mitigation measures are recommended and described below for the reduction of noise up to allowable evening time limit (70 dB(A)), including the use of silenced PME, restriction of the number of PME usage, the installation of noise barriers and the rearrangement of the work sequence, which should be incorporated into the Contract Specifications. *Table 3.2q* summarises the mitigated PNL on the NSR using the various measures.

In general, a planned rearrangement of the work programme or the construction sequence could give a reduction of the noise impact to the NSRs. It would be possible for the Contractor to install vertical barriers of the enclosure work along the mostly affected NSRs (Oi Yee, Oi Shun and Ting Tak House) prior to the operations of the PME so that a noise reduction of up to 5 dB(A) would be achieved.

Goodview Garden, Tsui Ning Garden and Siu Lun Court Block

The use of the silenced PME (silenced mobile crane and generator) alone could be adequate for reducing the noise level to the evening time limit. The installation of mobile barriers on some of the PMEs (saw and generator) could further reduce the noise impact on these NSRs.

Oi Yee, Oi Shun and Ting Tak House

Due to the proximity of the NSRs to the work site, the use of silenced PME

alone could not be adequate for reducing the noise level up to allowable limit. A combination of mitigation method described above could be employed. For example, saw and generator set could not be used together with mobile crane or other PME within the nearest 40m from the these NSRs, and silenced generator should be used together with the installation of barriers around the saw and generator. Prior to the operation of the mobile crane, a silenced model, the vertical barriers of the enclosure should be installed.

Table 3.2q *Mitigated PNL at the NSRs*

No.	NSRs	Mitigated Operations	Mitigated PNL, dB(A)
2	Oi Yee House	i) Generators & saws ii) Mobile crane	67 69
3	Oi Shun House	i) Generators & saws ii) Mobile crane	67 70
8	Ting Tak House	i) Generators & saws ii) Mobile crane	67 69
26	Goodview Garden	Combined	69
30	Tsui Ning Garden	Combined	70
56	Siu Lun Court Block	Combined	68

3.2.7 *EM&A Requirements*

As mentioned above it is difficult to predict the effectiveness of additional mitigation measures, therefore a rigorous noise monitoring regime should be required at the NSRs listed in *Tables 3.2o* and *3.2p* with the exception of NSRs 9 and 10 which are insulated and have been included in this section solely for illustrative purposes. The monitoring is required to ensure compliance with the noise criteria by providing feedback to the contractor to reduce the number of plants working simultaneously within a worksite near to an NSR as required. Detailed requirements are presented in the Environmental Schedule in *Annex C*.

3.2.8 *Conclusion*

The assessment indicates that unmitigated construction activities of the Roadworks would cause the noise assessment criteria at most of the nearby NSRs to be exceeded during weekday daytime hours. Thus adequate mitigation measures will be necessary for the works to meet the criteria. Mitigation measures have been recommended and described above, including the use of silenced PME, and the installation of mobile noise barriers close to particular noisy plant, which should be incorporated into Contractor Specifications. Additionally, the contractor will, from time to time be required to reduce the numbers of noisy PME operating close to NSRs. This requirement will be triggered by an Event Contingency Plan, enacted by a comprehensive noise monitoring programme throughout the construction period.

If construction work is to be carried out during examination periods, further mitigation will be required to reduce noise levels by an additional 5 dB(A) at

the appropriate NSRs. Again monitoring should be required to ensure compliance with the $L_{Aeq, 30\ minutes}$ 65, 70, or 75 dB(A) noise criteria, as appropriate to the NSR. It is likely that this will require reductions in the numbers of plant operating simultaneously near NSR, and limitations to only the quieter construction activities. In addition major construction activities during restricted hours (i.e. evenings, night time and all day on Sundays) are unlikely to be possible for activities that impact residential NSRs.

For the enclosure installation along Wong Chu Road, this assessment indicated that unmitigated construction activities would cause exceedances during restricted hours (all hours outside of 0900–1900 Monday through Saturday, as well as all day on Sunday and Public Holiday). Thus adequate mitigation measures will be necessary for installation work to meet the criteria. Working at night time is not considered acceptable as the impact could not be effectively mitigated. Mitigation measures have been recommended for the reduction of noise down to allowable evening time limit, which should be incorporated into the Contract Specifications. Such work will require the granting of a CNP by EPD, and the Contractor will be required to demonstrate that compliance with the $L_{Aeq, 30\ mins}$ 70 limit for evening time operations.

3.3 *ECOLOGICAL REVIEW*

It is a requirement in the Brief that an ecological review be undertaken to assess the potential impact on the areas adjacent to Tsing Shan Tsuen.

The Tsing Shan Tsuen Sites of Special Scientific Interest (SSSI), as advised by the Agricultural and Fisheries Department, is located near the Study Area. However the closest part of the SSSI is approximately over 800m away and up slope of the Roadworks. Therefore it is not expected to be affected by the road improvement works.

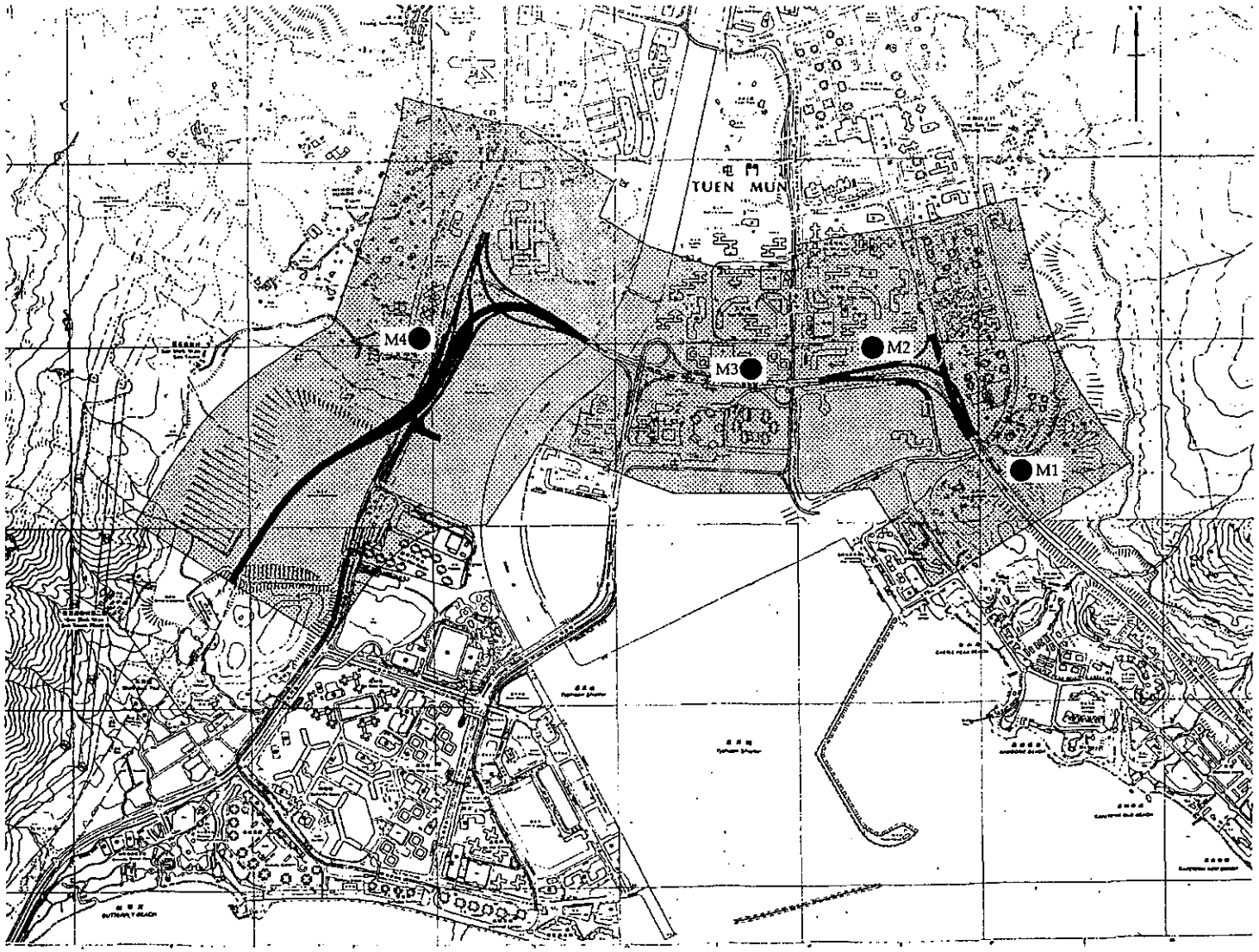
As mentioned in the Inception Report, a recent site visit in November 1994 found that the wooded areas and water course referred to in the Brief is actually located near San Shek Wan Tsuen (close to the Light Rail Transit (LRT) San Shek Wan Station). The initial section (approximately 5m in length) of the concerned small water course is culverted where it adjoins the existing pavement/LRT area. The water course further upstream has a "natural" stream bed with small boulders. At the time of the site visit, the lower stream course was found dry. Shrubs and grass with scattered trees were found along the riparian area, mostly common plant species of disturbed riparian habitats in Hong Kong. Around the culverted section, the vegetation is dominated by common weed species and remains of an abandoned banana plantation.

Examination of the detailed scheme plan (see *Figure 2.1b*) indicates that the Roadworks alignment does not impinge on the water course, although the associated construction work may affect the riparian areas of the initial section of the water course. However as described above, this part of the water course area is very much disturbed and very low ecological impact is anticipated. It is therefore recommended that landtake of areas further upstream be minimised and the following good construction site practice be implemented to minimise any impact on the upstream area:

- Fences should be erected on the boundary of construction sites before the commencement of work to prevent tipping, vehicle movements and encroachment of personnel into the stream course and riparian areas upstream.

- Regular checks must be made to ensure that the work site boundary is not exceeded and that no damage is being caused to the sensitive areas.

- Dust control measures as recommended in *Section 3.1.8* should be implemented.



KEY

STUDY AREA

PROPOSED ROADWORKS

NOISE MONITORING LOCATIONS

M1 - KAM FAI GARDEN
M2 - WU SIU KUI MEMORIAL PRIMARY SCHOOL
M3 - OI YEE HOUSE
M4 - MORNING LIGHT SCHOOL

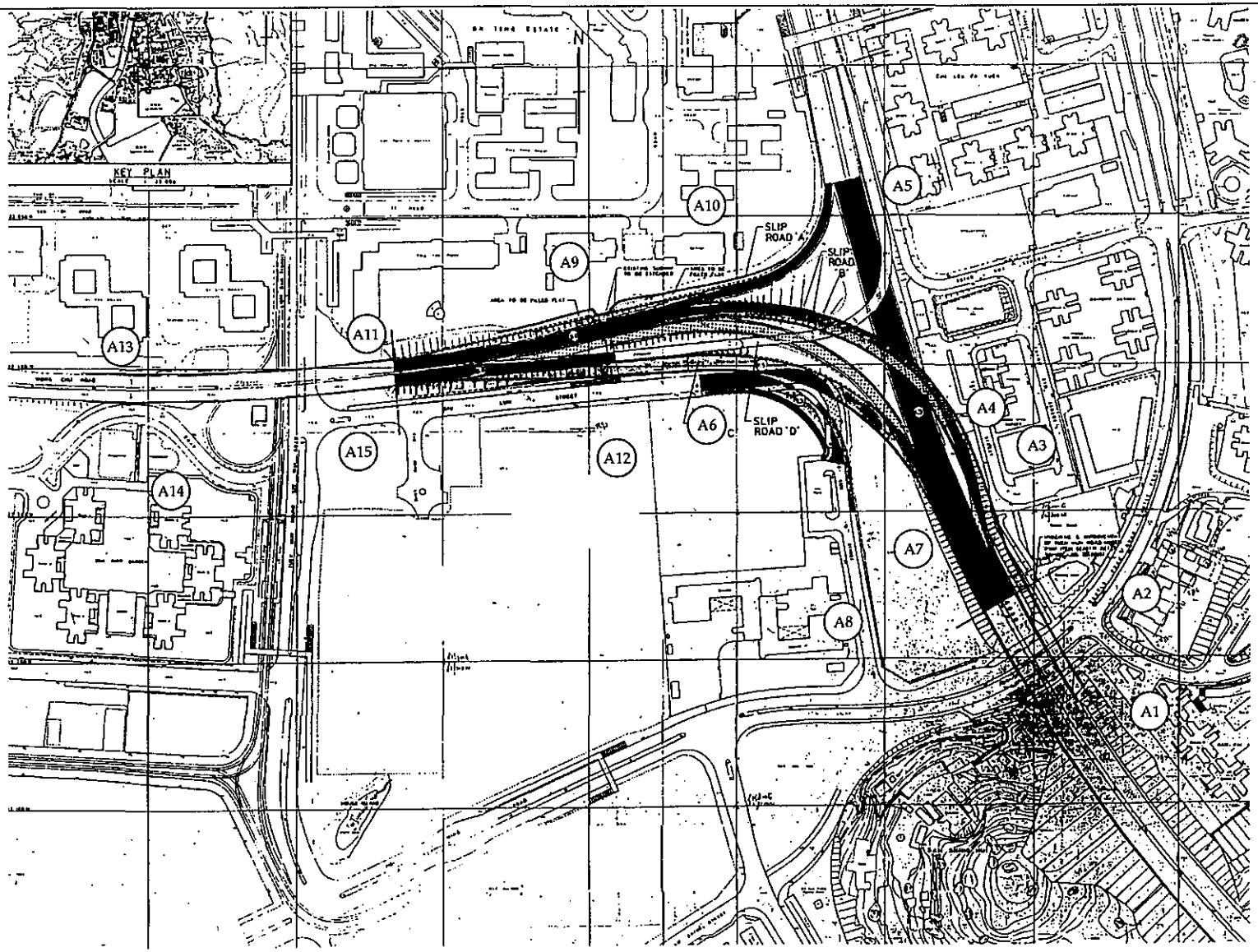
AIR QUALITY MONITORING LOCATIONS M2

FIGURE 3.1a - BASELINE AIR QUALITY AND NOISE MONITORING LOCATIONS

ERM Hong Kong

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

ERM



N

LEGEND

A1 KAM FAI GARDEN
A2 HARVEST GARDEN BUILDING
A3 TUNG PUI SERVICES BUILDING
A4 HONG KONG GARDEN
A5 CHI LOK FA YUEN
A6 SIU LUN ST SOCCER PITCH
A7 PLANNED SIU LIN ST G/IC SITE
A8 WU CHAN KAM CHEE COLLEGE
A9 WU SIU KU PRIMARY SCHOOL
A10 TING FUK HOUSE
A11 TING TAK HOUSE
A12 SIU LUN ESTATE
A13 OI LIU HOUSE
A14 TSUI NING GARDEN
A15 PLANNED SIU HING LANE G/IC SITE

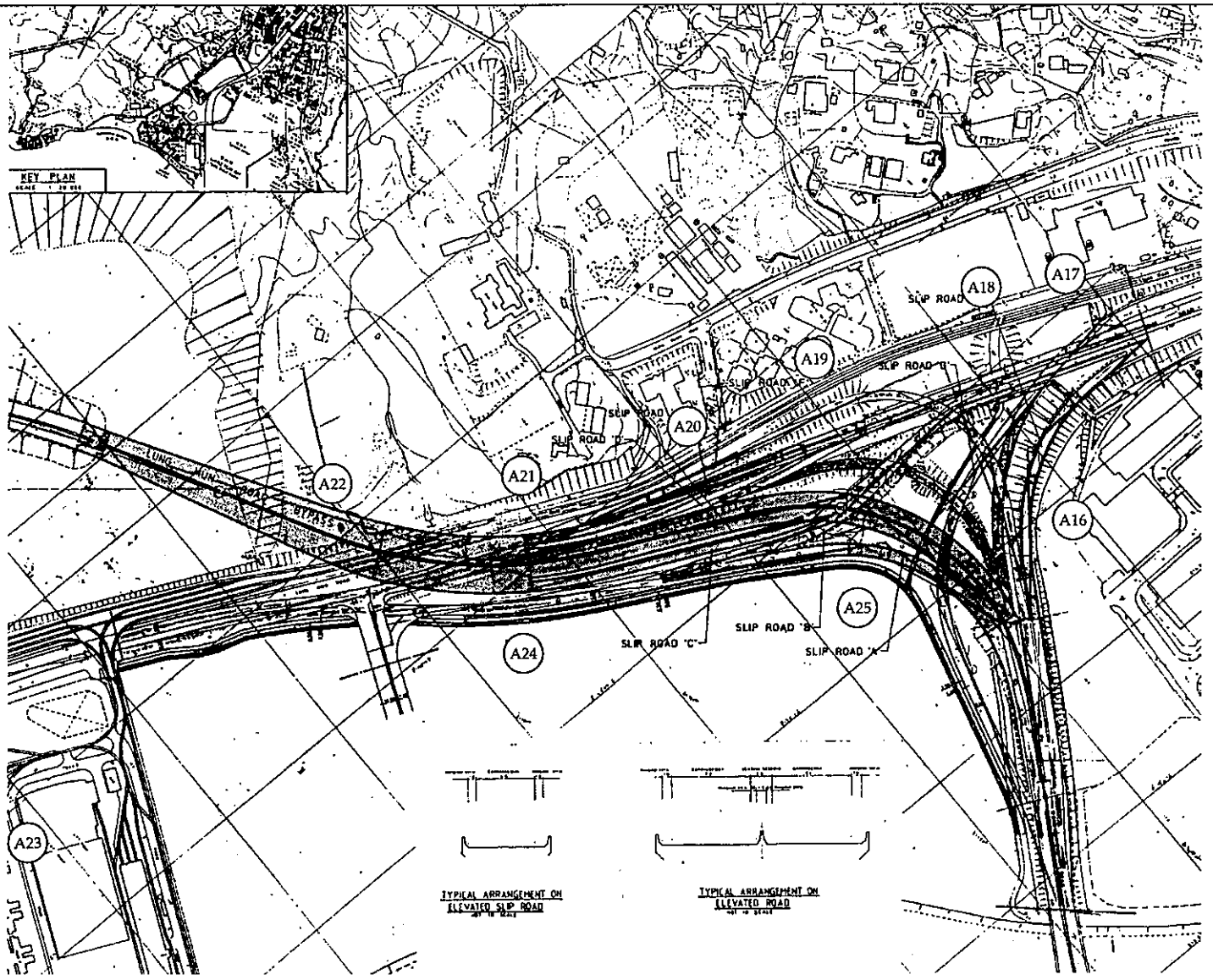
SCALE

0 50m 100m

FIGURE 3.1b - LOCATION OF AIR SENSITIVE RECEIVERS (WONG CHU ROAD/TUEN MUN ROAD INTERCHANGE)

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

ERM



N

LEGEND

A16 NAM FUNG INDUSTRIAL CITY
A17 YAN CHAI HOSPITAL NO2 SECONDARY SCHOOL
A18 JU CHING CHU SECONDARY SCHOOL
A19 GIRL'S HOSTEL
A20 MORNING LIGHT SCHOOL
A21 BOY'S HOME
A22 TUEN MUN RECREATIONAL SPORTS CENTRE
A23 NEW TUEN MUN CENTRE
A24 PLANNED AREA 18, PSPS DEVELOPMENT
A25 PLANNED AREA 18, PSPS DEVELOPMENT

SCALE
0 50m 100m

FIGURE 3.1c - LOCATION OF AIR SENSITIVE RECEIVERS - (LUNG MUN ROAD /WONG CHU ROAD INTERCHANGE)

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9 Chatham Road
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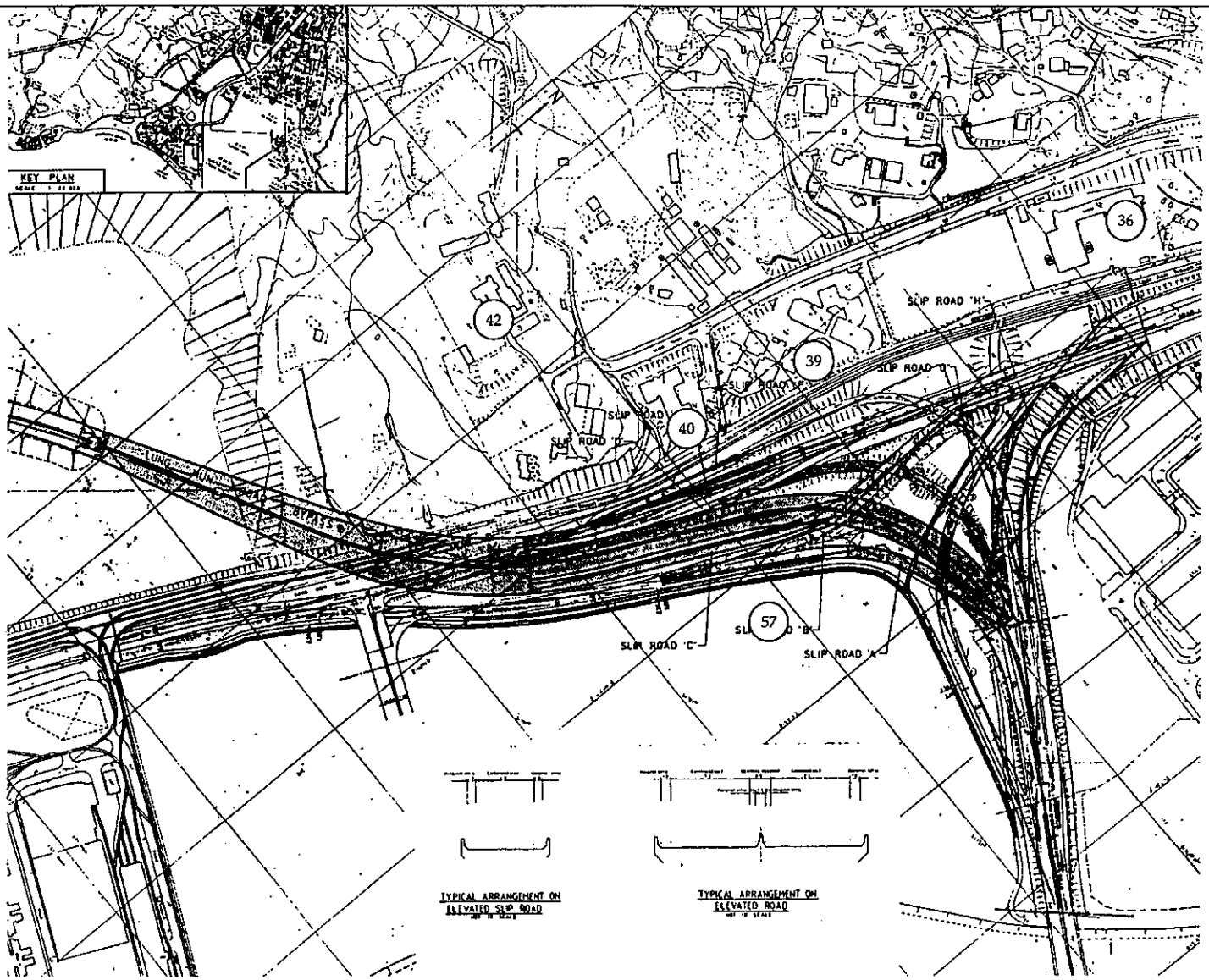

N

LEGEND

(42) NOISE SENSITIVE RECEIVER

SCALE

0 50m 100m

FIGURE 3.2a - LOCATION OF NOISE SENSITIVE RECEIVERS - (P1/D15 INTERCHANGE)

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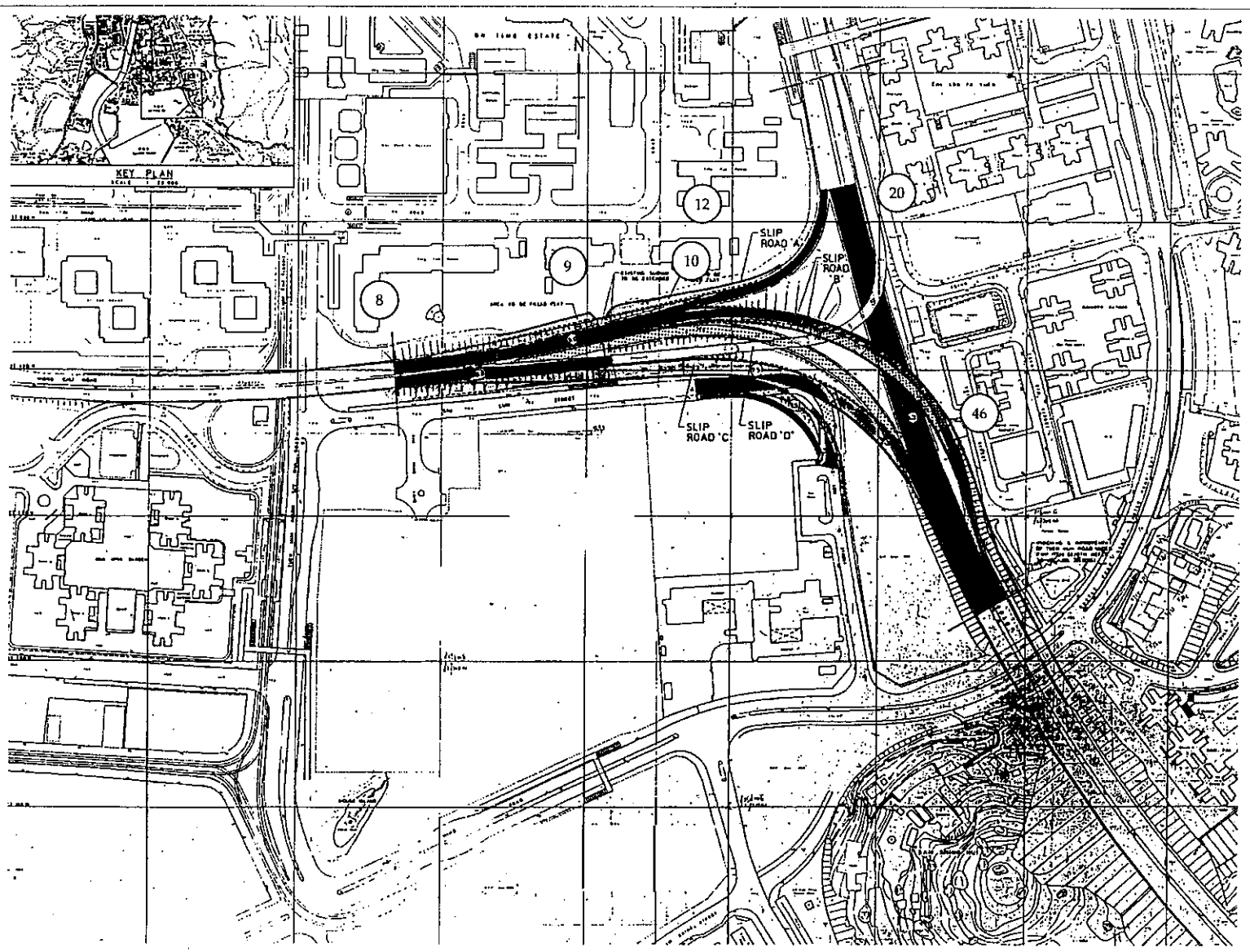

N

LEGEND

12 NOISE SENSITIVE RECEIVER

SCALE

0 50m 100m

FIGURE 3.2b - LOCATION OF NOISE SENSITIVE RECEIVERS (P1/P3 INTERCHANGE)

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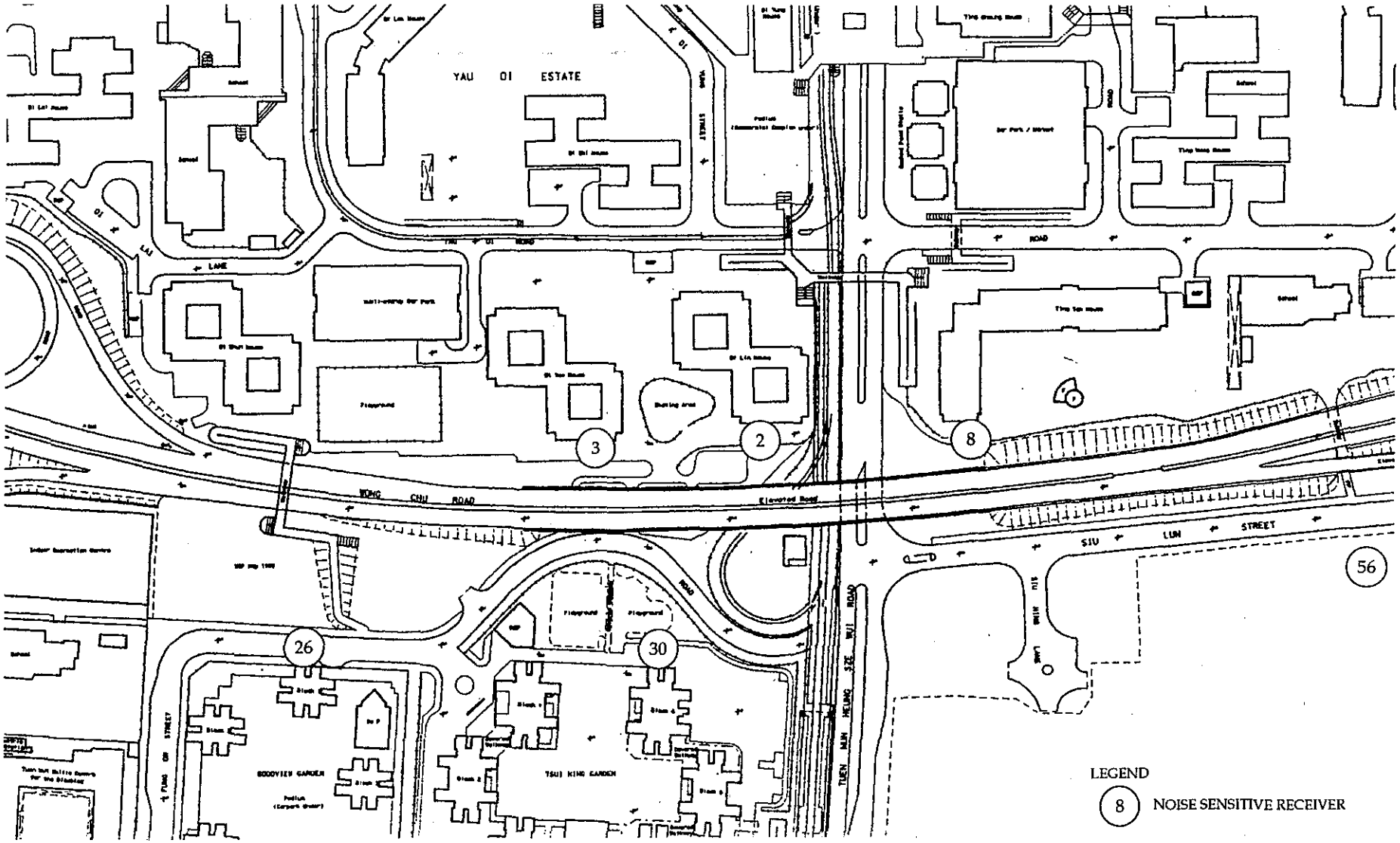

FIGURE 3.2c - LOCATION OF NOISE SENSITIVE RECEIVERS (NOISE ENCLOSURE)

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4 OPERATIONAL TRAFFIC EMISSION IMPACTS

4.1 INTRODUCTION

This section assesses the vehicular emission impact associated with the traffic from the Roadworks and the surrounding major roads. Locations of ASRs have been described in *Section 3.1.4*. Both scenarios of With and Without TMPD have been assessed based on the worst case traffic forecasts for 2011.

The air quality impacts of the recommended mitigatory full noise enclosures and barriers proposed as described in *Sections 5.5 & 5.6* (refer *Figures 5.6b & 5.6c* for arrangement) have also been assessed in this section. In addition to the ASRs identified in *Section 3.1.4*, an assessment point near the enclosure end, Oi Shun House, is included as shown in *Figure 4.1a*.

4.2 GOVERNMENTAL LEGISLATION AND STANDARDS

In addition to the statutory AQOs described in *Section 3.1.2*, the Tunnel Air Quality Guidelines (TAQG) is used as an assessment criteria for the air quality impact inside the proposed full noise enclosures. *Table 4.2a* shows the guideline values.

Table 4.2a Tunnel Air Quality Guidelines

Pollutant	Averaging time	Maximum concentration ($\mu g/m^3$)
Carbon Monoxide	5 minutes	115,000
Nitrogen dioxide	5 minutes	1,800
Sulphur dioxide	5 minutes	1,000

Note: All limits are expressed as at reference conditions of 298K and 101.325 kPa.

4.3 BASELINE CONDITION

Baseline air quality data from the *Expanded Development Study of Tuen Mun Area 38* has been reviewed and used in this study. Several short-term ambient air quality monitoring programme were conducted between 1985 and 1990. Monitored results shown that pollutants levels of the Study Area were within the AQO. *Table 4.2a* lists the background pollutant levels of NO_2 and CO for the Study Area. Ambient RSP levels monitored for this Study are also presented in *Table 4.3a* below.

Table 4.3a Ambient Air Quality of Study Area

Pollutant	Average Concentration ($\mu g/m^3$)	Location	Source
NO_2	36	Hung Shui Kiu	TMPDS
CO	800	Tai Hing Estate	TMPDS
RSP	78	Wu Siu Ku School	-

TMPDS: Tuen Mun Port Development Study

4.4 *POTENTIAL SOURCE OF IMPACT*

Vehicular emissions will be the major air pollutants during the operation of the Roadworks. NO_2, CO, and RSP are the major composition of the pollutants.

Noise barriers and full enclosures have been recommended for the Roadworks to reduce the noise impact at NSRs (see *Sections 5.5 and 5.6*). With a barrier, pollutant will be accumulated at the roads and ASRs located along the road alignment might receive a higher air quality impact. On the other hand, pollutants such as NO_2 and CO will be emitted through the enclosure ends and eave openings of the enclosure on Wong Chu Road. ASRs located near the enclosure ends may be affected.

4.5 *ASSESSMENT METHODOLOGY*

As recommended in *Section 5*, full noise enclosures have been recommended on Wong Chu Road. The air quality impacts of the with and without noise enclosures have been assessed.

4.5.1 *Without Noise Enclosure*

The *CALINE 4* model was used to predict the pollutant levels of NO_2, RSP and CO due to the vehicular emissions from the Roadworks. Concentrations of pollutant attribute to the Roadworks and the surrounding major roads have also been included in the model.

Projected peak hour traffic flows for the worst case scenario, morning peak hour traffic for the year 2011 are presented in *Figures 2.5b & 2.5c*.

Emission factors of NO_x, RSP and CO for each vehicular type in 2011 were provided by EPD and compound emission factors were calculated to represent average emission rates for the traffic within the Study Area. Gaseous pollutants were assumed to be inert and levels of NO_2 were taken as 20% of total NO_x emission as recommended by EPD.

As the peak hour traffic occurs during daytime, neutral meterological conditions have been assumed. Typical input parameters for the model are listed below:

- Wind Speed — 2 m s^{-1}
- Wind Direction — worst case for each receivers
- Stability Class — D
- Mixing Height — 1000 m
- Standard Deviation — 20 degree
- Temperature — 25°C

Currently, there is no hourly criteria for the 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. A conversion factor of 0.4 was used to convert hourly RSP to daily RSP.

4.5.2 *With Noise Enclosure*

Air quality within enclosure has been assessed based on the publication, *Longitudinal Diffusion of Exhaust Pollutant in Two-way Automobile Tunnels,* 1985, by H Ohashi and T Koso (O&K theory), as agreed with EPD.

Maximum concentrations of pollutants within the noise enclosure were assessed for a congested speed of 15 kph and clearance distance of 1m between consecutive vehicles.

For a full enclosure, maximum concentration of pollutants accumulated in a enclosure under natural ventilation is governed by the following equation:

$$c_{max} = \omega L_e^2 / 8DA_T$$

where

c_{max} = maximum concentration of pollutant
ω = emission of pollutant per unit length, m^3/sm
L_e = effective length of tunnel
D = longitudinal diffusion coefficient, m^2/s
A_T = cross section area of tunnel, m^2

As discussed in *Section 5.6* openings will be provided along the two eaves of the full enclosure, the arrangement of which is shown in *Figures 5.6b & 5.6c.* The following enclosure parameters have been assumed in the calculation.

- Enclosure length: 230 m
- Enclosure width: 20 m
- Headroom: 7 m
- Width of eave opening: 0.875 m
- Length of break: 60 m

The traffic on Wong Chu Road's enclosures is bi-directional. Piston effect caused by the moving vehicle will be effectively cancelled out due to the balanced traffic density. In addition, the enclosure is designed with openings along the eaves. Hence, the length of air jet caused by the vehicles will be very short. As the two enclosures are 60 m apart, pollutants build up inside one enclosure will not be transferred to another one.

Pollutants accumulate inside the enclosure will be discharged into the atmosphere through the eave openings and the ends of the enclosures.

Emissions through the eave openings are considered as a line source and the *CALINE 4* model were employed for the assessment. It was assumed that the pollutants would be emitted through the openings at a rate of 1 ms^{-1}. Daytime worst case meterological conditions, stability class D and wind speed of 2 ms^{-1} have been employed for the modelled run. Again, the pollutants were assumed to be inert and level of NO_2 were taken as 20% of the total NO_x emissions. The small conversation rate is attributed to the close proximity of receivers to the enclosure ends/break.

With the eave openings along the enclosure and bi-directional traffic flow, the piston effect caused by the moving vehicles will be small and hence the jet length and jet velocity will be small. Worst case scenario of 30 m jet length and 1 ms^{-1} jet velocity were assumed in the assessment. The undiluted air jets were taken as volume sources and their dispersions were

calculated using the *ISCST* 2 model. It was assumed that pollutants would be exhausted in the direction of flow only. Again, meterological condition of stability class D with wind speed of 2 ms^{-1} blowing towards the ASRs, were assumed in the model run.

4.6 *IMPACT ASSESSMENT*

Hourly averages of pollutants at two heights, ground level and 10 m above ground, were modelled. Due to the limitation of the dispersion model, *CALINE 4*, maximum height of roads are limited to 10 m above ground. The modelled results are presented in *Tables 4.6a and 4.6b* and it is shown that pollutants levels will be within the AQO criteria at all ASRs. Both scenarios of With and Without TMPD have been assessed and air quality impacts on ASRs are similar in the two cases.

4.6.1 *Wong Chu Road/ Lung Mun Road Interchange and Foothill Bypass Section*

Pollutant levels at ASRs of this road section will receive lower impact than that of the Tuen Mun Road/ Wong Chu Road Interchange. For this road section, pollutant levels at the ASRs will be slightly higher with the TMPD.

At ground level, levels of NO_2 at the ASRs range from 50 $\mu g/m^3$ to 90 $\mu g/m^3$. Higher levels of pollutants are expected at Nam Fung Industrial City and the proposed Area 18 PSPS site. The NO_2 criteria of 300 $\mu g/m^3$ will be met at all ASRs.

Both CO and RSP behave in a similar manner as NO_2.

Table 4.6a *Air Quality Modelling Results (Wong Chu Road/Lung Mun Road Interchange and Foothill Bypass Section)*

Location		Height	Concentration of Pollutant in $\mu g/m^3$					
			With TMPD			Without TMPD		
			NO_2	CO	RSP	NO_2	CO	RSP
			1-hr	1-hr	24-hr	1-hr	1-hr	24-hr
A16	Nam Fung Ind City	Ground	85	1916	110	74	1686	103
		10 m above ground	81	1801	107	70	1594	100
A17	Yan Chai Hospital No2 Secondary School	Ground	66	1502	98	85	1352	94
		10 m above ground	59	1341	93	70	1180	89
A18	Ju Ching Chu School	Ground	66	1513	98	77	1364	94
		10 m above ground	59	1295	92	66	1203	89
A19	Girl's Hostel	Ground	70	1571	100	66	1421	96
		10 m above ground	59	1272	91	59	1191	89
A20	Morning Light School	Ground	74	1640	102	66	1467	97
		10 m above ground	62	1352	93	55	1249	91
A21	Boys' Home	Ground	66	1433	96	59	1295	92
		10 m above ground	59	1295	92	51	1168	88
A22	Tuen Mun Recreational Sports Center	Ground	70	1559	99	62	1375	94
A23	New Tuen Mun Center	Ground	55	1214	90	51	1111	87
		10 m above ground	51	1157	88	51	1065	86
A24	Area 18 PSPS development	Ground	81	1824	107	74	1548	100
		10 m above ground	74	1651	102	66	1421	96
A25	Area 18 PSPS development	Ground	81	1766	106	74	1525	99
		10 m above ground	74	1674	103	70	1456	97
AQO			300	30000	180	300	30000	180

Note: (1) Background included in the pollutant levels.
(2) The levels for NO_2 and CO represent hourly concentration and that for RSP represent daily concentration.

4.6.2 *Wong Chu Road/Tuen Mun Road Interchange Section*

Without Noise Enclosures

At ground level, levels of NO_2 at ASRs range from 70 $\mu g/m^3$ to 140 $\mu g/m^3$. Higher levels of pollutants are predicted at Chi Lok Fa Yuen, and the planned Siu Lun Street G/IC. The NO_2 criteria of 300 $\mu g/m^3$ will be met at all ASRs.

Both CO and RSP behave in a similar manner as NO_2.

Table 4.6b ***Air Quality Modelling Results (Wong Chu Road/Tuen Mun Road Interchange Section)***

Location		Height	Concentration of Pollutant in $\mu g/m^3$					
			With TMPD			Without TMPD		
			NO_2	CO	RSP	NO_2	CO	RSP
			1-hr	1-hr	24-hr	1-hr	1-hr	24-hr
A1	Kam Fai Garden	Ground	92	1801	106	107	2077	115
		10 m above ground	96	1870	102	115	2180	109
A2	Harvest Garden Building	Ground	104	2042	112	126	2376	124
		10 m above ground	89	1709	100	100	1916	106
A3	Tung Pui Services Building	Ground	100	2100	114	115	2261	122
		10 m above ground	74	1560	100	77	1582	101
A4	Hong Kong Garden	Ground	96	2066	113	111	2134	119
		10 m above ground	74	1617	101	77	1571	103
A5	Chi Lok Fa Yuen	Ground	119	2560	128	111	2111	123
		10 m above ground	74	1686	103	74	1479	100
A8	Wu Chan Kam Chee College	Ground	62	1329	93	70	1364	95
		10 m above ground	59	1260	91	62	1283	92
A6	Siu Lun St Soccer Pitch	Ground	85	1881	108	85	1720	106
A7	Siu Lun St G/IC	Ground	119	2307	120	138	2502	128
		10 m above ground	74	1536	98	85	1640	102
A9	Wu Siu Ku Prim School	Ground	81	1778	105	85	1824	107
		10 m above ground	70	1571	99	74	1525	99
A10	Ting Fuk House	Ground	81	1709	103	89	1697	107
		10 m above ground	74	1513	97	77	1548	101
A11	Ting Tak House	Ground	92	2180	117	92	2031	113
		10 m above ground	77	1778	105	74	1617	103
A12	Siu Lun Estate	Ground	70	1594	100	70	1444	98
		10 m above ground	66	1479	97	62	1283	95
A13	Oi Liu House	Ground	111	2610	129	107	2123	124
		10 m above ground	77	1697	103	77	1467	103
A14	Tsui Ning Garden	Ground	81	1824	107	74	1502	104
		10 m above ground	70	1594	100	66	1352	98
A15	Siu Hing Lane G/IC	Ground	100	2307	121	89	1709	115
		10 m above ground	74	1617	102	70	1525	100
AQO			300	30000	180	300	30000	180

Note: (1) Background included in the pollutant levels.
(2) The levels for NO_2 and CO represent hourly concentration and that for RSP represent daily concentration.

With Noise Enclosures

Levels of pollutants under the scenario of with TMPD are presented in this section. Without TMPD scenario will have similar impacts on the study area and therefore not been assessed.

According to the ventilation theory developed by Ohashi and Koso,

$$c_{max} = \omega L_e^2 / 8DA_T$$

For the natural ventilated enclosure,

L_e = 310.1 m
D = 96.9 m^2s^{-1}
A_T = 140 m^2

Now, $\omega_{NO2} = 0.5469 \times 10^{-6}$ $m^3/s-m$
$\omega_{CO} = 12.12 \times 10^{-6}$ $m^3/s-m$

Thus, $[NO_2]_{max}$ = 872 $\mu g/m^3$;
$[CO]_{max}$ = 12,350 $\mu g/m^3$

Background levels of NO_2 and CO are 36 $\mu g/m^3$ and 800 $\mu g/m^3$ respectively. Hence, the maximum concentration of pollutants within enclosure are:

$[NO_2]_{max}$ = 908 $\mu g/m^3$
$[CO]_{max}$ = 13,149 $\mu g/m^3$

Hence, the maximum level of pollutants within the enclosure comply with the TAQG for a full enclosure. With openings along the eaves, pollutant level inside the enclosures should be further reduced. Hence, the above assessment is overestimated.

Cumulative levels of NO_2 and CO at two heights, ground level and 10 m above ground, have been modelled. Emissions from the enclosures in association of the open road network in the Study Area have been included in the model. The air quality impacts on the ASRs with the incorporation of enclosures are shown in *Table 4.6c* and the isopleths of pollutants are shown in *Figures 4.6a and 4.6b. Table 4.6c* presents the air quality impact under the with TMPD scenario. The impact under the without TMPD scenario should be similar to that of the with TMPD scenario.

Table 4.6c *Air Quality Impact with Incorporation of Noise Enclosures*

Location		Height	Hourly Averages of Pollutant in $\mu g/m^3$	
			NO_2	CO
A1	Kam Fai Garden	Ground	94	1748
		10 m above ground	128	2391
A2	Harvest Garden Building	Ground	94	1737
		10 m above ground	140	2530
A3	Tung Pui Services Building	Ground	126	2131
		10 m above ground	104	1693
A4	Hong Kong Garden	Ground	137	2278
		10 m above ground	114	1873
A5	Chi Lok Fa Yuen	Ground	169	2719
		10 m above ground	126	1885
A8	Wu Chan Kam Chee College	Ground	82	1549
		10 m above ground	82	1490
A6	Siu Lun St Soccer Pitch	Ground	181	2458
A7	Siu Lun St G/IC	Ground	138	2511
		10 m above ground	96	1797
A9	Wu Siu Ku Prim School	Ground	154	2042
		10 m above ground	141	1879
A10	Ting Fuk House	Ground	153	2101
		10 m above ground	142	1858
A11	Ting Tak House	Ground	235	2791
		10 m above ground	220	2423
A12	Siu Lun Estate	Ground	124	2052
		10 m above ground	126	1835
A13	Oi Liu House	Ground	291	3432
		10 m above ground	251	2580
A13a	Oi Shun House	Ground	275	2733
		10 m above ground	204	2260
A14	Tsui Ning Garden	Ground	179	2376
		10 m above ground	162	2105
A15	Siu Hing Lane G/IC	Ground	266	3134
		10 m above ground	239	2474
AQO			300	30000

Note: Background included in the pollutant levels.

With the noise enclosures, the air quality in the vicinity of the enclosure will be affected by the pollutants discharged via the eave openings and enclosure ends. The predicted levels of pollutants at ASRs along Wong Chu Road, such as Oi Liu House, Oi Shun House, Ting Tak House and the proposed Siu Hing Lane G/IC, would be higher than the predicted results in *Table 4.6b*. At Oi Liu House, the NO_2 levels at ground level will be marginally within the criteria of 300 $\mu g/m^3$ due to close proximity to the enclosures and the break. However, the AQOs will be complied at all ASRs

As described in *Section 5.6.1*, eave openings 10% of the total road surface area is recommended in the final design of the full enclosures, which is more stringent than the FSD's 6.25% requirement. The recommended enclosures have a headroom of 7.6 m and eave openings of 1 m width. With a higher headroom, the longitudinal diffusion coefficient, D, will be increased and hence the maximum concentrations of pollutants inside the enclosures will be reduced and hence its impacts on its surrounding area. With larger eave openings, piston effects of moving vehicles will be further reduced. Therefore this final enclosure arrangement should have less air quality impacts than that presented above. It is estimated that levels of NO_2, the critical pollutant, at the ground level of Oi Liu House, the worst affected ASR, will be reduced to 279 $\mu g/m^3$ with the recommended enclosure arrangements.

The assumed enclosure parameters are critical for assessment. The design parameters are:

- Enclosure length: 230 m
- Enclosure width: 20 m
- Headroom: 7.6 m
- Width of eave openings: 1 m
- Length of break: 60 m

It is considered that the enclosures with the above design parameters will result in less air quality impact than that from the modelled parameters described in *Section 4.5.2*, and is therefore recommended. Should any of these parameters be changed in the detailed design stage, the overall air quality impacts, both inside and outside the enclosures, have to be re-assessed in order to confirm that the air quality criteria are satisfied.

4.7 MITIGATION MEASURES

Without the noise enclosures, air quality at the ASRs will comply with the AQOs and mitigation measures are therefore not required.

Mitigatory barriers have been proposed for the Roadworks to reduce the noise impacts. With a barrier, pollutants will be accumulated at the roads and ASRs located along the alignment might receive a higher air quality impact. As the pollutant levels at the ASRs attributed to the Roadworks are not high, it is expected that the cumulative air quality impact with the incorporation of barriers will be within the AQOs.

With the incorporation of the proposed full enclosures, the NO_2 criteria will be marginally acceptable at ASRs near the break. The levels can be reduced

by allowing more breaks and eave openings along the enclosures. However, such arrangement will reduce the effectiveness of the acoustic enclosure.

4.8 CONCLUSIONS

The worst case scenario vehicular emission impact from the surrounding traffic associated with the Roadworks have been assessed, including both scenarios of With and Without TMPD. Without the proposed full enclosures, modelling results indicate that the vehicular emission impacts will comply with the AQO requirements for both scenarios.

Air quality impacts of the proposed full enclosures have also been assessed. Air quality inside the enclosures has been assessed based on the ventilation theory developed by Ohashi and Koso. Calculations show that the TAQG will be complied. Hence the noise enclosure is feasible under natural ventilation provided by the opening 10% of the total road surface area.

Even with the incorporation of the proposed two 230m noise enclosure sections with a 60m break, the AQOs at the ASRs will be met. However, air quality near the enclosure ends and the break will be reduced, and the NO_2 levels at Oi Liu House and Oi Shun House will be approaching the AQO criterion at ground level. However, the impact could be further mitigated by good engineering design at the detailed design stage and the full enclosures should not form an insurmountable air quality impacts to the environment.

Should the design parameters of the enclosures be changed, the air quality impact should be re-assessed to ensure that the criteria will be met.

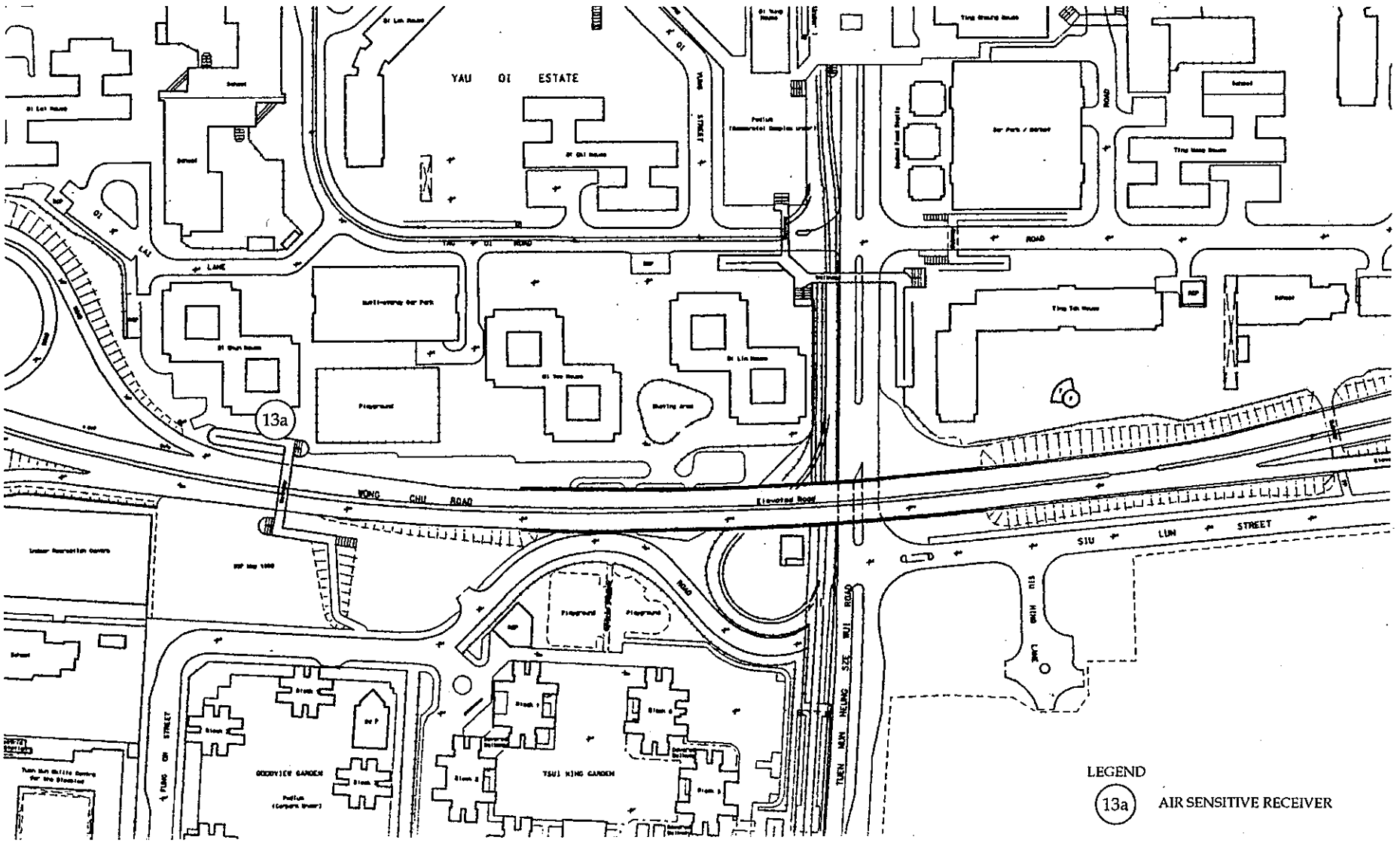

FIGURE 4.1a - LOCATION OF ADDITIONAL AIR SENSITIVE RECEIVERS (ENCLOSURE)

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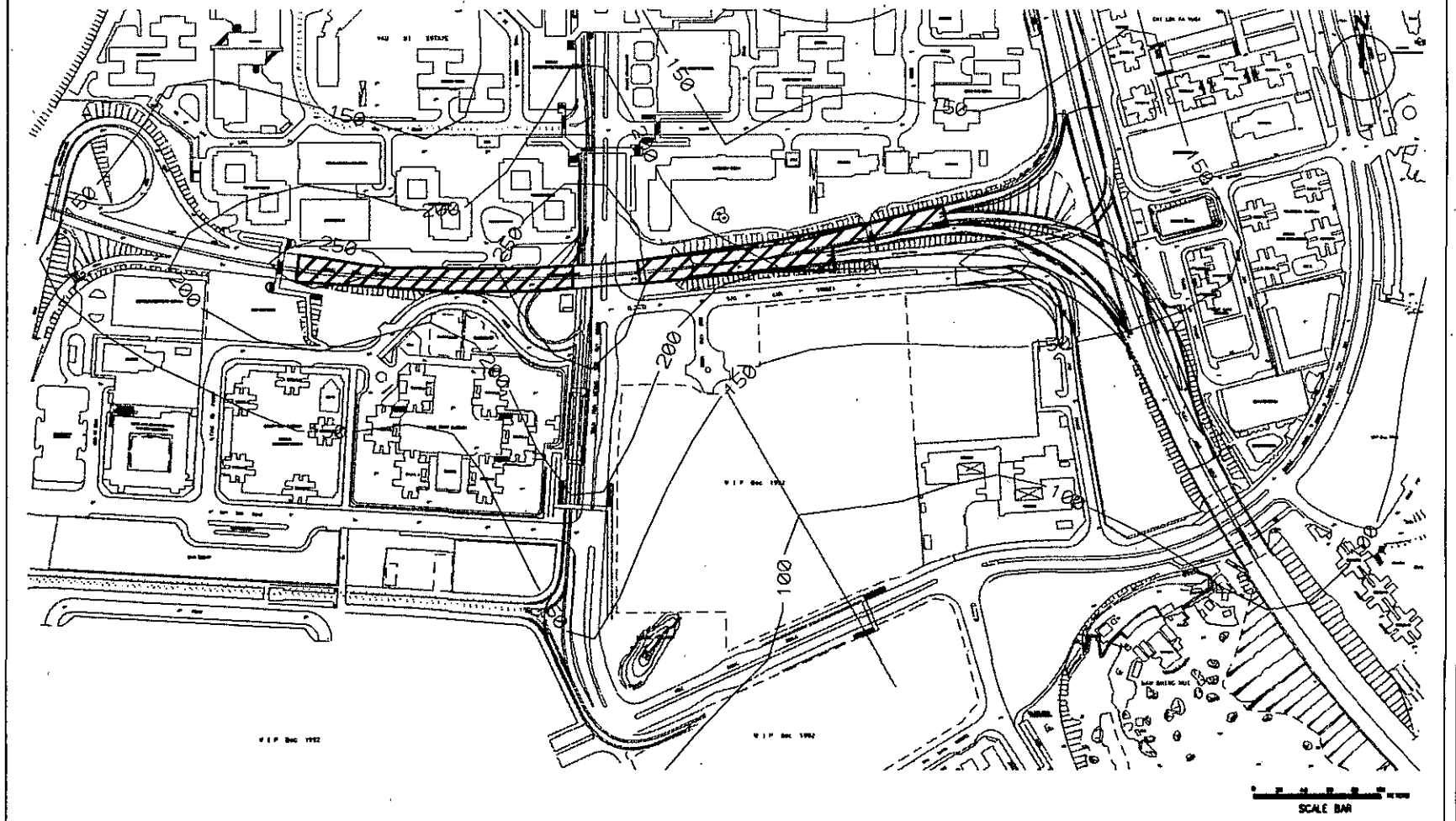

FIGURE 4.6a_1 Isopleths of NO2 at ground level

Date : 12 Jan 1996 | Drawing No.: /Contract/C1304/C1304_7

Sources :Base map - Lands Dept. 1:1000 topo

Prepared by ERM's GIS & MAPPING Group

KEY

NO2 Contour

Unit: $\mu g/m3$

Enclosure

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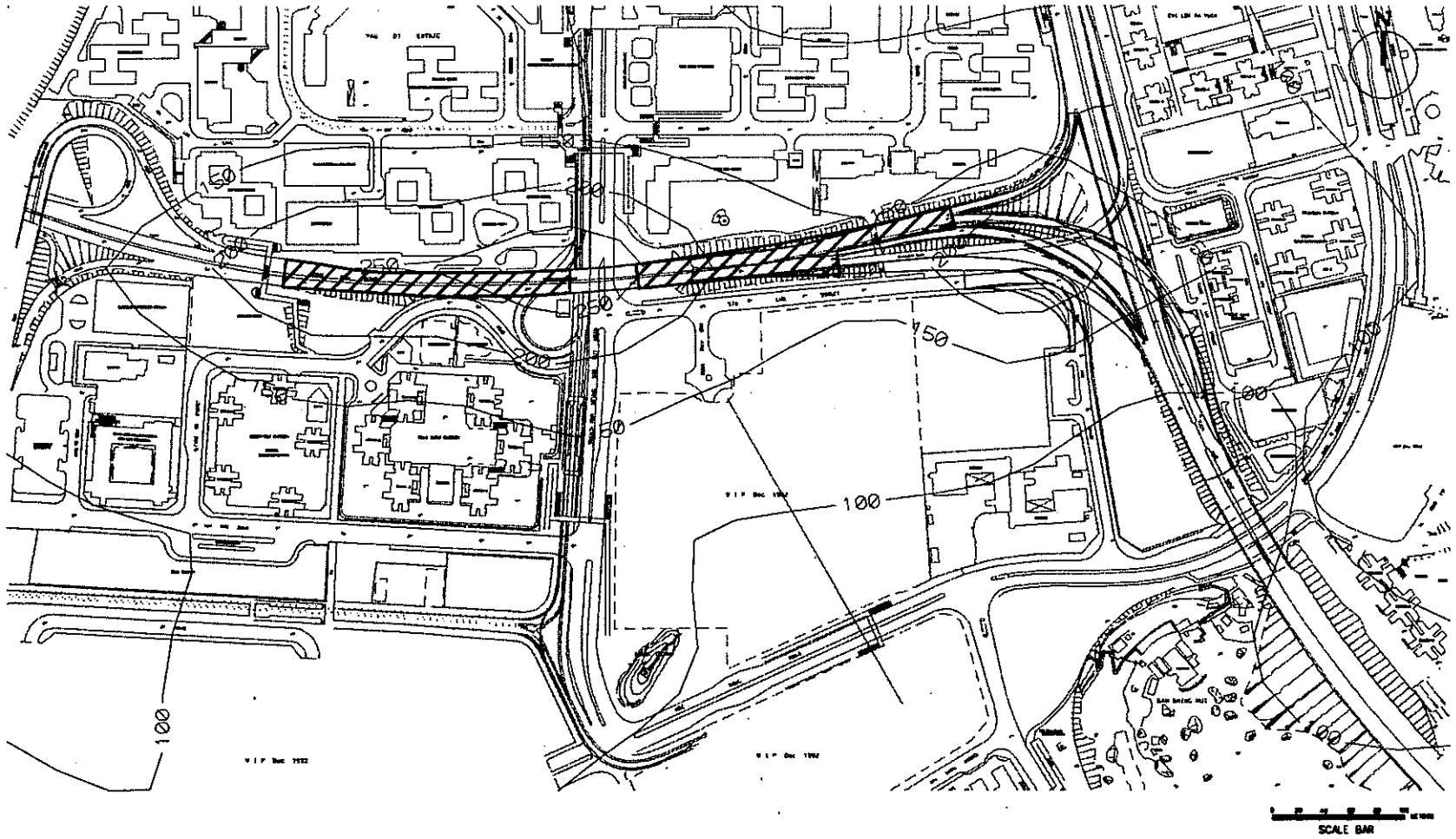

FIGURE 4.6a_2 Isopleths of NO2 at 10m above ground

Date : 12 Jan 1996	Drawing No.: /Contract/C1304/C1304_8
Sources :Base map - Lands Dept. 1:1000 topo	
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KEY

NO2 Contour

Unit: $\mu g/m3$

Enclosure

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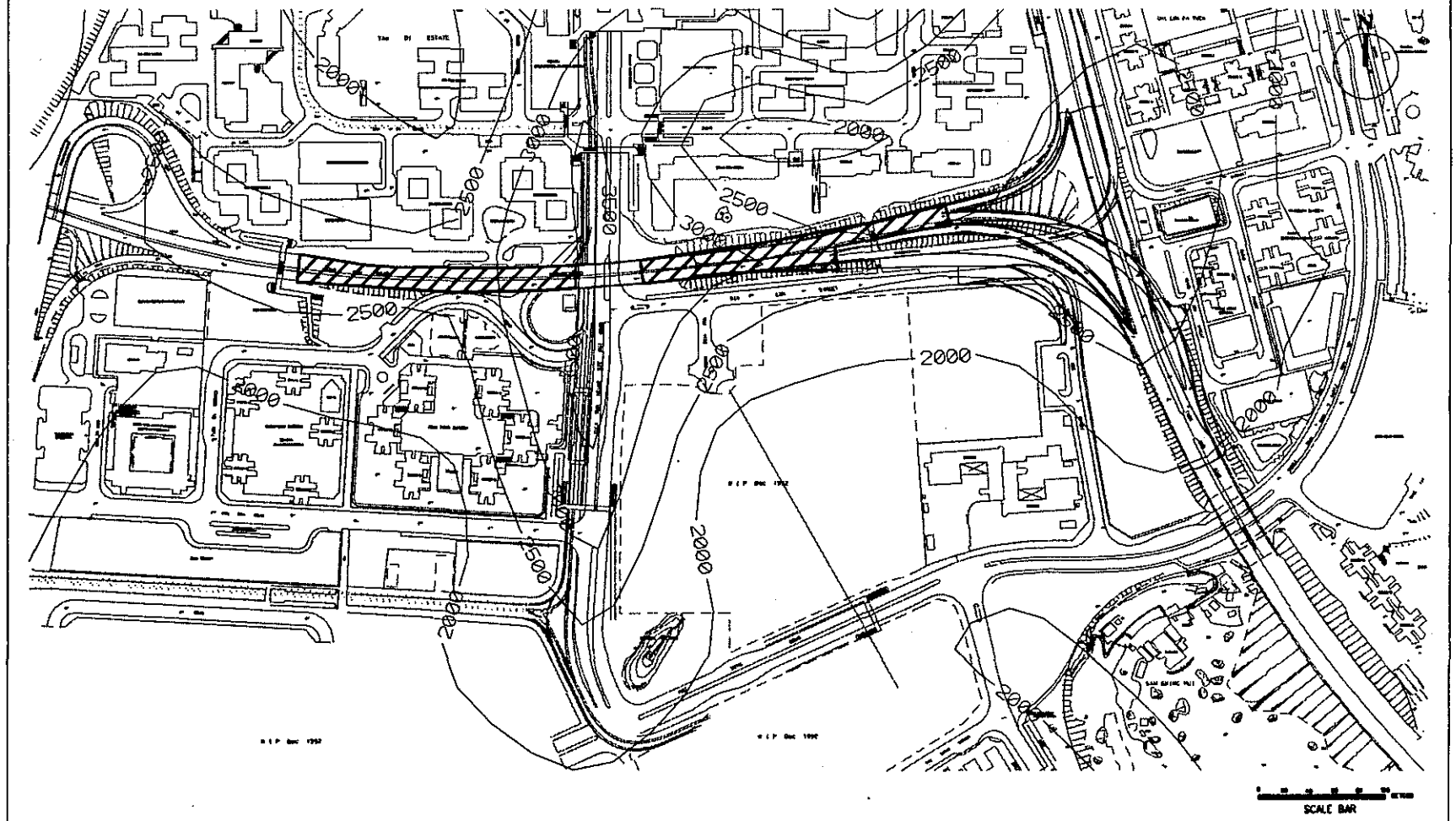

FIGURE 4.6b_1 Isopleths of CO at ground level

Date : 12 Jan 1996	Drawing No.: /Contract/C1304/C1304_5
Sources :Base map - Lands Dept. 1:1000 topo	
Prepared by ERM's GIS & MAPPING Group	

KEY

CO Contour

Unit: $\mu g/m3$

Enclosure

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Hong Kong

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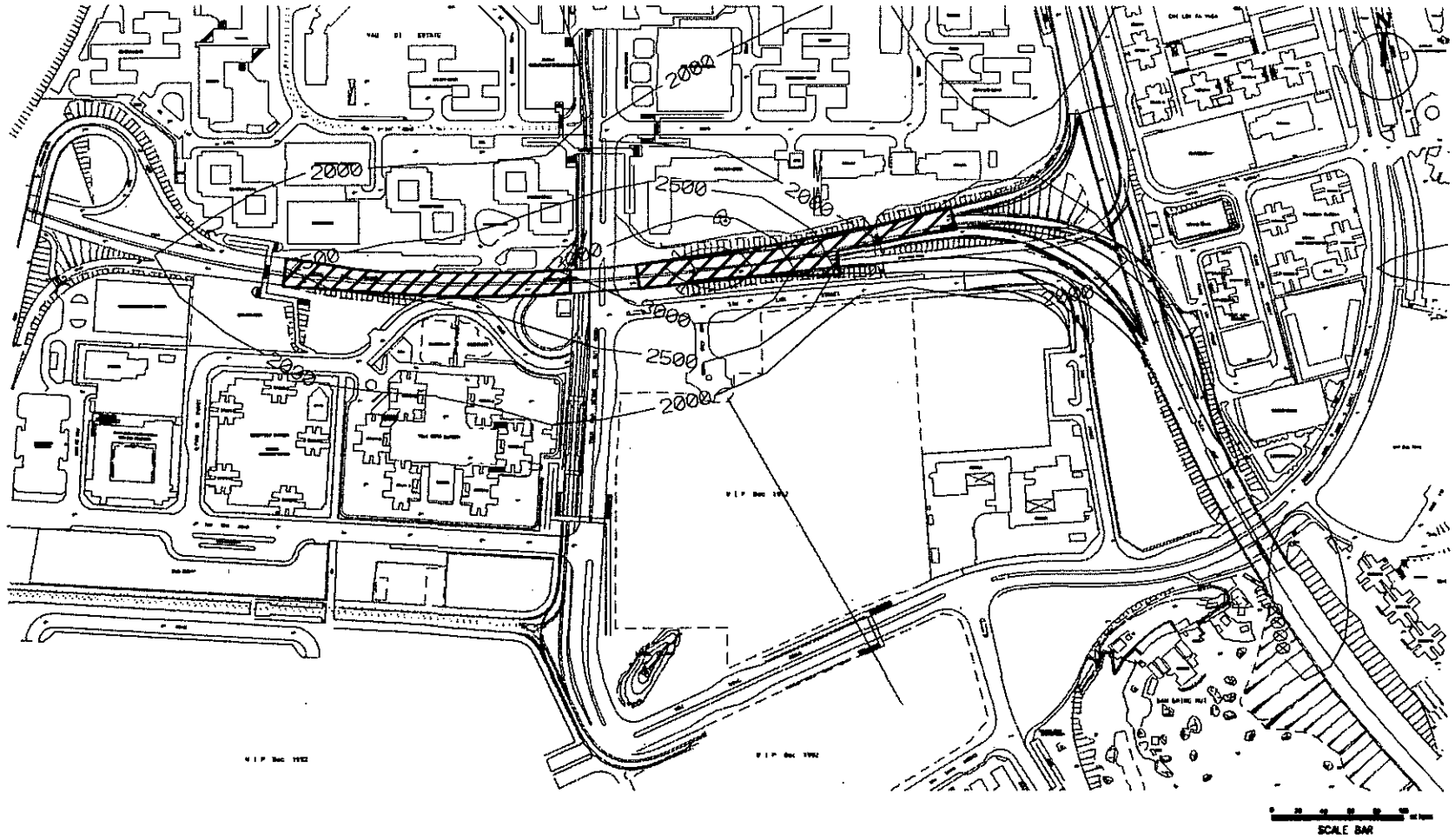

FIGURE 4.6b_2 Isopleths of CO at 10m above ground

Date : 12 Jan 1996	Drawing No.: /Contract/C1304/C1304_6
Sources :Base map - Lands Dept. 1:1000 topo	
Prepared by ERM's GIS & MAPPING Group	

KEY

CO Contour

Unit: $\mu g/m3$

Enclosure

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Hecny Tower
9 Chatham Road
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ERM

5 ROAD TRAFFIC NOISE IMPACT DURING OPERATION

5.1 INTRODUCTION

Future traffic flows on the Roadworks has the potential to impact existing sensitive receivers. These impacts under two different scenarios (with TMPD and without TMPD) are assessed by predicting the traffic noise levels for 2011 conditions and comparing them with the Hong Kong Planning Standards And Guidelines (HKPSG) traffic noise guideline, the prevailing noise levels (i.e. the baseline conditions) and the noise levels from existing roads in 2011. A detailed noise model of the Roadworks and the surrounding road network is used to investigate the noise contributions from all roads affecting the NSRs of interest and to examine and evaluate the effectiveness of various direct mitigation measures applied to the Roadworks including the erection of an enclosure along Wong Chu Road as recommended in the EDS. Engineering feasibility and cost effectiveness are taken into consideration, and an optimum mitigation package is then recommended for implementation.

5.2 NOISE SENSITIVE RECEIVERS

The worst impacted representative noise sensitive receivers (NSRs) (as identified in the Working Paper) are listed in *Tables 5.2a* and *5.2b* below. The noise levels for each NSR have been predicted at three different floor levels (low, medium and high) and the representative floors and the corresponding m.PD height of each NSRs are also shown in the tables below. Locations of the NSRs are shown in *Figure 5.2a*.

Table 5.2a Eastern Area Noise Sensitive Receivers

NSRs		Representative floors mPD (m)	Representative floors
1	Oi Lin House	6.4/31.6/59.6	1st/10th/20th
2	Oi Yee House	6.4/31.6/59.6	1st/10th/20th
3	Oi Shun House	6.4/31.6/59.6	1st/10th/20th
4	Shun Tak Fraternal Association Tam Pak Yu College	6.4/12.0/23.2	1st/3rd/7th
5	Oi Lok House	6.4/31.6/76.4	1st/10th/25th
6	Oi Chi House	6.4/31.6/76.4	1st/10th/25th
7	Oi Lai House	6.4/31.6/76.4	1st/10th/25th
8	Ting Tak House	6.9/32.1/50.3	1st/10th/16th
8a	Ting Tak House	6.9/32.1/50.3	1st/10th/16th
9	Shun Tak Fraternal Association Wu Siu Kut Memorial Primary School	6.9/12.0/23.7	1st/3rd/7th
10	Lui Cheung Kwong Lutheran Primary School	6.9/12.0/23.7	1st/3rd/7th
11	Ting Hong House	6.9/32.1/76.9	1st/10th/25th
12	Ting Fuk House	6.9/32.1/76.9	1st/10th/25th
13	Shun Tak Fraternal Association Leung Kam Kui College/Lui Cheung Kwong Lutheran College	6.9/12.0/23.7	1st/3rd/7th
14	Ting On House	6.4/59.6/101.6	1st/20th/35th
15	Ting Hui House	6.4/59.6/101.6	1st/20th/35th
16	Tuen King Building	7.4/32.6/88.6	1st/10th/30th
17	Lai Po Building	7.4/32.6/88.6	1st/10th/30th
18	Chi Lok Fa Yuen Bk 3	6.7/31.6/48.4	1st/10th/16th
19	Chi Lok Fa Yuen Bk 4	6.7/31.6/48.4	1st/10th/16th
20	Chi Lok Fa Yuen Bk 5	6.7/31.6/48.4	1st/10th/16th
22	Ho Sik Lam Primary School	5.9/11.5/22.7	1st/3rd/7th
25	Goodview Garden Bk 2	5.9/59.1/101.1	1st/20th/35th
26	Goodview Garden Bk 1	5.9/59.1/101.1	1st/20th/35th
27	Goodview Garden Bk 3	5.9/59.1/101.1	1st/20th/35th
28	Tsui Ning Garden Bk 2	5.6/58.8/100.8	1st/20th/35th
29	Tsui Ning Garden Bk 1	5.9/59.1/101.1	1st/20th/35th
30	Tsui Ning Garden Bk 6	5.9/59.1/101.1	1st/20th/35th
31	Tsui Ning Garden Bk 5	5.9/59.1/101.1	1st/20th/35th
46	Hong King Garden Bk A & B	6.4/31.6/59.6	1st/10th/20th

NSRs		Representative floors mPD (m)	Representative floors
47	Harvest Garden	9.4/34.6/62.6	1st/10th/20th
48	Kam Fai Garden Bk 1, 2 & 3	12.4/37.6/54.4	1st/10th/16th
49	Temple	31.4	1st
50	Mrs Aw Boon Haw Secondary School	6.1/11.7/22.9	1st/3rd/7th
51	Chun Yu House (Sham Shing Estate)	5.9/31.1/73.1	1st/10th/25th
52	Lau Ng Ying Primary School	5.9/11.5/22.7	1st/3rd/7th
53	Hang Fok Garden Bk 1	5.9/31.1/87.1	1st/10th/30th
54	Hang Fok Garden Bk 2	5.9/31.1/87.1	1st/10th/30th
55	Siu Lun Court Bk 1	6.0/59.2/101.2	1st/20th/35th
56	Siu Lun Court Bk 2	6.0/59.2/101.2	1st/20th/35th

Table 5.2b *Western Area Noise Sensitive Receivers*

NSRs		Representative floors mPD (m)	Representative Floor
32	St Simon's Child Welfare Centre (school)	18.4/24.0	1st/3rd
34	Village House 1	18.4	1st
36	Yan Chai Hospital No.2 Secondary School	11.4/17.0	1st/3rd
37	Village House 2	14.4	1st
38	Village House 3	14.4	1st
39	Girls' House	14.4	1st
40	Morning Light School	14.4/20.0	1st/3rd
41	Monastery	14.4/20.0	1st/3rd
42	Boy's Hostel	31.4/37.0	1st/3rd
43	Sun Tuen Mun Centre Bk 5 & 6	6.9/60.1/102.1	1st/20th/35th
44	Sun Tuen Mun Centre Bk 1 & 2	6.9/60.1/102.1	1st/20th/35th
45	Boy's Hostel	31.4/37.0	1st/3rd
57	Area 18 PSPS Housing Development	6.4/31.6/73.6	1st/10th/25th

The existing baseline noise levels were measured on 23 and 24 March 1995 and are reported in *Table 3.2a*. In general, the traffic noise modelling results using prevailing traffic flows are slightly lower than the measured levels and good agreement (within +2 dB(A) difference) is found between the modelling results and the measured levels at two locations (Kam Fai Garden and Wu Shiu Kui Primary School), suggesting that the noise model gives a good indication of the actual noise levels at the study areas. The measured level were higher at Morning Light School, but monitoring logs indicated the

dominant noise sources during the measurement were light rail trains as well as traffic at the measurement location. Hence, the modelled prevailing levels are considered to show good agreement with the measured levels.

5.3 NOISE ASSESSMENT METHODOLOGY

The surrounding road scheme was divided up into 277 road segments, each of which was assigned one of 96 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 the Calculation of Road Traffic Noise (CRTN) procedures and the noise model was built using the HFANoise 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.

Figure 5.3a shows the digitised road scheme as HFANoise graphical outputs. The Peak Hour traffic flows are shown for three conditions as shown in *Section 2*: *Figure 2.5a* gives prevailing flow, *Figure 2.5b* gives 2011 flow With TMPD, *Figure 2.5c* give 2011 flow without TMPD. Also shown in these Figures are the % heavy vehicles. Traffic speeds of 50 kph at all local roads, 70 kph and 80 kph at Tuen Mun Road and Foothill By-pass were assumed in this assessment. Road surfaces were assumed to be standard wearing course.

Traffic noise impacts are assessed against the HKPSG noise level of $L_{A10,\ peak\ hour}$ 70 dB(A) for residential area and $L_{A10,\ peak\ hour}$ 65 dB(A) for school as the target levels for all 'direct' forms of mitigation (ie those that can be applied to the road itself). Any predicted levels exceeding the above 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 practicable direct mitigation measures cannot be designed, residual impacts are assessed against a second criterion to consider if, as a last resort, the affected residential premises should be qualified for noise insulation. This criterion would have to be exceeded (when rounded to the nearest 0.1 dB(A)) for the NSR to be qualified for insulation. This 'noise insulation criterion' embodies the conditions specified in paragraph 6 of the UK CRTN methodology as applied to Hong Kong under the ExCo directive "Equitable Redress for Persons Exposed to Increase Noise resulting from the use of New Roads", such that the assessment criterion would be exceeded if all three of the following conditions are met.

i) The combined expected maximum traffic noise level, ie the overall noise level, from the new or altered roads together with other traffic in the vicinity is more than the specified noise level ($L_{A10,\ peak\ hour}$ 70 dB(A)).

ii) The overall noise level is at least 1.0 dB(A) more than the prevailing noise level (the prevailing noise level being the total traffic noise level existing before the works to construct or improve the road begin).

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

In order to discuss these conditions, all roads are described as either 'new' which in the context of this report describes all roads that are completely new or are substantially altered by the proposed works (e.g. the location of the road has been altered or it has been widened substantially), or 'unaltered' for the other roads. The 'new' roads adopted in this assessment are shown in *Figure 5.2a.*

5.4 *ASSESSMENT OF NOISE IMPACTS*

The potential noise impact on the NSRs by 2011 with the operation of the proposed Roadworks are discussed below. The 1995 prevailing noise levels and the 2011 predicted noise levels for the With TMPD scenario are given in *Tables 5.4a* and *5.4b* along with the HKPSG criteria. The predicted noise levels for the Without TMPD are given in *Tables 5.4c* and *5.4d.*

Table 5.4a ***Eastern Area: Predicted 2011 Traffic Noise Impact*** [1] ***– WITH TMPD (Noise Levels in*** $L_{A10,\ peak\ hour}$ ***(dB(A)))***

NSR		1995 Prevailing Traffic Noise Levels	HKPSG Criteria	2011 Noise Levels No Mitigation
1	Oi Lin House (1/10/20F)	79.6/77.6/75.4	70	81.0/80.2/78.8
2	Oi Yee House (1/10/20F)	76.4/77.5/73.8	70	77.7/84.4/82.2
3	Oi Shun House (1/10/20F)	75.5/74.4/72.6	70	82.1/81.4/79.6
4	Shun Tak Fraternal Association Tam Pak Yu College (1/3/7F)	68.4/68.8/68.9	65	73.0/73.3/74.5
5	Oi Lok House (1/10/25F)	55.3/59.1/62.6	70	62.7/66.1/69.3
6	Oi Chi House (1/10/25F)	66.3/66.3/66.5	70	68.1/69.4/70.9
7	Oi Lai House (1/10/25F)	72.4/72.5/70.3	70	74.6/77.6/76.1
8	Ting Tak House (1/10/16F)	77.7/76.6/75.5	70	78.8/79.5/79.0
8a	Ting Tak House (1/10/16F)	71.6/72.4/72.1	70	77.2/78.1/77.8
9	Shun Tak Fraternal Association Wu Siu Kut Memorial Primary School (1/3/7F)	71.5/72.0/70.2	65	78.3/78.7/79.2
10	Lui Cheung Kwong Lutheran Primary School (1/3/7F)	70.2/71.5/74.1	65	79.7/80.3/80.5
11	Ting Hong House (1/10/25F)	65.0/67.5/69.3	70	69.9/72.0/74.1
12	Ting Fuk House (1/10/25F)	67.2/71.4/71.7	70	71.3/75.7/77.3
13	STFA Leung Kam Kui College/Lui Cheung Kwong Lutheran College (1/3/7F)	76.7/76.8/76.1	65	84.4/84.3/83.3
14	Ting On House (1/20/35F)	68.5/70.0/69.5	70	75.3/75.4/75.1
15	Ting Hui House (1/20/35F)	74.9/73.1/71.4	70	81.5/79.0/77.0
16	Tuen King Building (1/10/30F)	76.3/75.2/72.2	70	83.3/82.0/78.6

NSR		1995 Prevailing Traffic Noise Levels	HKPSG Criteria	2011 Noise Levels No Mitigation
17	Lai Po Building (1/10/30F)	76.6/75.5/72.8	70	83.2/81.9/78.6
18	Chi Lok Fa Yuen Bk 3 (1/10/16F)	74.0/73.0/72.1	70	83.2/79.9/78.8
19	Chi Lok Fa Yuen Bk 4 (1/10/16F)	73.3/72.8/72.3	70	78.3/78.7/78.0
20	Chi Lok Fa Yuen Bk 5 (1/10/16F)	73.7/73.3/72.8	70	78.1/78.5/77.9
22	Ho Sik Lam Primary School (1/3/7F)	67.0/67.4/68.4	65	71.5/72.6/74.3
25	Goodview Garden Bk 2 (1/20/35F)	66.9/67.8/67.5	70	73.5/75.3/75.1
26	Goodview Garden Bk 1 (1/20/35F)	70.4/70.0/69.2	70	76.3/77.5/76.7
27	Goodview Garden Bk 3 (1/20/35F)	64.9/64.5/63.9	70	69.3/72.9/72.7
28	Tsui Ning Garden Bk 2 (1/20/35F)	66.4/66.0/65.4	70	72.4/74.3/73.8
29	Tsui Ning Garden Bk 1 (1/20/35F)	72.2/71.4/70.3	70	76.1/79.6/78.3
30	Tsui Ning Garden Bk 6 (1/20/35F)	73.6/72.9/71.9	70	75.9/79.8/78.6
31	Tsui Ning Garden Bk 5 (1/20/35F)	72.8/72.1/71.0	70	74.5/77.0/76.4
46	Hong King Garden Bk A & B (1/10/20F)	76.5/76.2/75.2	70	79.5/80.1/79.3
47	Harvest Garden (1/10/20F)	81.8/79.3/77.3	70	83.0/80.8/79.3
48	Kam Fai Garden Bk 1, 2 & 3 (1/10/16F)	77.8/77.6/76.9	70	78.9/79.2/78.5
49	Temple (1F)	76.4	70	78.3
50	Mrs Aw Boon Haw Secondary School (1/3/7F)	70.0/70.4/71.9	65	74.2/74.3/75.0
51	Chun Yu House (Sham Shing Estate) (1/10/25F)	71.1/71.8/71.3	70	72.5/72.9
52	Lau Ng Ying Primary School (1/3/7F)	67.7/67.8/69.0	65	69.5/69.6/70.2
53	Hang Fok Garden Bk 1 (1/10/30F)	79.0/77.4/74.0	70	80.4/78.8/75.7
54	Hang Fok Garden Bk 2 (1/10/30F)	75.3/74.8/73.1	70	76.8/76.3/75.1
55	Siu Lun Court Bk 1 (1/20/35F)	74.2/72.5/71.0	70	75.9/75.9/75.3
56	Siu Lun Court Bk 2 (1/20/35F)	68.9/69.9/69.4	70	72.4/76.1/75.4

(1) Low/Medium/High levels

Table 5.4b *Western Area: Predicted 2011 Traffic Noise Impact [1] - WITH TMPD (Noise Levels in $L_{A10,\ peak\ hour}$ (dB(A)))*

NSR		1995 Prevailing Traffic Noise Level	HKPSG Criterion	2011 Noise Levels No Mitigation
32	St Simon's Child Welfare Centre (school) (1/3F)	72.4/72.2	65	81.5/81.4
34	Village House 1 (1/F)	71.0	70	80.5
36	Yan Chai Hospital No.2 Secondary School (1/3F)	66.0/66.3	65	76.4
37	Village House 2 (1/F)	55.5	70	64.2
38	Village House 3 (1/F)	56.7	70	65.4
39	Girls' House (1/F)	68.5	70	77.8
40	Morning Light School (1/3F)	67.5/67.8	65	74.0/74.6
41	Monastery (1/3F)	57.1/59.7	70	67.6/69.3
42	Boy's Hostel (1/3F)	62.3/62.8	70	73.7/74.2
43	Sun Tuen Mun Centre Bk 5 & 6 (1/20/35F)	62.7/64.0/63.5	70	70.4/72.7/73.0
44	Sun Tuen Mun Centre Bk 1 & 2 (1/20/35F)	62.3/65.5/63.9	70	71.1/74.2/74.0
45	Boy's Hostel (1/3F)	56.7/58.0	70	68.9/69.8
57	Area 18 PSPS Housing Development		70	76.8

(1) Low/Medium/High levels

Table 5.4c *Eastern Area: Predicted 2011 Traffic Noise Impact [1]-WITHOUT TMPD (Noise Levels in $L_{A10,\ peak\ hour}$ (dB(A)))*

NSR		1995 Prevailing Traffic Noise Level	HKPSG Criterion	2011 Noise Levels No Mitigation
1	Oi Lin House (1/10/20F)	79.6/77.6/75.4	70	79.7/79.3/78.1
2	Oi Yee House (1/10/20F)	76.4/77.5/73.8	70	77.5/84.4/82.2
3	Oi Shun House (1/10/20F)	75.5/74.4/72.6	70	82.3/81.7/79.8
4	Shun Tak Fraternal Association Tam Pak Yu College (1/3/7F)	68.4/68.8/68.9	65	72.4/72.8/74.7
5	Oi Lok House (1/10/25F)	55.3/59.1/62.6	70	62.6/65.7/69.2
6	Oi Chi House (1/10/25F)	66.3/66.3/66.5	70	67.3/68.8/70.7
7	Oi Lai House (1/10/25F)	72.4/72.5/70.3	70	74.4/78.7/76.8
8	Ting Tak House (1/10/16F)	77.7/76.6/75.5	70	77.4/78.7/78.3
8a	Ting Tak House (1/10/16F)	71.6/72.4/72.1	70	77.1/77.9/77.7
9	Shun Tak Fraternal Association Wu Siu Kut Memorial Primary School (1/3/7F)	71.5/72.0/70.2	65	78.1/78.5/79.0
10	Lui Cheung Kwong Lutheran Primary School (1/3/7F)	70.2/71.5/74.1	65	77.6/78.4/80.3

NSR		1995 Prevailing Traffic Noise Level	HKPSG Criterion	2011 Noise Levels No Mitigation
11	Ting Hong House (1/10/25F)	65.0/67.5/69.3	70	69.1/71.7/73.8
12	Ting Fuk House (1/10/25F)	67.2/71.4/71.7	70	70.9/75.9/77.0
13	Shun Tak Fraternal Association Leung Kam Kui College/Lui Cheung Kwong Lutheran College (1/3/7F)	76.7/76.8/76.1	65	83.8/83.7/82.7
14	Ting On House (1/20/35F)	68.5/70.0/69.5	70	74.6/74.9/74.5
15	Ting Hui House (1/20/35F)	74.9/73.1/71.4	70	81.1/78.7/76.7
16	Tuen King Building (1/10/30F)	76.3/75.2/72.2	70	82.7/81.4/78.0
17	Lai Po Building (1/10/30F)	76.6/75.5/72.8	70	82.6/81.3/78.1
18	Chi Lok Fa Yuen Bk 3 (1/10/16F)	74.0/73.0/72.1	70	80.6/79.3/78.1
19	Chi Lok Fa Yuen Bk 4 (1/10/16F)	73.3/72.8/72.3	70	78.5/78.3/77.7
20	Chi Lok Fa Yuen Bk 5 (1/10/16F)	73.7/73.3/72.8	70	78.9/78.9/78.3
22	Ho Sik Lam Primary School (1/3/7F)	67.0/67.4/68.4	65	71.2/72.1/73.9
25	Goodview Garden Bk 2 (1/20/35F)	66.9/67.8/67.5	70	73.6/75.4/75.1
26	Goodview Garden Bk 1 (1/20/35F)	70.4/70.0/69.2	70	76.3/77.5/76.7
27	Goodview Garden Bk 3 (1/20/35F)	64.9/64.5/63.9	70	69.1/72.9/72.6
28	Tsui Ning Garden Bk 2 (1/20/35F)	66.4/66.0/65.4	70	72.3/74.3/73.8
29	Tsui Ning Garden Bk 1 (1/20/35F)	72.2/71.4/70.3	70	76.0/79.5/78.2
30	Tsui Ning Garden Bk 6 (1/20/35F)	73.6/72.9/71.9	70	75.5/79.7/78.5
31	Tsui Ning Garden Bk 5 (1/20/35F)	72.8/72.1/71.0	70	73.7/76.6/76.1
46	Hong King Garden Bk A & B (1/10/20F)	76.5/76.2/75.2	70	81.1/81.9/80.8
47	Harvest Garden (1/10/20F)	81.8/79.3/77.3	70	80.6/79.4/78.7
48	Kam Fai Garden Bk 1, 2 & 3 (1/10/16F)	77.8/77.6/76.9	70	81.0/80.9/80.1
49	Temple (1F)	76.4	70	77.7
50	Mrs Aw Boon Haw Secondary School (1/3/7F)	70.0/70.4/71.9	65	76.0/76.1/76.5
51	Chun Yu House (Sham Shing Estate) (1/10/25F)	71.1/71.8/71.3	70	72.0/72.4/72.1
52	Lau Ng Ying Primary School (1/3/7F)	67.7/67.8/69.0	65	69.4/69.5/70.4
53	Hang Fok Garden Bk 1 (1/10/30F)	79.0/77.4/74.0	70	77.2/75.8/73.3

NSR	1995 Prevailing Traffic Noise Level	HKPSG Criterion	2011 Noise Levels No Mitigation
54 Hang Fok Garden Bk 2 (1/10/30F)	75.3/74.8/73.1	70	74.1/73.9/73.6
55 Siu Lun Court Bk 1 (1/20/35F)	74.2/72.5/71.0	70	74.8/75.3/74.8
56 Siu Lun Court Bk 2 (1/20/35F)	68.9/69.9/69.4	70	72.0/75.7/75.0

(1) Low/Medium/High levels

Table 5.4d *Western Area: Predicted 2011 Traffic Noise Impact[1] – WITHOUT TMPD (Noise Levels in $L_{A10,\ peak\ hour}$ (dB(A)))*

NSR	1995 Prevailing Traffic Noise Level	HKPSG Criterion	2011 Noise Levels No Mitigation
32 St Simon's Child Welfare Centre (school) (1/3F)	72.4/72.2	65	79.2/79.0
34 Village House 1 (1/F)	71	70	78.2
36 Yan Chai Hospital No.2 Secondary School (1/3F)	66.0/66.3	65	74.2/74.3
37 Village House 2 (1/F)	55.5	70	62.9
38 Village House 3 (1/F)	56.7	70	63.9
39 Girls' House (1/F)	68.5	70	76.7
40 Morning Light School (1/3F)	67.5/67.8	65	72.7/73.3
41 Monastery (1/3F)	57.1/59.7	70	65.9/68.2
42 Boy's Hostel (1/3F)	62.3/62.8	70	72.5/72.9
43 Sun Tuen Mun Centre Bk 5 & 6 (1/20/35F)	62.7/64.0/63.5	70	69.2/71.4/71.7
44 Sun Tuen Mun Centre Bk 1 & 2 (1/20/35F)	62.3/65.5/63.9	70	69.8/72.9/72.6
45 Boy's Hostel (1/3F)	56.7/58.0	70	67.5/68.4

(1) Low/Medium/High levels

For most NSRs, the predicted noise levels in 2011 will exceed the $L_{A10,peak\ hour}$ 70 dB(A) and 65 dB(A) limits (see *Tables 5.3a* to *5.3d*). Hence, mitigation will be necessary to reduce the extent of the noise impact. From the above tables, it can be seen that the extent and degree of impact from the Without TMPD scenario is similar to the With TMPD scenario. For Simplicity the noise assessment will be focused on the With TMPD scenario.

Tables 5.4a and *b* and *5.4c* and *d* indicate that for most of the NSRs there are exceedances of the HKPSG criteria (predicted noise levels that are higher than the HKPSG criteria has been indicated in italics) except at the NSR 5 (Oi Lok House), NSR 37 & 38 (Village House 2 & 3) and NSR 45 (Boy's Hostel).

In all other cases, the predicted noise levels with no mitigation are above the 70 dB(A) level at the worst impacted representative NSRs, with the highest exceedance of up to 13 dB (A), implying that all the dwellings on that facade of the building will be significantly impacted. However, as confirmed by the Education Department, all the schools within the study area will be insulation installed for traffic noise protection. It is expected that for NSR 9

(STFA Wu Siu Kut Memorial Primary School), NSR 10 (Lui Cheung Kwong Lutheran Primary School), NSR 13 (STFA Leung Kam Kui College/Lui Cheung Kwong Lutheran College) and NSR 52 (Lau Ng Ying Primary School) the noise insulation will be completed before Easter 1996. For other schools, NSR 4 (STFA Tam Pak Yu College), NSR 22 (Ho Sik Lam Primary School), NSR 36 (Yan Chai Hospital No 2 Secondary School), NSR 40 (Morning Light School) and NSR 50 (Mrs Aw Boon Haw Secondary School) the works are expected to be completed before 1999 (i.e. before the operation of the Roadworks).

It is clear that direct mitigation measures will be necessary for the NSRs with noise levels exceeding the HKPSG criteria (Reference to *Tables 5.4a* and *b* and *5.4c* and *d* above) to reduce to acceptable levels. The NSRs which have been predicted with no unacceptable noise impact from the proposed Roadworks (i.e. NSRs 5, 37, 38 & 45 and the schools with insulation) will be omitted in the Noise Mitigation Measures Section for simplicity.

The noise levels predicted at the planned Area 18 PSPS Housing Development are in the region of 75 to 81 dB(A) and are similar to that predicted in the *Traffic Impact and Environmental Assessment Study* of the development. Therefore the adopted requirements of single aspect building blocks along the north and west site boundaries as stated in the Planning Brief is considered adequate and the development should not be impacted by the Roadworks. It has also been recommended that low noise road surfacing should be used on Foothill By-pass.

5.5 NOISE MITIGATION MEASURES

The assessment in the above section indicates that the noise impacted areas will be the residential building around the proposed Roadworks and residential buildings along Wong Chu Road. Mitigation measures will be required to reduce these impacts to within acceptable levels.

A progressively extensive set of direct mitigation measures for the affected NSRs has been investigated for both the Eastern and Western Area in order to reduce the noise contribution from the 'new' roads and Wong Chu Road. The different mitigation options are described in the section below. The predicted results for the different mitigation options for the With and Without TMPD scenario are shown in *Tables 5.5a–b* and *5.5c–d* respectively.

For the ease of presenting the predicted results, NSRs 6, 11, 14, 17, 18, 27, 28, 31, 48, 49, 51, 52, 53, 54 and 55 are omitted as these locations can be represented by other worst affected NSRs at similar locations (such as NSRs 2, 12, 15, 19,. 26, 30, 47 and 56).

The broad civil and traffic engineering requirements discussed in *Section 2.6* have been taken into account in development of the various mitigation measures options.

Mitigation 1 : Low Noise Road Surfaces

Low noise road surfaces (i.e. friction course) is considered a practical mitigation option for the roads in this report has been modelled on all the 'new' roads (see *Figure 5.2a*) and on existing Wong Chu Road. The predicted results after mitigation for With TMPD scenario is shown in *Table 5.5a & b*

below.

For With TMPD scenario, *Table 5.5a* indicates that for all NSRs the predicted noise levels are still above the HKPSG criteria. Further mitigation measures are added to this option to investigate additional noise benefits.

For Without TMPD scenario, *Table 5.5c* indicates that for all NSRs the predicted noise levels are still above the HKPSG criteria. Further mitigation measures are added to this option to investigate additional noise benefits.

Mitigation 2: Low Noise Road Surfaces and 3 + 5m high barriers

Low noise road surfaces (as described above) and 3m high roadside barriers of lengths 220m, 280m, 215m and 525m located on slip road A, B and C of the Wong Chu Road/Tuen Mun Road Interchange, and northbound of Foothill Bypass respectively; and 5m high roadside barriers of lengths 500m and 600m located on eastbound and westbound of Wong Chu Road and southbound Foothill Bypass have also been modelled. Barriers are generally modelled at 1m from the curb unless specifies by other constraints such as traffic clearance requirements (references to *Table 2.6–1, 2 and 3*) and are reflective. The location of the barriers is shown in *Figure 5.5a*.

It can be seen that residential developments along Wong Chu Road, and Tuen Mun Road including Yau Oi Estate (NSR 1, 2, 3 and 7), On Ting Estate (NSRs 12), Goodview Gardens (NSRs 25 and 26), Tsui Ning Garden (NSRs 29 and 31), Sui Lun Court (NSRs 55 and 56), Chi Lok Fa Yuen (NSRs 19 and 20) and Hong King Garden Bk 1, 2 and 3 (NSR 46) are the main problem areas. As shown in *Tables 5.5a* and *5.5c*, the predicted noise levels for both with and without TMPD scenarios indicate that the barriers are effective for lower floors only, and not effective in mitigating the noise impact at higher levels. The locations of the residential buildings close to Wong Chu Road are such that the upper floor residents will look down onto the roads at a steep angle, and consequently the barriers will have limited effect.

For residential areas near Wong Chu Road/Lung Mun Road Interchange (NSRs 42, 43 and 44), the effect of the 3m high barrier along the northbound section and, 5m high barrier along the southbound section of Foothill Bypass and the low noise road surfaces, as seen in *Tables 5.5b* and *5.5d*, will mitigate noise levels to below the 70 dB(A) noise assessment criterion (when rounded to the nearest whole dB(A)) at all NSRs except NSRs 44. At NSR 44 noise levels up to 72 dB(A) are predicted, and further mitigation will be necessary to further mitigate the noise impact.

Mitigation 3: Low Noise Road Surfaces and 3 + 5m Cantilevered Barriers

Low noise road surface and 3m high roadside noise barriers as in Mitigation 2 and 5m cantilevered barriers on Wong Chu Road and southbound Foothill Bypass. The location of the barriers is shown in *Figure 5.5b*.

For the residential development along Wong Chu Road and Tuen Mun Road including Yau Oi Estate (NSR 1, 2, 3 and 7), On Ting Estate (NSRs 12), Goodview Gardens (NSRs 25 and 26), Tsui Ning Garden (NSRs 29 and 31), Sui Lun Court (NSRs 55 and 56), Chi Lok Fa Yuen (NSRs 19 and 20) and Hong King Garden Bk 1, 2 and 3 (NSR 46) a 5m high cantilever barrier on eastbound and westbound carriageway of Wong Chu Road (with the same barrier lengths as in mitigation option 2) have been modelled. The

cantilevered barriers are generally modelled at 1m from the curb unless specifies by other constraints such as traffic clearance requirements (references to *Table 2.6–1, 2 and 3*) and have an 0.3m overhang towards the road curb (see *Figure 5.6a*).

As shown in *Table 5.5a* and *5.5c*, the predicted noise levels for both scenarios indicate that the barriers are effective at the lower floors only. Although the overall extent of exceedances is reduced by using a 5m cantilever noise barrier, it is not sufficient to mitigate the noise exceedances at high levels

or NSR 44, the HKPSG criteria are only achieved at low and high levels. However residual impact of up to 71 dB(A) are still predicted at medium levels.

Mitigation 4: Low Noise Road Surfaces, 3 + 5m Cantilevered Barrier and Enclosure

Low Noise Road Surface and 3m high and 5m cantilever roadside noise barriers as in Mitigation 3 and two full enclosure sections each of length 230m erected along Wong Chu Road as shown in *Figure 5.5c* has been modelled.

Details of the enclosure arrangements are shown in *Figure 5.6c*, which have been designed to incorporate FSD requirements for unrestricted passage of DGVs as described in *Section 5.6.1*.

The location of the gap necessary for FSD requirements has been selected over Heung Sze Wui Road where NSRs are relatively setback farthest from Wong Chu Road and therefore it is considered the least sensitive location. Openings along the eaves of the enclosures are also necessary to meet FSD requirements and the design of the enclosure should ensure small leakage of noise. One possible arrangement as illustrated in *Figure 5.6c* is to ensure that the vertical and horizontal panels of the enclosure panels overlap to screen direct line of sight from the NSRs to the enclosure opening. It is also suggested that absorptive noise enclosure panel to be used inside the noise enclosure in order to reduce the reverberant noise levels inside the enclosure. *Annex F* shows the calculations to demonstrate the acoustic performance of the noise enclosure arrangements. The performance of the noise enclosure arrangement should subject to detailed design at the following stage.

The new enclosure arrangements has been modelled and the effect of the enclosure and the low noise road surfaces for with and without TMPD is shown in *Table 5.5a* and *Table 5.5c* respectively. The result indicates that for NSRs 2, 25, 26, 29 and 56 the predicted noise levels are within the HKPSG criteria. However residual impacts are still predicted at all other NSRs.

For NSRs 3, 7 and 12 the exceedances could not be further mitigated by means of direct mitigation, the length of enclosure could not be extended due to traffic engineering constraints at junctions where it is necessary to provide adequate visibility splays for motorists approaching junctions (Hoi Wong Road joining Wong Chu Road and at the Wong Chu Road/Tuen Mun Road Interchange).

This combination of enclosure, barriers and low noise road surfaces is considered to represent the best practicable package of direct mitigation measures which would alleviate the degree of traffic noise impact at most of the NSRs.

Table 5.5a *Eastern Area: Mitigated 2011 Traffic Noise Impact –WITH TMPD*

NSR	HKPSG Criterion	2011 Noise Levels No Mitigation	Mitigation 1 LNRS on 'new' road	Mitigation 2 3m & 5m high noise barrier	Mitigation 3 3m & 5m cantilever barrier	Mitigation 4 enclosure & cantilever barrier
1 Oi Lin House (1/10/20F)	70	81.0/80.2/78.8	80.9/79.4/77.7	80.7/78.5/77.1	80.7/78.5/76.7	80.7/78.5/76.7
2 Oi Yee House (1/10/20F)	70	77.7/84.4/82.2	75.6/82.0/79.8	70.9/78.2/82.8	70.6/76.2/82.3	69.9/70.8/72.1
3 Oi Shun House (1/10/20F)	70	82.1/81.4/79.6	80.1/79.4/77.5	71.2/80.2/79.0	68.4/77.0/78.9	68.4/77.0/78.8
7 Oi Lai House (1/10/25F)	70	74.6/77.6/76.1	73.5/78.1/76.0	67.4/76.5/75.2	66.2/74.2/75.2	66.2/74.2/75.1
8 Ting Tak House (1/10/16F)	70	78.8/79.5/79.0	78.7/78.6/77.9	78.5/77.4/76.5	78.5/77.3/76.3	78.5/77.3/76.3
8a Ting Tak House (1/10/16F)	70	77.2/78.1/77.8	75.0/76.0/75.8	68.3/72.5/73.5	68.2/72.3/72.9	69.1/71.6/71.7
12 Ting Fuk House (1/10/25F)	70	71.3/75.7/77.3	69.3/74.1/75.7	65.7/72.6/75.2	65.8/72.7/74.8	65.8/72.6/74.6
15 Ting Hui House (1/20/35F)	70	81.5/79.0/77.0	81.5/78.9/77.0	81.5/78.9/77.0	81.5/78.9/77.0	81.5/78.9/77.0
16 Tuen King House (1/10/30F)	70	83.3/82.0/78.6	83.3/81.9/78.5	83.2/81.9/78.4	83.2/81.9/78.4	83.2/81.9/78.4
19 Chi Lok Fa Yuen Bk 4 (1/10/16F)	70	78.3/78.7/78.0	76.8/77.6/76.8	76.4/76.7/76.0	76.8/77.6/76.8	76.8/77.6/76.8
20 Chi Lok Fa Yuen Bk 5 (1/10/16F)	70	78.1/78.5/77.9	76.1/77.0/76.4	75.5/76.1/75.6	76.0/76.9/76.3	76.0/76.9/76.2
25 Goodview Garden Bk 2 (1/20/35F)	70	73.5/75.3/75.1	71.3/73.4/73.3	62.3/71.4/74.0	60.7/69.3/71.7	60.1/68.9/70.8
26 Goodview Garden Bk 1 (1/20/35F)	70	76.3/77.5/76.7	74.1/75.4/74.7	65.9/74.7/76.6	64.7/71.0/75.2	64.0/69.8/73.3
29 Tsui Ning Garden Bk 1 (1/20/35F)	70	76.1/79.6/78.3	74.0/77.2/76.0	68.4/75.2/78.6	67.9/72.7/77.5	66.8/69.4/71.2
30 Tsui Ning Garden Bk 6 (1/20/35F)	70	75.9/79.8/78.6	74.3/77.6/76.5	71.7/74.8/78.7	71.7/73.6/77.4	71.2/71.7/72.7
46 Hong King Garden Bk A & B (1/10/20F)	70	79.5/80.1/79.3	77.6/78.4/77.7	77.5/78.2/77.8	77.5/78.3/77.9	77.5/78.2/77.8
47 Harvest Garden (1/10/20F)	70	83.0/80.8/79.3	82.9/80.6/78.9	82.9/80.6/78.8	82.9/80.6/78.8	82.9/80.6/78.8
56 Siu Lun Court Bk 2 (1/20/35F)	70	72.4/76.1/75.4	70.8/74.1/73.4	67.9/72.0/73.4	67.8/71.2/72.4	67.7/68.7/69.6

Table 5.5b *Western Area: Mitigated 2011 Traffic Noise Impact -WITH TMPD*

NSRs	HKPSG Criterion	2011 Noise Levels No Mitigation	Mitigation 1 LNRS on 'new' road	Mitigation 2 3m & 5m high noise barrier	Mitigation 3
39 Girl's Hostel (1/F)	70	77.8	77.3	77.1	77.1
42 Boy's Hostel (1/3F)	70	73.7/74.2	71.7/72.2	69.8/70.3	69.7/70.3
43 Sun Tuen Mun Centre Bk 5 & 6 (1/20/35F)	70	70.4/72.7/73.0	69.1/71.1/71.2	68.3/70.0/69.9	68.1/69.8/69.5
44 Sun Tuen Mun Centre Bk 1 & 2 (1/20/35F)	70	71.1/74.2/74.0	69.7/72.9/72.3	68.7/71.6/70.5	68.6/71.4/70.0

Table 5.5c *Eastern Area: Mitigated 2011 Traffic Noise Impact -WITHOUT TMPD*

NSR		HKPSG Criterion	2011 Noise Levels No Mitigation	Mitigation 1 LNRS on 'new' road	Mitigation 2 3m & 5m high noise barrier	Mitigation 3 3m & 5m cantilever barrier	Mitigation 4 enclosure & cantilever barrier
1	Oi Lin House (1/10/20F)	70	79.7/79.3/78.1	79.4/78.2/76.7	79.2/77.2/76.0	79.2/77.1/75.4	79.2/77.1/75.4
2	Oi Yee House (1/10/20F)	70	77.5/84.4/82.2	75.0/81.6/79.4	69.4/77.1/82.4	69.2/75.6/81.9	68.2/69.4/71.1
3	Oi Shun House (1/10/20F)	70	82.3/81.7/79.8	79.3/78.7/76.9	67.3/77.5/79.4	67.0/76.1/78.9	66.7/76.0/78.7
7	Oi Lai House (1/10/25F)	70	74.4/78.7/76.8	71.0/76.2/74.0	65.6/73.8/74.8	65.6/73.8/74.8	65.6/73.8/74.8
8	Ting Tak House (1/10/16F)	70	77.4/78.7/78.3	77.2/77.4/76.8	77.1/75.9/75.2	77.1/75.8/75.0	77.0/75.8/74.9
8a	Ting Tak House (1/10/16F)	70	77.1/77.9/77.7	74.4/75.4/75.2	67.9/72.3/73.0	67.5/71.6/72.2	68.4/70.8/71.0
12	Ting Fuk House (1/10/25F)	70	70.9/75.9/77.0	68.7/73.9/75.0	66.8/73.9/75.3	65.2/72.5/74.0	65.2/72.4/73.7
15	Ting Hui House (1/20/35F)	70	81.1/78.7/76.7	81.1/78.6/76.6	81.1/78.6/76.6	81.1/78.6/76.6	81.1/78.6/76.6
16	Tuen King House (1/10/30F)	70	82.7/81.4/78.0	82.7/81.3/77.9	82.7/81.4/77.9	82.7/81.3/77.9	82.7/81.3/77.9
19	Chi Lok Fa Yuen Bk 4 (1/10/16F)	70	78.5/78.3/77.7	76.7/76.8/76.1	78.1/78.0/77.1	76.6/76.7/75.9	76.6/76.6/75.9
20	Chi Lok Fa Yuen Bk 5 (1/10/16F)	70	78.9/78.9/78.3	76.7/76.9/76.3	78.4/78.3/77.6	76.3/76.5/75.9	76.3/76.5/75.8
25	Goodview Garden Bk 2 (1/20/35F)	70	73.6/75.4/75.1	70.8/72.7/72.2	60.7/69.2/72.3	60.5/68.7/71.2	59.6/68.3/70.2
26	Goodview Garden Bk 1 (1/20/35F)	70	76.3/77.5/76.7	73.6/74.7/73.9	64.3/71.6/76.3	63.9/70.4/74.9	63.0/69.8/72.6
29	Tsui Ning Garden Bk 1 (1/20/35F)	70	76.0/79.5/78.2	73.2/76.7/75.5	67.3/73.5/78.4	67.1/72.1/77.1	65.6/68.3/70.3
30	Tsui Ning Garden Bk 6 (1/20/35F)	70	75.5/79.7/78.5	73.5/77.1/76.0	70.7/73.9/78.3	70.5/72.8/76.9	69.8/70.5/71.8
46	Hong King Garden Bk A & B (1/10/20F)	70	81.1/81.9/80.8	79.1/79.0/78.8	80.8/81.0/80.8	78.9/79.3/79.3	78.9/79.2/79.2
47	Harvest Garden (1/10/20F)	70	80.6/79.4/78.7	80.4/79.0/77.9	80.6/79.3/78.5	80.4/78.9/77.8	80.4/78.9/77.8
56	Siu Lun Court Bk 2 (1/20/35F)	70	72.0/75.7/75.0	69.8/73.3/72.6	66.5/70.8/72.6	66.4/70.4/71.6	66.3/67.4/68.3

Table 5.5d *Western Area: Mitigated 2011 Traffic Noise Impact -WITHOUT TMPD*

NSRs	HKPSG Criterion	2011 Noise Levels No Mitiagion	Mitigation 1 LNRS on 'new' road	Mitigation 2 3m & 5m high noise barrier	Mitigation 3
39 Girl's Hostel (1/F)	70	76.7	76.2	76	76.0
42 Boy's Hostel (1/3F)	70	72.5/72.9	70.4/70.9	68.6/70.3	68.6/69.2
43 Sun Tuen Mun Centre Bk 5 & 6 (1/20/35F)	70	69.2/71.4/71.7	67.8/69.8/69.9	67.0/70.0/69.9	66.9/68.6/68.3
44 Sun Tuen Mun Centre Bk 1 & 2 (1/20/35F)	70	69.8/72.9/72.6	68.4/71.6/70.9	67.4/71.6/70.5	67.4/70.2/68.8

Number of Dwellings Benefited

As required in the Brief, the HKPSG traffic noise criteria of 70 dB(A) for residential developments is used as the assessment criteria for direct mitigation measure considerations, despite the fact that the existing background noise levels already exceed the 70 dB(A) level, ranging from 72dB(A) to 79 dB(A) (see *Table 3.2a*).

Without any form of noise mitigation, it is estimated that the total number of dwellings in the Study Area that will be subject to exceedances of the HKPSG noise criteria is approximately 9010, similar in both with TMPD and without TMPD scenarios. Out of the 9010 dwellings, there are only approximately 4839 dwellings that are affected by Wong Chu Road. The other dwellings are mainly affected by Tuen Mun Road which is mostly outside the Study Area and therefore no direct mitigation measures are considered.

The approximate number and % of dwellings (out of the total 4839 dwellings affected) that will benefit from the four mitigation options along Wong Chu Road are provided in *Table 5.5e*. It can be observed from the table that with the increase in the extent of mitigation from Options 1 to 4, there are considerably more dwellings benefited from the noise level reduction to meet the 70 dB(A) criteria.

Table 5.5e ***Approximate Numbers of Dwellings Along Wong Chu Road Meeting The HKPSG Criterion After Mitigation***

Mitigation Option	Approximate No. and % of Dwellings Benefited
Mitigation Option 1	106 (2%)
Mitigation Option 2	776 (16%)
Mitigation Option 3	1007 (21%)
Mitigation Option 4	1527 (31%)

It should be noted that the table does not illustrate the actual extent of noise reduction that affected NSRs have benefited from the mitigation. For example, Option 4 when compared to Option 3 provides up to 6 dB(A) more noise reduction at the residential building along Wong Chu Road.

Figure 5.5d illustrates the benefits provided by Option 4 to the residents along Wong Chu Road in terms of the extent of noise reduction compared to without any mitigation. It is estimated that, with the implementation of the recommended noise mitigation package 4786, approximately 99% of the total 4839 dwellings along Wong Chu Road, would benefit with noise reduction from 1 to 16 dB(A). However within the Study Area there will still be approximately 7044 dwellings, out of the total 9010 dwellings, subject to exceedance of HKPSG criterion as a result of noise contributions from surrounding existing roads including Hoi Wong Road, Tuen Mun Road, Lung Mun Road and Tsing Wun Road.

Noise Insulation

Even with the use of enclosures and 5 m cantilever barriers (as recommended in mitigation option 4) which is the best practicable means of direct mitigation measure, there are still residual impact predicted at some NSRs

exceeding the HKPSG noise criteria. According to the ExCo directive, institutional buildings such as schools should be provided with indirect technical remedies in the form of noise insulation to redress the residual impacts. As presented in *Table 5.5f* to *i* (refer to last column, Eligible for Insulation), the residual impacts at a a number of schools within the Study Area exceed the 65 dB(A) HKPSG criteria, therefore requiring provision of insulation. Although all the schools within the Study Area are scheduled for insulation under ED's NAMISP scheme, it is recommended that further studies be undertaken to formulate a detailed insulation programme for the affected schools for incorporation into the NAMISP scheme to ensure that the schools are protected from unacceptable residual impacts associated with the Roadworks.

Indirect technical remedies for residential premises affected by the "new" roads should be considered on the merits of case and presented to the ExCo for consideration. In order to assess the number of dwelling that could be qualified for consideration of noise insulation, the mitigated noise levels will be compared with the three noise insulation criteria as presented in *Table 5.5f* to *i* below for both with and without TMPD scenario.

The background noise levels from unaltered road in 2011 will be high due to the heavy traffic on the existing roads. As can be observed in *Table 5.5f* to *i*, the proposed Roadworks will not contribute by more than 1 dB(A) to the 2011 background noise levels, implying that the new roads will not significantly worsen the noise environment around the Study Area.

From the assessment results presented in *Table 5.5f* to *i*, it is found that no dwellings will meet the eligibility criteria for insulation after the implementation of Mitigation Option 4.

Table 5.5f *Eastern Area: Predicted Noise Levels – WITH TMPD (Mitigation Option 4)*

NSR		Prevailing Noise Levels	2011 Predicted Noise Levels Total	Predicted Noise Levels 'Unaltered Rd'	Predicted Noise Levels 'New Road'	Meet HKPSG Criterion	> Noise Insulation Criterion i	Noise Insulation Criterion ii (> prevailing +1)	Noise Insulation Criterion iii (> unaltered +1)	Eligible for insulation [1](Window Types)
1	Oi Lin House	79.6	80.7	80.7	33.3	no	yes	yes	no	no
	(1/10/20F)	77.6	78.5	78.5	34.2	no	yes	no	no	no
		75.4	76.7	76.7	41.5	no	yes	no	no	no
2	Oi Yee House	76.4	69.9	69.6	57.9	yes	no	no	no	no
	(1/10/20F)	77.5	70.8	70.6	58.4	no	yes	no	no	no
		73.8	72.1	72.0	58.2	no	yes	no	no	no
3	Oi Shun House	75.5	68.4	68.3	50.9	yes	no	no	no	no
	(1/10/20F)	74.4	77.0	77.0	54.9	no	yes	yes	no	no
		72.6	78.8	78.8	55.3	no	yes	yes	no	no
4	STFA Tam Pak	68.4	64.4	63.6	56.7	yes	n/a	n/a	n/a	no
	Yu College	68.8	65.6	64.9	57.2	no	n/a	n/a	n/a	yes (Type I)
	(1/3/7F)	68.9	71.7	71.4	59.4	no	n/a	n/a	n/a	yes (Type I)
5	Oi Lok House	55.3	49.5	49.1	39.4	yes	no	no	no	no
	(1/10/25F)	59.1	62.9	62.0	55.7	yes	no	yes	no	no
		62.6	67.2	67.0	54.6	yes	no	yes	no	no
6	Oi Chi House	66.3	66.7	66.7	46.5	yes	no	no	no	no
	(1/10/25F)	66.3	67.0	66.9	51.0	yes	no	no	no	no
		66.5	67.7	67.5	53.1	yes	no	yes	no	no
7	Oi Lai House	72.4	66.2	65.7	57.1	yes	no	no	no	no
	(1/10/25F)	72.5	74.2	74.1	58.1	no	yes	yes	no	no
		70.3	75.1	75.0	59.4	no	yes	yes	no	no
8	Ting Tak	77.7	78.5	78.5	36.0	no	yes	no	no	no
	House	76.6	77.3	77.3	36.4	no	yes	no	no	no
	(1/10/16F)	75.5	76.3	76.3	38.0	no	yes	yes	no	no
8a	Ting Tak House	71.6	69.1	69.1	46.8	no	yes	no	no	no
	(1/10/16F)	72.4	71.6	71.5	56.6	yes	no	no	no	no
		72.1	71.7	71.6	56.4	yes	no	no	no	no
9	STFA Wu Siu	71.5	70.1	70.0	53.0	no	n/a	n/a	n/a	yes (Type I)
	Kut School	72.0	70.9	70.8	54.3	no	n/a	n/a	n/a	yes (Type I)
	(1/3/7F)	70.2	73.2	73.1	57.8	no	n/a	n/a	n/a	yes (Type I)
10	LCK Lutheran	70.2	64.9	64.7	51.5	yes	n/a	n/a	n/a	no
	School	71.5	66.5	66.3	53.2	no	n/a	n/a	n/a	yes (Type I)
	(1/3/7F)	74.1	73.8	73.6	60.2	no	n/a	n/a	n/a	yes (Type I)

NSR		Prevailing Noise Levels	2011 Predicted Noise Levels Total	Predicted Noise Levels 'Unaltered Rd'	Predicted Noise Levels 'New Road'	Meet HKPSG Criterion	> Noise Insulation Criterion i	Noise Insulation Criterion ii (> prevailing +1)	Noise Insulation Criterion iii (> unaltered +1)	Eligible for insulation [1](Window Types)
11	TIng Hong	65.0	65.4	65.4	45.0	yes	no	no	no	no
	House	67.5	69.1	69.0	52.2	yes	no	yes	no	no
	(1/10/25F)	69.3	71.7	71.5	58.7	no	yes	yes	no	no
12	Ting Fuk	67.2	65.8	65.7	48.3	yes	no	no	no	no
	House	71.4	72.6	72.5	58.5	no	yes	yes	no	no
	(1/10/25F)	71.7	74.6	74.2	63.9	no	yes	yes	no	no
13	STFA LKK	76.7	84.4	84.4	42.9	no	n/a	n/a	n/a	yes (Type II)
	/LCK College	76.8	84.2	84.2	43.4	no	n/a	n/a	n/a	yes (Type II)
	(1/3/7F)	76.1	83.3	83.3	45.7	no	n/a	n/a	n/a	yes (Type II)
14	Ting On House	68.5	75.3	75.3	37.5	no	yes	yes	no	no
	(1/20/35F)	70.0	75.3	75.3	46.2	no	yes	yes	no	no
		69.5	75.0	74.9	47.4	no	yes	yes	no	no
15	Ting Hui	74.9	81.5	81.5	32.5	no	yes	yes	no	no
	House	73.1	78.9	78.9	45.5	no	yes	yes	no	no
	(1/20/35F)	71.4	77.0	77.0	47.5	no	yes	yes	no	no
16	Tuen King	76.3	83.2	83.2	45.4	no	yes	yes	no	no
	Building	75.2	81.9	81.9	48.0	no	yes	yes	no	no
	(1/10/30F)	72.2	78.4	78.4	52.7	no	yes	yes	no	no
17	Lai Po	76.6	83.1	83.1	45.9	no	yes	yes	no	no
	Building	75.5	81.8	81.8	51.2	no	yes	yes	no	no
	(1/10/30F)	72.8	78.4	78.4	55.1	no	yes	yes	no	no
18	Chi Lok Fa	74.0	81.3	81.3	32.2	no	yes	yes	no	no
	Yuen Bk 3	73.0	79.9	79.9	37.7	no	yes	yes	no	no
	(1/10/16F)	72.1	78.8	78.8	45.4	no	yes	yes	no	no
19	Chi Lok Fa	73.3	76.8	76.8	48.4	no	yes	yes	no	no
	Yuen Bk 4	72.8	77.6	77.5	53.2	no	yes	yes	no	no
	(1/10/16F)	72.3	76.8	76.8	54.9	no	yes	no	no	no
20	Chi Lok Fa	73.7	76.0	75.9	51.2	no	yes	yes	no	no
	Yuen Bk 5	73.3	76.9	76.8	56.7	no	yes	yes	no	no
	(1/10/16F)	72.8	76.2	76.2	58.8	no	yes	yes	no	no
22	Ho Sik Lam	67.0	70.4	70.1	57.8	no	n/a	n/a	n/a	yes (Type I)
	Primary School	67.4	71.1	70.8	59.0	no	n/a	n/a	n/a	yes (Type I)
	(1/3/7F)	68.4	72.3	72.0	60.4	no	n/a	n/a	n/a	yes (Type I)
25	Goodview	66.9	60.1	59.6	50.7	yes	no	no	no	no
	Garden Bk 2	67.8	68.9	68.5	59.0	yes	no	no	no	no
	(1/20/35F)	67.5	70.8	70.5	60.0	no	yes	yes	no	no

NSR		Prevailing Noise Levels	2011 Predicted Noise Levels Total	Predicted Noise Levels 'Unaltered Rd'	Predicted Noise Levels 'New Road'	Meet HKPSG Criterion	> Noise Insulation Criterion i	Noise Insulation Criterion ii (> prevailing +1)	Noise Insulation Criterion iii (> unaltered +1)	Eligible for insulation [1](Window Types)
26	Goodview	70.4	64.0	63.9	49.5	yes	no	no	no	**no**
	Garden Bk 1	70.0	69.8	69.5	58.4	yes	no	no	no	**no**
	(1/20/35F)	69.2	73.3	73.1	59.4	no	yes	yes	no	**no**
27	Goodview	64.9	58.1	58.1	34.6	yes	no	no	no	**no**
	Garden Bk 3	64.5	57.8	57.8	35.0	yes	no	no	no	**no**
	(1/20/35F)	63.9	59.2	59.0	45.7	yes	no	no	no	**no**
28	Tsui Ning	66.4	56.6	56.2	45.3	yes	no	no	no	**no**
	Garden Bk 2	66.0	63.3	62.7	54.5	yes	no	no	no	**no**
	(1/20/35F)	65.4	66.2	65.2	59.1	yes	no	no	yes	**no**
29	Tsui Ning	72.2	66.8	66.6	52.6	yes	no	no	no	**no**
	Garden Bk 1	71.4	69.4	69.1	57.3	yes	no	no	no	**no**
	(1/20/35F)	70.3	71.2	70.9	58.2	no	yes	no	no	**no**
30	Tsui Ning	73.6	71.2	71.1	52.3	no	yes	no	no	**no**
	Garden Bk 6	72.9	71.7	71.5	56.3	no	yes	no	no	**no**
	(1/20/35F)	71.9	72.7	72.6	57.2	no	yes	no	no	**no**
31	Tsui Ning	72.8	72.4	72.4	38.5	no	yes	no	no	**no**
	Garden Bk 5	72.1	71.7	71.7	42.9	no	yes	no	no	**no**
	(1/20/35F)	71.0	71.2	71.2	47.8	no	yes	no	no	**no**
46	Hong King	76.5	77.5	77.4	57.1	no	yes	yes	no	**no**
	Garden Bk A	76.2	78.2	77.8	67.6	no	yes	yes	no	**no**
	& B	75.2	77.8	77.2	68.8	no	yes	yes	no	**no**
	(1/10/20F)									
47	Harvest	81.8	82.9	82.9	43.1	no	yes	yes	no	**no**
	Garden	79.3	80.6	80.6	53.2	no	yes	yes	no	**no**
	(1/10/20F)	77.3	78.8	78.8	55.8	no	yes	yes	no	**no**
48	Kam Fai	77.8	78.8	78.8	41.7	no	yes	yes	no	**no**
	Garden Bk 1, 2	77.6	79.0	79.0	50.9	no	yes	yes	no	**no**
	& 3 (1/10/16F)	76.9	78.2	78.2	51.4	no	yes	yes	no	**no**
49	Temple (1F)	76.4	77.9	77.9	46.4	no	yes	yes	no	**no**
50	Mrs Aw Boon	70.0	71.6	71.5	46.0	no	n/a	n/a	n/a	**yes (Type I)**
	Haw School	70.4	71.8	71.8	46.3	no	n/a	n/a	n/a	**yes (Type I)**
	(1/3/7F)	71.9	72.9	72.9	49.8	no	n/a	n/a	n/a	**yes (Type I)**
51	Chun Yu	71.1	72.3	72.2	38.3	no	yes	yes	no	**no**
	House (Sham	71.8	72.6	72.6	42.1	no	yes	yes	no	**no**
	Shing Estate)	71.3	72.7	72.7	43.8	no	yes	yes	no	**no**
	(1/10/25F)									

NSR		Prevailing Noise Levels	2011 Predicted Noise Levels Total	Predicted Noise Levels 'Unaltered Rd'	Predicted Noise Levels 'New Road'	Meet HKPSG Criterion	> Noise Insulation Criterion i	Noise Insulation Criterion ii (> prevailing +1)	Noise Insulation Criterion iii (> unaltered +1)	Eligible for insulation [1](Window Types)
52	Lau Ng Ying	67.7	69.0	69.0	37.6	no	n/a	n/a	n/a	yes (Type I)
	Primary School	67.8	69.1	69.1	37.8	no	n/a	n/a	n/a	yes (Type I)
	(1/3/7F)	69.0	70.2	70.2	40.2	no	n/a	n/a	n/a	yes (Type I)
53	Hang Fok	79.0	80.3	80.3	43.7	no	yes	yes	no	no
	Garden Bk 1	77.4	78.6	78.6	47.8	no	yes	yes	no	no
	(1/10/30F)	74.0	75.3	75.2	51.3	no	yes	yes	no	no
54	Hang Fok	75.3	76.6	76.6	38.5	no	yes	yes	no	no
	Garden Bk 2	74.8	76.1	76.1	43.0	no	yes	yes	no	no
	(1/10/30F)	73.1	74.6	74.6	46.9	no	yes	yes	no	no
55	Siu Lun Court	74.2	74.8	74.8	36.9	no	yes	no	no	no
	Bk 1	72.5	72.7	72.7	37.6	no	yes	no	no	no
	(1/20/35F)	71.0	71.1	71.1	42.6	no	yes	no	no	no
56	Siu Lun Court	68.9	67.7	67.4	55.7	yes	no	no	no	no
	Bk 2	69.9	68.7	68.5	55.3	yes	no	no	no	no
	(1/20/35F)	69.4	69.6	69.4	54.7	yes	no	no	no	no

Note 1: Window Types for insulation as defined in HKPSG.
It should be noted that the actual window types required are subject to detailed studies.

Table 5.5g *Western Area: Predicted Noise Levels – WITH TMPD (Mitigation Option 4)*

NSR		Prevailing Noise Levels	Predicted Noise Levels Total	Predicted Noise Levels 'Unaltered Rd'	Predicted Noise Levels 'New Road'	Meet HKPSG Criteria	> Noise Insulation Criterion i	Noise Insulation Criterion ii (> prevailing +1)	Noise Insulation Criterion iii (> unaltered +1)	Eligible for insulation [1](Window Types)
32	St Simon's school (1/3F)	72.4 72.2	81.5 81.3	81.5 81.3	56.1 56.3	no no	n/a n/a	n/a n/a	n/a n/a	yes (Type II) yes (Type II)
34	Village House 1 (1F)	71.0	80.4	80.4	60.5	no	yes	yes	no	no
36	Yan Chai Hospital School (1/3F)	66.0 66.3	76.3 76.3	76.1 76.1	62.9 63.2	no no	yes yes	yes yes	no no	no no
37	Village House 2 (1F)	55.5	63.0	61.8	56.8	yes	no	yes	yes	no
38	Village House 3 (1F)	56.7	64.0	62.8	57.7	yes	no	yes	no	no
39	Girls' Hostel (1/F)	68.5	77.1	76.7	66.5	no	yes	yes	no	no
40	Morning Light School (1/3F)	67.5 67.8	72.8 73.1	71.9 72.1	65.8 66.5	no no	n/a n/a	n/a n/a	n/a n/a	yes (Type I) yes (Type I)
41	Monastery (1/3F)	57.1 59.7	64.9 67.0	63.3 65.5	59.7 61.8	yes yes	no no	no no	no no	no no
42	Boy's Hostel (1/3F)	62.3 62.8	69.7 70.2	67.0 67.6	66.5 66.8	yes yes	no no	yes yes	yes yes	no no
43	Sun Tuen Mun Centre Bk 5 & 6 (1/20/35F)	62.7 64.0 63.5	68.1 69.8 69.5	67.0 68.5 68.0	61.8 64.0 64.2	yes yes yes	no no no	yes yes yes	yes yes yes	no no no
44	Sun Tuen Mun Centre Bk 1 & 2 (1/20/35F)	62.3 65.5 63.9	68.6 71.4 70.0	67.4 70.8 69.2	62.2 62.7 62.6	yes no yes	no yes no	yes yes yes	yes no no	no no no
45	Boy's Hostel (1/3F)	56.7 58.0	67.2 67.9	64.3 65.1	64.1 64.6	yes yes	no no	yes yes	yes yes	no no

Note 1: Window Types for insulation as defined in HKPSG.
It should be noted that the actual window types required are subject to detailed studies.

Table 5.5h *Eastern Area; Predicted Noise Levels – WITHOUT TMPD (Mitigation Option 4)*

NSR		Prevailing Noise Levels	Predicted Noise Levels Total	Predicted Noise Levels 'Unaltered Rd'	Predicted Noise Levels 'New Road'	Meet HKPSG Criteria	> Noise Insulation Criterion i	Noise Insulation Criterion ii (> prevailing +1)	Noise Insulation Criterion iii (> unaltered +1)	Eligible for insulation [1](Window Types)
1	Oi Lin House	79.6	79.2	79.2	32.6	no	yes	no	no	no
	(1/10/20F)	77.6	77.1	77.1	33.8	no	yes	no	no	no
		75.4	75.4	75.4	43.3	no	yes	no	no	no
2	Oi Yee House	76.4	68.2	68.2	48.5	yes	no	no	no	no
	(1/10/20F)	77.5	69.4	69.3	52.9	yes	no	no	no	no
		73.8	71.1	71.1	53.5	no	yes	no	no	no
3	Oi Shun House	75.5	66.7	66.6	49.6	yes	no	no	no	no
	(1/10/20F)	74.4	75.9	75.9	53.4	no	yes	yes	no	no
		72.6	78.7	78.7	53.8	no	yes	yes	no	no
4	STFA Tam Pak	68.4	63.8	63.1	55.7	yes	n/a	n/a	n/a	no
	Yu College	68.8	65.0	64.3	56.2	yes	n/a	n/a	n/a	no
	(1/3/7F)	68.9	71.2	71.0	58.3	no	n/a	n/a	n/a	yes (Type I)
5	Oi Lok House	55.3	48.6	48.2	38.1	yes	no	no	no	no
	(1/10/25F)	59.1	61.7	61.2	51.7	yes	no	yes	no	no
		62.6	66.4	66.2	53.2	yes	no	yes	no	no
6	Oi Chi House	66.3	65.2	65.2	45.5	yes	no	no	no	no
	(1/10/25F)	66.3	65.6	65.5	49.8	yes	no	no	no	no
		66.5	66.7	66.5	52.1	yes	no	no	no	no
7	Oi Lai House	72.4	65.6	65.1	55.9	yes	no	no	no	no
	(1/10/25F)	72.5	73.8	73.7	56.9	no	yes	yes	no	no
		70.3	74.8	74.7	58.2	no	yes	yes	no	no
8	Ting Tak	77.7	77.0	77.0	38.0	no	yes	no	no	no
	House	76.6	75.8	75.8	38.2	no	yes	no	no	no
	(1/10/16F)	75.5	74.9	74.9	39.4	no	yes	no	no	no
8a	Ting Tak	71.6	68.4	68.4	50.4	yes	no	no	no	no
	House	72.4	70.8	70.5	59.2	no	yes	no	no	no
	(1/10/16F)	72.1	71.0	70.7	59.2	no	yes	no	no	no
9	STFA Wu Siu	71.5	70.0	69.8	56.9	no	n/a	n/a	n/a	yes (Type I)
	Kut School	72.0	70.3	70.3	58.2	no	n/a	n/a	n/a	yes (Type I)
	(1/3/7F)	70.2	72.5	72.2	61.5	no	n/a	n/a	n/a	yes (Type I)

NSR	Prevailing Noise Levels	Predicted Noise Levels Total	Predicted Noise Levels 'Unaltered Rd'	Predicted Noise Levels 'New Road'	Meet HKPSG Criteria	> Noise Insulation Criterion i	Noise Insulation Criterion ii (> prevailing +1)	Noise Insulation Criterion iii (> unaltered +1)	Eligible for insulation [1](Window Types)
10 LCK Lutheran	70.2	63.6	62.9	55.4	yes	n/a	n/a	n/a	no
School	71.5	65.3	64.6	57.1	yes	n/a	n/a	n/a	yes (Type I)
(1/3/7F)	74.1	73.4	72.9	63.8	no	n/a	n/a	n/a	yes (Type I)
11 Ting Hong	65.0	63.9	63.9	43.5	yes	no	no	no	no
House	67.5	68.8	68.6	53.0	yes	no	no	no	no
(1/10/25F)	69.3	71.0	70.7	60.4	no	yes	yes	no	no
12 Ting Fuk	67.2	65.2	65.0	50.5	yes	no	no	no	no
House	71.4	72.4	72.0	61.3	no	yes	yes	no	no
(1/10/25F)	71.7	73.7	72.8	66.6	no	yes	yes	no	no
13 STFA LKK	76.7	83.7	83.7	46.0	no	n/a	n/a	n/a	yes (Type II)
College/LCK	76.8	83.6	83.6	46.6	no	n/a	n/a	n/a	yes (Type II)
College	76.1	82.6	82.6	48.5	no	n/a	n/a	n/a	yes (Type II)
(1/3/7F)									
14 Ting On House	68.5	74.6	74.6	41.1	no	yes	yes	no	no
(1/20/35F)	70.0	74.7	74.7	48.1	no	yes	yes	no	no
	69.5	74.3	74.3	50.0	no	yes	yes	no	no
15 Ting Hui	74.9	81.1	81.1	34.7	no	yes	yes	no	no
House	73.1	78.6	78.6	48.4	no	yes	yes	no	no
(1/20/35F)	71.4	76.6	76.6	49.4	no	yes	yes	no	no
16 Tuen King	76.3	82.7	82.7	46.5	no	yes	yes	no	no
Building	75.2	81.3	81.3	49.2	no	yes	yes	no	no
(1/10/30F)	72.2	77.9	77.8	52.3	no	yes	yes	no	no
17 Lai Po Building	76.6	82.5	82.5	49.2	no	yes	yes	no	no
(1/10/30F)	75.5	81.1	81.1	52.6	no	yes	yes	no	no
	72.8	77.8	77.7	56.3	no	yes	yes	no	no
18 Chi Lok Fa	74.0	80.6	80.6	35.1	no	yes	yes	no	no
Yuen Bk3	73.0	79.3	79.3	38.9	no	yes	yes	no	no
(1/10/16F)	72.1	78.1	78.1	48.4	no	yes	yes	no	no
19 Chi Lok Fa	73.3	76.6	76.6	52.0	no	yes	yes	no	no
Yuen Bk 4	72.8	76.6	76.6	56.7	no	yes	yes	no	no
(1/10/16F)	72.3	75.9	75.8	58.4	no	yes	yes	no	no
20 Chi Lok Fa	73.7	76.3	76.3	54.5	no	yes	yes	no	no
Yuen Bk 5	73.3	76.5	76.4	59.8	no	yes	yes	no	no
(1/10/16F)	72.8	75.8	75.7	61.4	no	yes	yes	no	no

NSR	Prevailing Noise Levels	Predicted Noise Levels Total	Predicted Noise Levels 'Unaltered Rd'	Predicted Noise Levels 'New Road'	Meet HKPSG Criteria	> Noise Insulation Criterion i	Noise Insulation Criterion ii (> prevailing +1)	Noise Insulation Criterion iii (> unaltered +1)	Eligible for insulation [1](Window Types)
22 Ho Sik Lam	67.0	70.0	69.8	56.8	no	n/a	n/a	n/a	yes (Type I)
Primary School	67.4	70.6	70.4	58.0	no	n/a	n/a	n/a	yes (Type I)
(1/3/7F)	68.4	71.7	71.5	58.9	no	n/a	n/a	n/a	yes (Type I)
25 Goodview	66.9	59.6	59.2	49.5	yes	no	no	no	no
Garden Bk 2	67.8	68.3	67.9	57.9	yes	no	no	no	no
(1/20/35F)	67.5	70.2	69.9	58.9	yes	no	yes	no	no
26 Goodview	70.4	63.0	62.9	48.6	yes	no	no	no	no
Garden Bk 1	70.0	69.8	68.7	57.4	yes	no	no	no	no
(1/20/35F)	69.2	72.6	72.4	58.5	no	yes	yes	no	no
27 Goodview	64.9	56.8	56.8	32.5	yes	no	no	no	no
Garden Bk 3	64.5	56.6	56.6	32.9	yes	no	no	no	no
(1/20/35F)	63.9	58.1	57.9	44.5	yes	no	no	no	no
28 Tsui Ning	66.4	55.5	55.2	43.9	yes	no	no	no	no
Garden Bk 2	66.0	62.9	62.5	52.6	yes	no	no	no	no
(1/20/35F)	65.4	65.6	65.3	59.3	yes	no	no	no	no
29 Tsui Ning	72.2	65.6	65.4	51.9	yes	no	no	no	no
Garden Bk 1	71.4	68.3	68.0	56.6	yes	no	no	no	no
(1/20/35F)	70.3	70.3	70.1	57.5	yes	no	no	no	no
30 Tsui Ning	73.6	69.8	69.8	51.0	yes	no	no	no	no
Garden Bk 6	72.9	70.5	70.3	55.3	no	yes	no	no	no
(1/20/35F)	71.9	71.8	71.7	56.5	no	yes	no	no	no
31 Tsui Ning	72.8	71.0	71.0	40.3	no	yes	no	no	no
Garden Bk 5	72.1	70.3	70.3	44.7	yes	no	no	no	no
(1/20/35F)	71.0	70.0	70.0	48.8	yes	no	no	no	no
46 Hong King	76.5	78.9	78.8	59.4	no	yes	yes	no	no
Garden Bk A &	76.2	79.2	78.9	67.5	no	yes	yes	no	no
B (1/10/20F)	75.2	79.2	78.1	72.8	no	yes	yes	no	no
47 Harvest	81.8	80.4	80.4	44.9	no	yes	no	no	no
Garden	79.3	78.9	78.8	55.7	no	yes	no	no	no
(1/10/20F)	77.3	77.8	77.7	56.9	no	yes	no	no	no
48 Kam Fai	77.8	80.9	80.9	44.2	no	yes	yes	no	no
Garden Bk 1, 2	77.6	80.6	80.6	48.2	no	yes	yes	no	no
& 3 (1/10/16F)	76.9	79.8	79.8	48.3	no	yes	yes	no	no

NSR		Prevailing Noise Levels	Predicted Noise Levels Total	Predicted Noise Levels 'Unaltered Rd'	Predicted Noise Levels 'New Road'	Meet HKPSG Criteria	> Noise Insulation Criterion i	Noise Insulation Criterion ii (> prevailing +1)	Noise Insulation Criterion iii (> unaltered +1)	Eligible for insulation [1](Window Types)
49	Temple (1F)	76.4	77.0	77.0	47.4	no	yes	no	no	no
50	Mrs Aw Boon Haw School	70.0	73.3	73.3	47.9	no	n/a	n/a	n/a	yes (Type I)
		70.4	73.4	73.4	48.1	no	n/a	n/a	n/a	yes (Type I)
	(1/3/7F)	71.9	74.0	74.0	51.5	no	n/a	n/a	n/a	yes (Type I)
51	Chun Yu House (Sham Shing Estate)	71.1	71.5	71.5	40.3	no	yes	no	no	no
		71.8	71.8	71.7	44.4	no	yes	no	no	no
	(1/10/25F)	71.3	72.1	72.1	45.4	no	yes	no	no	no
52	Lau Ng Ying School	67.7	68.5	68.5	39.5	no	n/a	n/a	n/a	yes (Type I)
		67.8	68.6	68.6	39.6	no	n/a	n/a	n/a	yes (Type I)
	(1/3/7F)	69.0	70.4	70.4	42.5	no	n/a	n/a	n/a	yes (Type I)
53	Hang Fok Garden Bk 1	79.0	77.0	77.0	43.6	no	yes	no	no	no
		77.4	75.5	75.4	47.3	no	yes	no	no	no
	(1/10/30F)	74.0	72.3	72.3	49.6	no	yes	no	no	no
54	Hang Fok Garden Bk 2	75.3	73.7	73.7	41.2	no	yes	no	no	no
		74.8	73.3	73.3	45.5	no	yes	no	no	no
	(1/10/30F)	73.1	72.4	72.4	47.6	no	yes	no	no	no
55	Siu Lun Court Bk 1	74.2	73.4	73.4	35.9	no	yes	no	no	no
		72.5	71.3	71.3	37.0	no	yes	no	no	no
	(1/20/35F)	71.0	69.7	69.7	42.0	yes	no	no	no	no
56	Siu Lun Court Bk 2	68.9	66.3	66.3	44.3	yes	no	no	no	no
		69.9	67.4	67.3	48.3	yes	no	no	no	no
	(1/20/35F)	69.4	68.3	68.3	50.8	yes	no	no	no	no

Note 1: Window Types for insulation as defined in HKPSG.
It should be noted that the actual window types required are subject to detailed studies.

Table 5.5i *Western Area: Predicted Noise Levels – WITHOUT TMPD (Mitigation Option 4)*

NSR	Prevailing Noise Levels	Predicted Noise Levels Total	Predicted Noise Levels 'Unaltered Rd'	Predicted Noise Levels 'New Road'	Meet HKPSG Criteria	> Noise Insulation Criterion i	Noise Insulation Criterion ii (> prevailing +1)	Noise Insulation Criterion iii (> unaltered +1)	Eligible for insulation [1](window types)
32 St Simon's	72.4	79.1	79.1	54.2	no	n/a	n/a	n/a	yes (Type II)
school (1/3F)	72.2	79.0	78.9	54.4	no	n/a	n/a	n/a	yes (Type II)
34 Village House 1 (1F)	71.0	78.1	78.0	59.6	no	yes	yes	no	no
36 Yan Chai	66.0	73.9	73.6	63.0	no	n/a	n/a	n/a	yes (Type I)
Hospital	66.3	74.0	73.6	63.3	no	n/a	n/a	n/a	yes (Type I)
School (1/3F)									
37 Village House 2 (1F)	55.5	61.5	60.1	55.7	yes	no	yes	no	no
38 Village House 3 (1F)	56.7	62.4	61.0	56.8	yes	no	yes	yes	no
39 Girls' Hostel (1/F)	68.5	76.0	75.7	64.4	no	yes	yes	no	no
40 Morning Light	67.5	71.0	70.6	60.4	no	n/a	n/a	n/a	yes (Type I)
School (1/3F)	67.8	71.3	70.8	61.7	no	n/a	n/a	n/a	yes (Type I)
41 Monastery	57.1	63.7	62.2	58.2	yes	no	yes	yes	no
(1/3F)	59.7	65.8	64.4	60.2	yes	no	yes	yes	no
42 Boy's Hostel	62.3	68.6	65.8	65.3	yes	no	yes	yes	no
(1/3F)	62.8	69.2	66.5	65.7	yes	no	yes	yes	no
43 Sun Tuen Mun	62.7	66.9	65.8	60.4	yes	no	yes	yes	no
Centre Bk 5 &	64.0	68.6	67.3	62.7	yes	no	yes	yes	no
6 (1/20/35F)	63.5	68.3	66.9	62.9	yes	no	yes	yes	no
44 Sun Tuen Mun	62.3	67.4	66.3	60.9	yes	no	yes	yes	no
Centre Bk 1 &	65.5	70.2	69.6	61.3	yes	no	yes	no	no
2 (1/20/35F)	63.9	68.8	68.0	61.2	yes	no	yes	no	no
45 Boy's Hostel	56.7	66.2	62.9	63.5	yes	no	yes	yes	no
(1/3F)	58.0	66.9	63.7	64.0	yes	no	yes	yes	no

Note 1: Window Types for insulation as defined in HKPSG.
It should be noted that the actual window types required are subject to detailed studies.

5.6 CONSTRAINTS TO THE MITIGATION OPTIONS AND VISUAL/LANDSCAPE CONSIDERATIONS

5.6.1 *Constraints*

The civil and engineering constraints described in *Section 2.6* have been examined during the development of the mitigation options, and it is considered that all the mitigation options are feasible subject to more detailed investigation at the detailed design stage. The conceptual design drawings of the barriers, cantilever barriers and enclosures are shown in *Figures 5.6a, 5.6b & 5.6c*. However particular attention has to be paid to the following:

Design

- Barriers should be supported by painted steel frames situated on top of parapets. (refer *Figure 5.6a*).

- The structural integrity of the barriers/enclosures should be designed such that they will not collapse in case of fire.

- Along the alignment of Wong Chu Road (refer *Figures 5.6b & 5.6c*) two enclosure sections not exceeding 230m each in length with approximately 10% of total road surface area opening along the enclosure will be provided. The enclosures will be separated by a 5m high cantilevered barrier placed within the 60m break. This arrangement is considered suitable for meeting fire fighting and emergency operation requirements in addition to the noise objectives and will further permit the passage of Dangerous Goods Vehicles (DGVs) as discussed in *Section 2.6*.

- Adequate clearance between the barrier/enclosure and the marginal strip are required to satisfy traffic requirements and maintain adequate line of sight. The estimated requirements in *Section 2.6* have been taken into account in the noise modelling of the barriers. It would appear the proposed bridge at the P1/P3 Interchange will need to be widened in order to maintain adequate line of sight distance along the inside radius.

- At this stage the minimum height of the enclosure will be approximately 7.6m which allows for the provision of overhead signage, if required, and for emergency recovery of vehicles. Where necessary the existing signs may require relocating outside of the enclosure, however these issues will be subject to further investigation at the detailed design stage.

Compatibility with Existing Structures

- HyD have advised that the erection of 3m high noise barriers on bridges should be structurally tolerable. Barriers higher than this are likely to require additional strengthening of bridge components and could well double the cost of the bridge structure itself. This would need to be verified at the detailed design stage.

- This report has considered 5m high barriers will be of a cantilever type for which beam strengthening is proposed (refer *Figure 5.6a*). It is to be noted however that alternative solutions including bridge propping may be equally appropriate and selection will be subject to detailed design.

- A design check has been carried out on the Wong Chu Road P3/D2 bridge indicating the additional loads brought about by connecting the enclosure to the bridge would result in excessive torsion and uplift. Measures to counteract these effects, including replacement with uplift bearings, have been considered, none of which appear feasible. It therefore appears that an independent supporting structure is required. A possible arrangement is given on *Figure 5.6d*.

- Where the elevated walkway crosses over Wong Chu Road, the barrier could be modified to accommodate this existing structure, subject to detailed design..

Traffic

- At various locations along Wong Chu Road, including the intermediate interchange with Hoi Wong Road, construction works will be necessary to erect noise barriers. These will need to be arranged to minimise the disruption to traffic along Wong Chu Road and the necessity for closure of a lane on even a temporary basis. Every endeavour should be made to maintain traffic movements at the Wong Chu Road/Lung Mun Road interchange during the construction stage. Obtaining agreement from the Transport Department will be necessary for any proposed lane closure required to accommodate temporary traffic arrangements. Equally important will be to ensure that the existing pedestrian routes over and under Wong Chu Road are kept open at all times as these form an important link between residents on either side of the road.

- The design of covers over Wong Chu Road should allow for construction over each carriageway (eastbound or westbound) to be carried out independently. This is essential to minimise the traffic impact during construction. The basic form of cover comprises structural members spanning the carriageway with plexiglass infill panels. In order to minimise the traffic and environmental impacts of installing these prefabricated members, structural members can be installed by means of short duration traffic lane diversions while the units are lifted into position and fixed. The vertical infill panels can be installed at any time without affecting traffic. The infill panels over the carriageway however can only be installed with traffic lane diversions.

  At the eastern end of Wong Chu Road, because of the road configuration it is not possible to provide for contraflow traffic and serious traffic congestion could result if traffic were diverted during day time peak periods. The closure of one or more slip roads would require careful planning and implementation so that motorists are adequately forewarned and so that alternative diversion routes are suitably signed.

  At the western end of Wong Chu Road, it is proposed that contraflow traffic is introduced on the unaffected carriageway and the infill panels installed. Temporary crossovers and cones would be required.

  For installation work during restricted hours (1900–0700 hours on Weekdays and all hours on Sundays and Public Holidays), the contractor will need to apply for and obtain a Construction Noise Permit with respect to the Noise Control Ordinance. However, as indicated in *Section 3.2.6*, it is unlikely that night time (2300–0700 hours) installation will be acceptable even with mitigation. Transport Department may also require

the contractor to carry out a traffic impact assessment which should follow Highways Department Guidance Note RD/GN/021, in order to demonstrate that all proposed traffic management measures during construction will be effective.

Land Matters

No private land will be required for the provision of the proposed mitigation structures and therefore, land resumption will not be necessary.

However, some of the supporting structures for the proposed enclosure on Wong Chu Road will encroach into the Light Rail Transit (LRT) Reserve and on Government land allocated to the Regional Council (RC) near Yau Oi Estate (see *Figure 5.6e*).

Initial consultation with KCRC and Regional Services Department (RSD) has been undertaken. The KCRC has provided general guidance and safety notes on the works to be carried out within LRT Reserve and the RSD has no specific comment except the general request that disturbance to the existing recreational facilities should be avoided as far as possible. Provided these bodies are consulted well ahead of commencement of construction works for the proposed enclosure at the detailed design stage and that adequate measures are implemented to minimize the possible disturbance to their facilities, no major land constraint is expected for implementation of the proposed noise mitigation measures.

The proposed Foothill By-pass to the west of Lung Mun Road lies within the present site boundary of the Tuen Mun Recreation and Sports Centre. However, it is understood that prior agreement has been made with RSD to hand over the piece of land for the Foothill By-pass.

Installation, Utilities and Right of Ways

The majority of the proposed mitigation structures can be provided on the bridge/retaining wall structure, where no conflict with the existing utilities networks and rights of way are expected.

Where conflicts between utilities and the piling/concrete wall supporting the noise barriers are encountered these may be resolved by either realigning the utilities or the barrier slightly or altering the spacing of the piles.

Such conflicts can only be identified during the construction stage when the exact locations of the utilities can be confirmed on site with respect to the detailed design.

For the proposed barrier/enclosure along Wong Chu Road, there is potential for conflict with existing stormwater drains, telephone ducts and an 11kV cable along/across the road. There is further potential for conflict along the elevated section over Tuen Mun Heung Sze Road between the supporting frame and the LRT reserve and fresh/salt watermains running beneath the road (refer *Figure 5.6f*). However, with the exception of the elevated length of road it is not considered that these issues will pose major design constraints and most will be capable of resolution as part of the detailed design process.

It will be necessary for the supporting structure to be designed in such a form/way that no conflicts with the utilities services and right of ways

occurs. Diversion of the utilities networks may be necessary where such conflicts are inevitable. In any circumstance, the servicing agencies, including Drainage Services Department, Water Supplies Department, Hong Kong Gas Co, China Light and Power Company, Hong Kong Telecom and Highways Department should be consulted to derive an acceptable solution.

A preliminary arrangement for the installation of enclosure on the elevated section which overcomes the constraints discussed above is given in *Figure 5.6d*. The supports of the enclosure are spaced at approximately 40m centres so as not to obstruct pedestrian access beneath the bridge and to minimise conflict with utilities, refer *Figures 5.6d & 5.6f*.

5.6.2 *Visual/Landscape Considerations*

Basically, the potential impact of the proposed structures on the existing visual context is generally proportional to the dimension of the structures. As such, it is considered that the potential visual impacts to be caused by the 3m barriers will be the least whilst that of 7.6m high enclosures will be greatest. However, with proper design techniques and landscape treatment, it is considered that the visual impact can be minimised for all proposed structures.

The design techniques involve manipulation of the design elements to achieve the objectives and principles as detailed in *Section 2.7*. Generally, the techniques can be grouped into the functional and aesthetic aspects. A brief account of the possible techniques which may be possible in this case is provided below.

Functional

- Durable material with minimum maintenance requirements and costs should be used;

- Construction of supporting structures should be avoided to minimize disturbance to the surrounding open space, pedestrian ways and facilities. For the proposed enclosure on Wong Chu Road, separate supporting structures are necessary. To minimize the disturbance, the number of supporting structures should be kept to the minimum, by adopting high-strength structures. As the maximum separation between the structures could be as far as 50 m, sufficient flexibility is allowed to erect the structures at locations with the least disturbance.

Aesthetic

- The proposed colour of the structures should take into account the chromatic `mood' of the local environment and the appearance, functions and overall design of the structures themselves. The proposed enclosure and barriers on Wong Chu Road and the adjoining slip roads are located in a setting of predominantly high-rise residential blocks, the majority of which are in public housing estates. Most of the high-rise buildings are characterized with relatively pale colours in simple standardized patterns and no single dominating visual feature is identified. To harmonize with the surrounding area, a low-key (eg. light blue or yellow colour) is recommended for the enclosure. The visual context of the proposed Foothill By-pass is dominated by the green backdrop formed by the Castle Peak and golf driving range at Tuen Mun Recreation and Sports

Centre. A predominantly green colour scheme for the proposed barriers would be suitable in this green backdrop.

- Transparent acrylic sheets such as "Plexiglass" can be used in the noise barriers to minimise the visual impact.

- Majority of the proposed mitigation structures on ground level could be screened or decorated with existing trees or additional plants. Subject to further study, possible locations for additional planting include the embankment for the proposed Foothill By-pass west of Lung Mun Road; and the embankments for Wong Chu Road adjoining slip roads from/to Tuen Mun Road (south of On Ting Estate) and from Hoi Wong Road (south of Yau Oi Estate).

Figure 5.6g shows a perspective sketch of the proposed enclosures and cantilever barrier on Wong Chu Road. Other possible design techniques could be considered in the detailed design process to enhance the appearance of the structures:

- A curved-roof enclosure can be adopted as opposed to the rectangular enclosure;

- The height of the proposed barrier can be manipulated to create a rhythm to break the repetition, for example, creating a wave-like rhythm on the top as opposed to a straight flat wall;

- Textures can be used to provide contrast and interest, to modify apparent proportions and to emphasize the different roles of structural components;

- Covers/opaque enclosure panels can be used to partially conceal the supporting structures; and

5.7 *FINANCIAL IMPLICATIONS*

In accordance with the Brief, the costs of the direct mitigation options have been estimated as follows (details of cost breakdowns are shown in *Annex D*):

- Mitigation Option 1: 9.8 million
- Mitigation Option 2: 117.4 million
- Mitigation Option 3: 144.7 million
- Mitigation Option 4: 185.3 million

It is to be noted that the above stated costs include for all preliminaries, consultants fees and resident site staff costs.

5.8 *CONCLUSION AND RECOMMENDATION*

The potential road traffic noise impacts associated with the Roadworks under the With and Without TMPD scenarios have been assessed for the worst case traffic flows in the year 2011. Exceedances of the HKPSG noise criteria at most of the identified NSRs are predicted. Four direct mitigation options have been developed including various combinations of low noise road surfacing, 3m and 5m roadside noise barriers, 5m roadside cantilever barriers

and full enclosures.

The proposed mitigation will generally reduce the traffic noise levels at NSRs, particularly along Wong Chu Road, lower than the existing levels. There are residual impacts at some of the NSRs that do not benefit due to engineering constraints to the extent of the mitigation. However the residual impacts will have insignificant contribution to the existing traffic noise levels, with less than 1 dB(A) increase.

From examining the constraints and visual/landscaping considerations presented in *Section 5.6*, it is considered that the proposed mitigation options appear to be all feasible and the potential problems could be resolved.

In line with the recommendation in the EDS, Mitigation Option 4, with two full enclosure sections, 5m cantilever barriers, 3m barriers and low noise road surfacing, is recommended as the best option as it demonstrates the best practicable means of directly mitigating the road noise at source providing the most benefit to residents in the Study Area, although it is the most costly option.

FIGURE 5.2a - LOCATIONS OF NSRs AND 'NEW' ROADS

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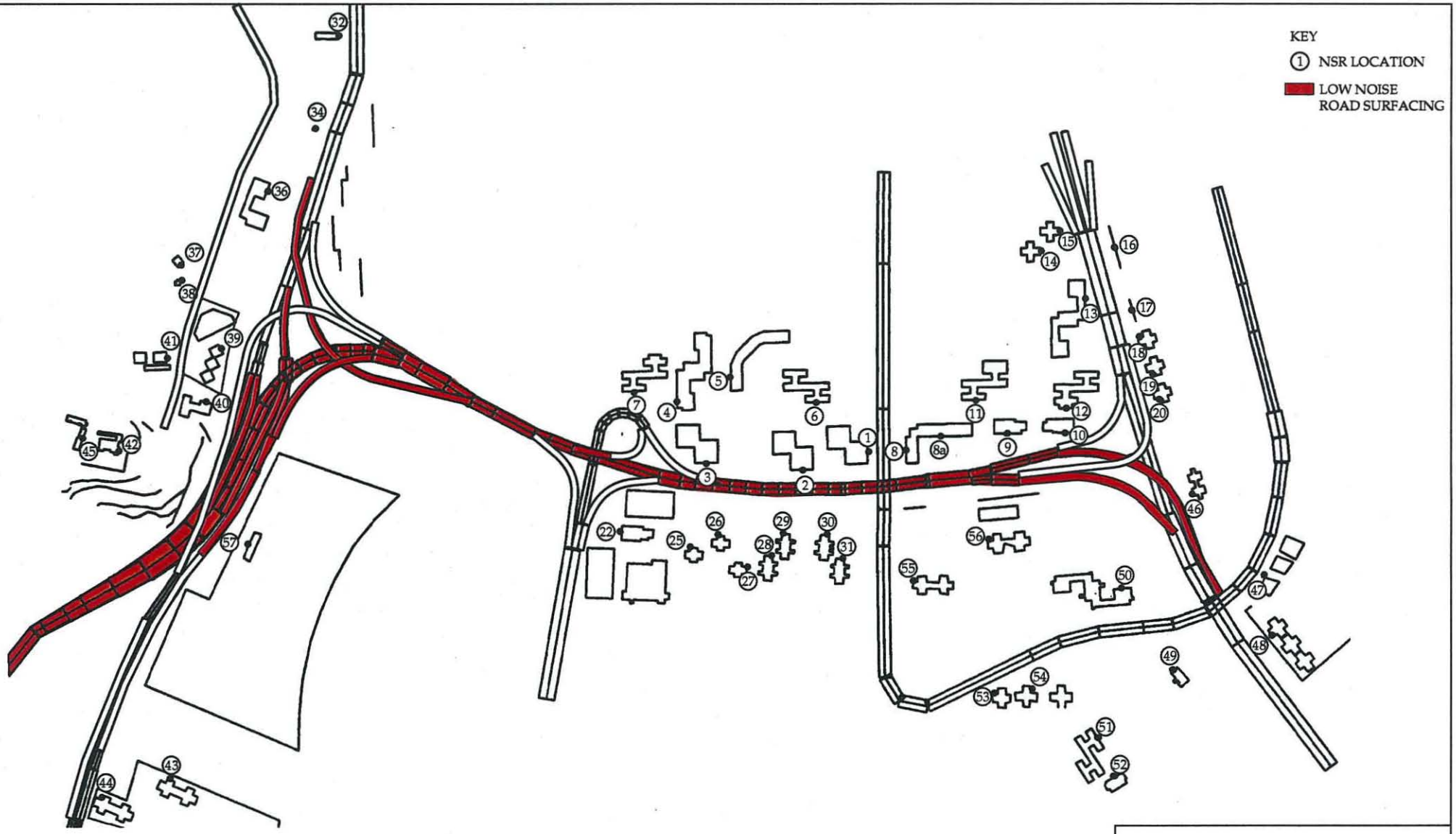

FIGURE 5.5a - EXTENT OF LOW NOISE ROAD SURFACING FOR MITIGATION 1

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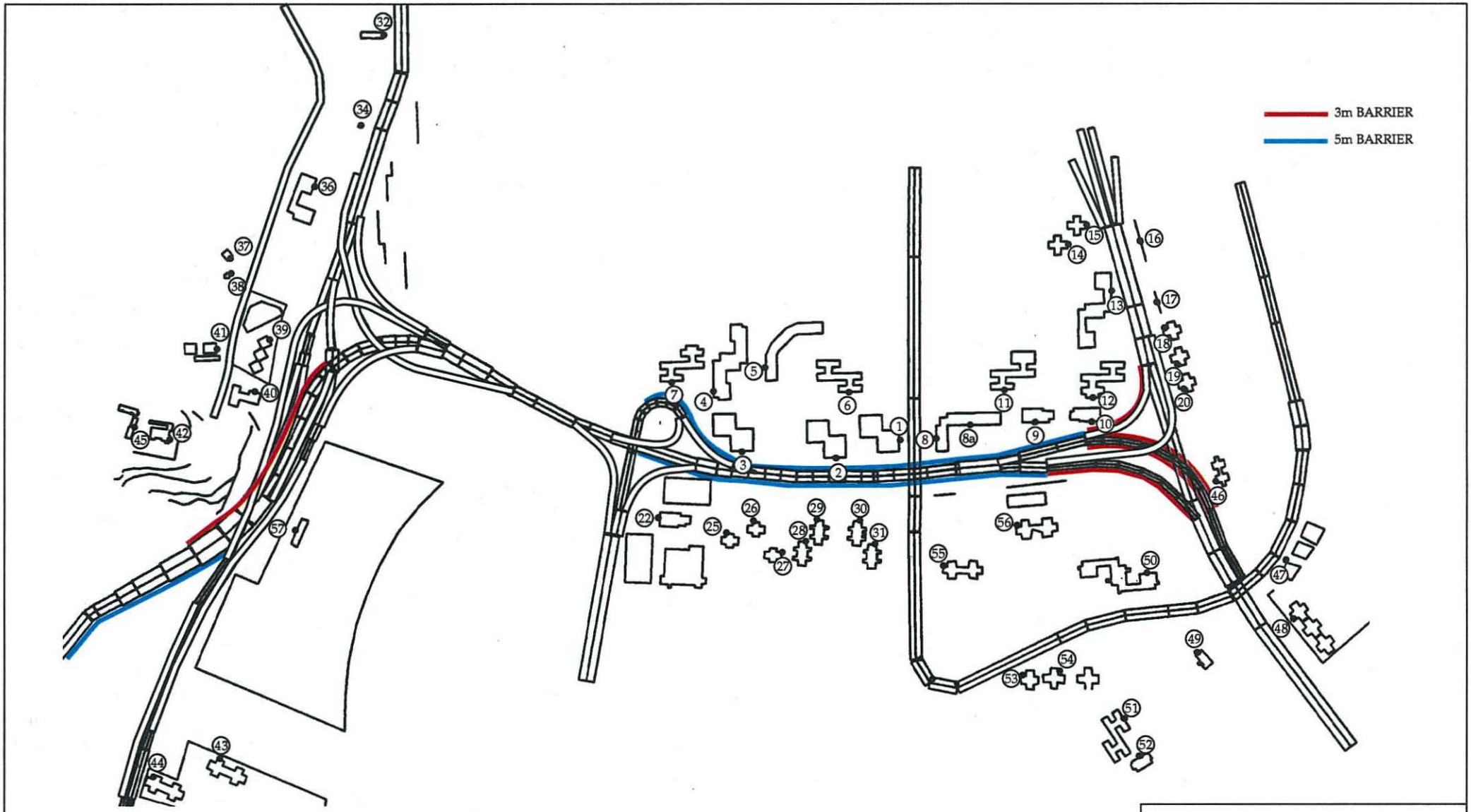

FIGURE 5.5b - BARRIERS LOCATION FOR MITIGATION OPTION 2

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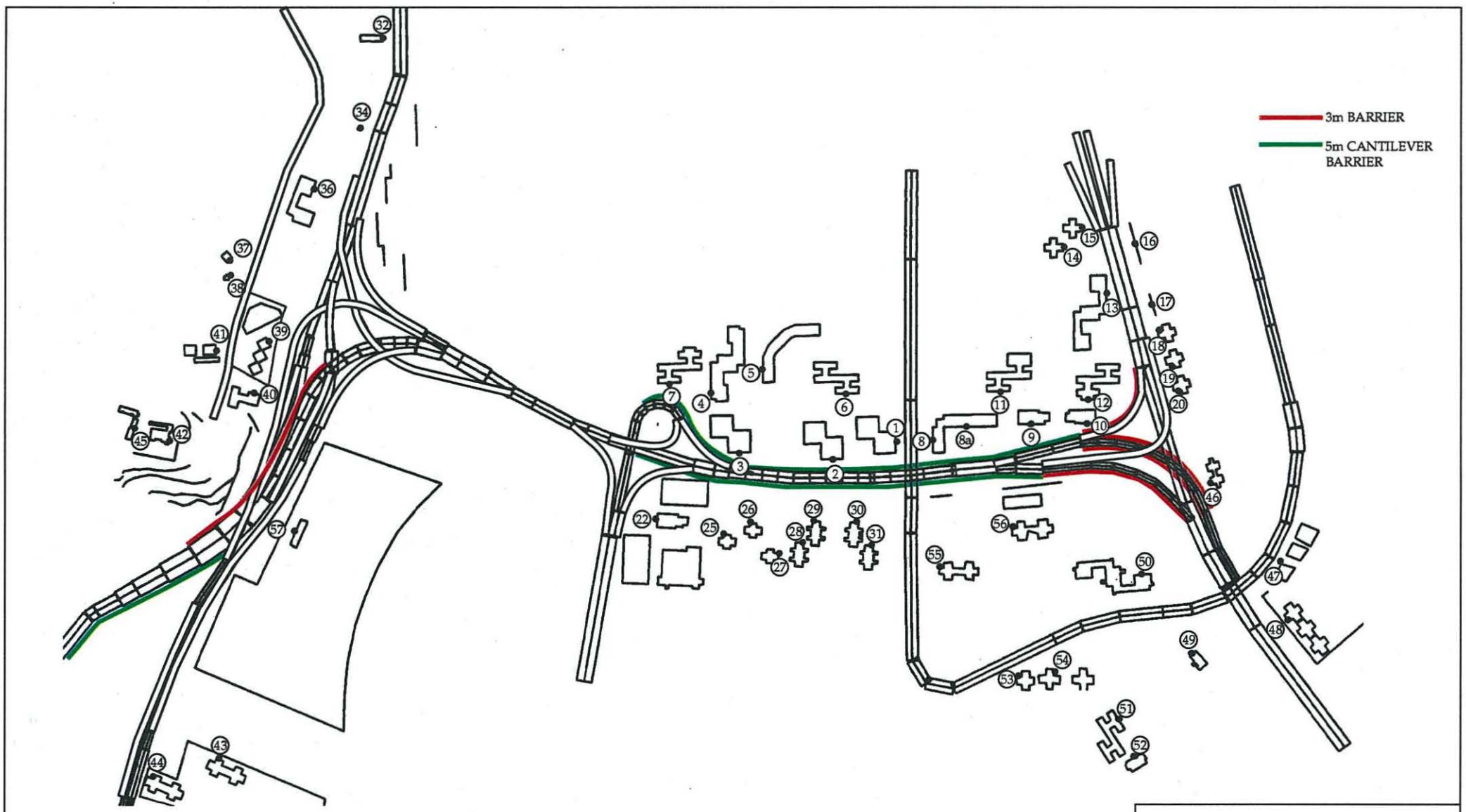

FIGURE 5.5c - BARRIERS LOCATION FOR MITIGATION OPTION 3

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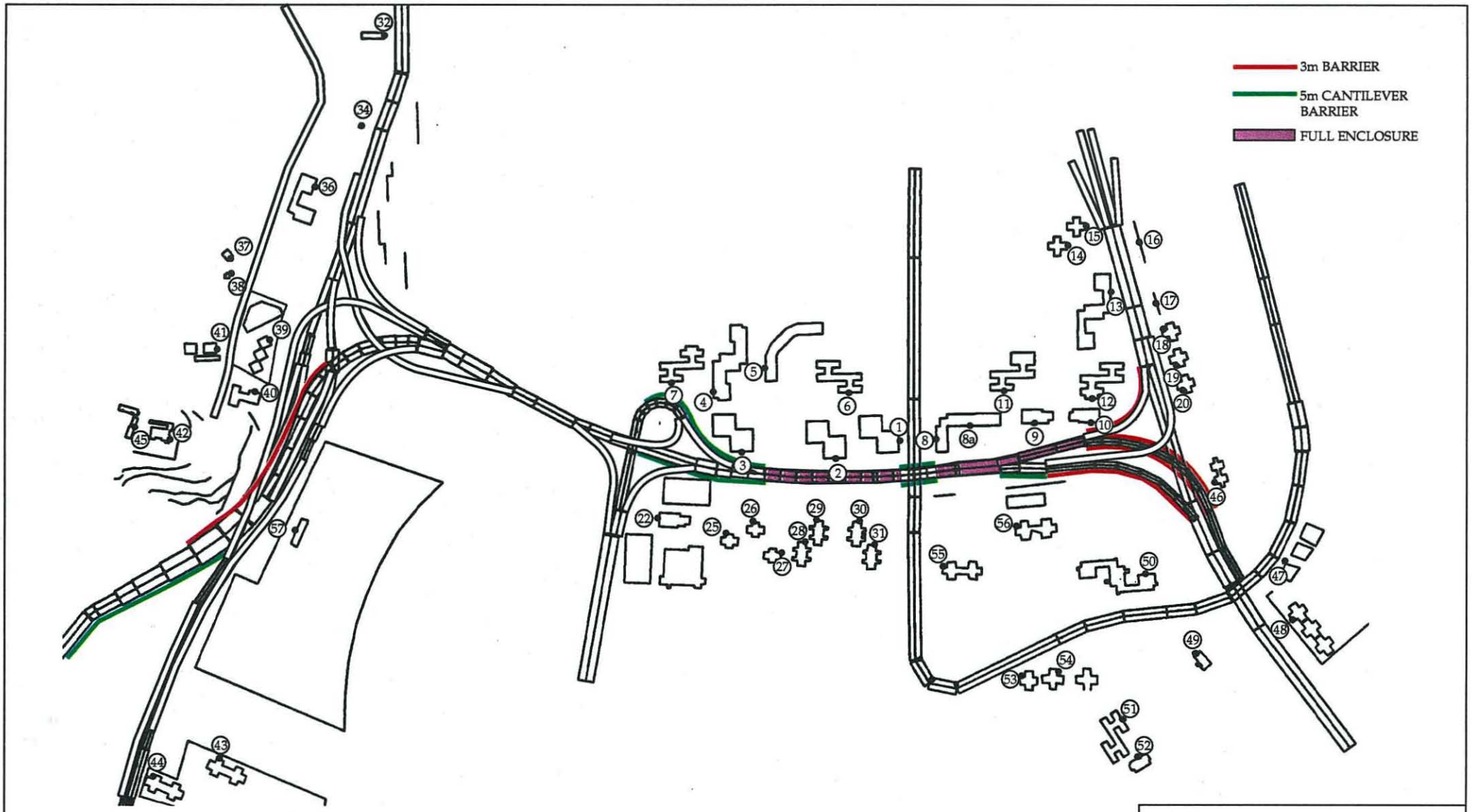

FIGURE 5.5d - BARRIERS AND ENCLOSURE LOCATION FOR MITIGATION OPTION 4

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Hong Kong

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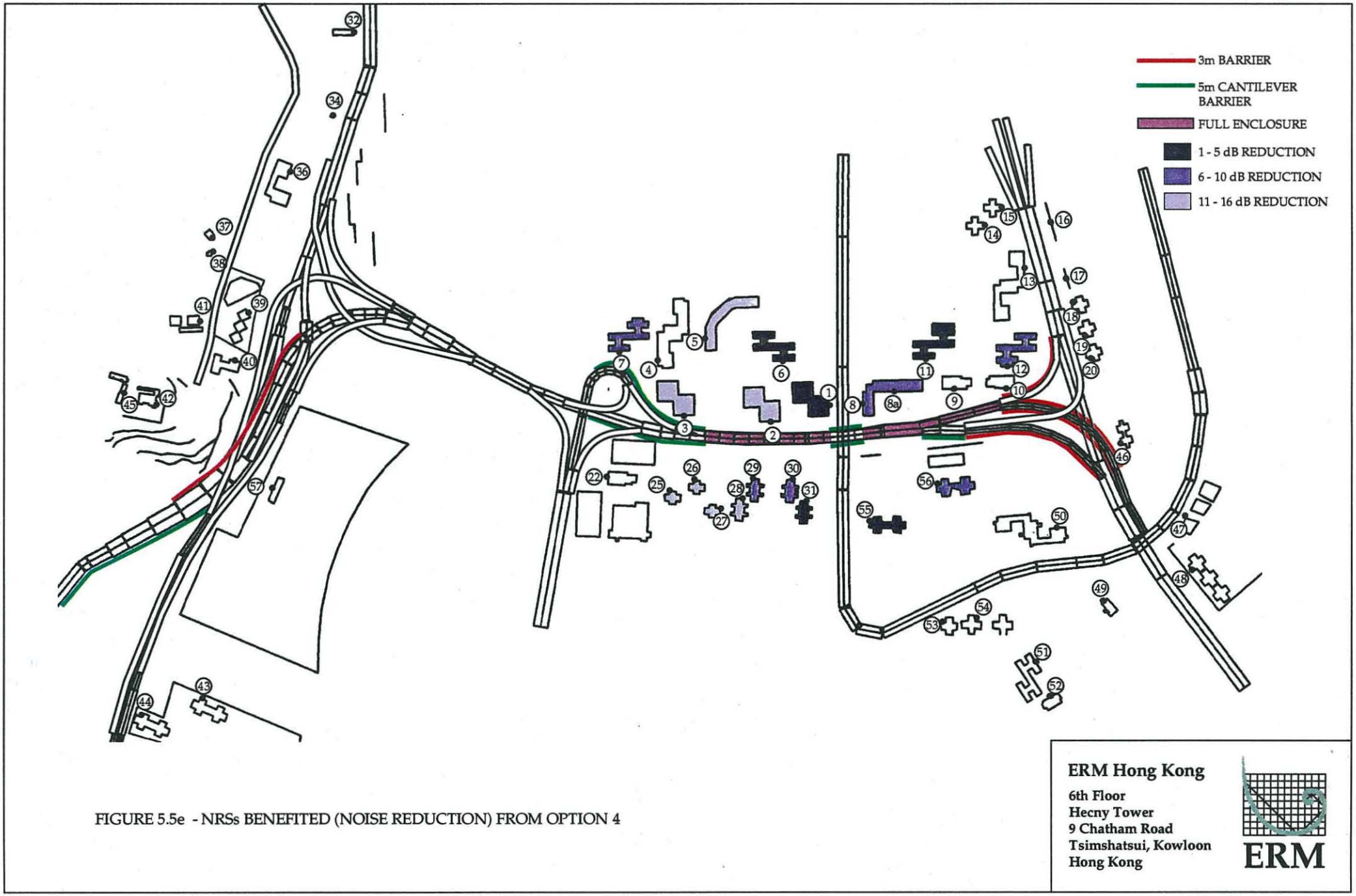
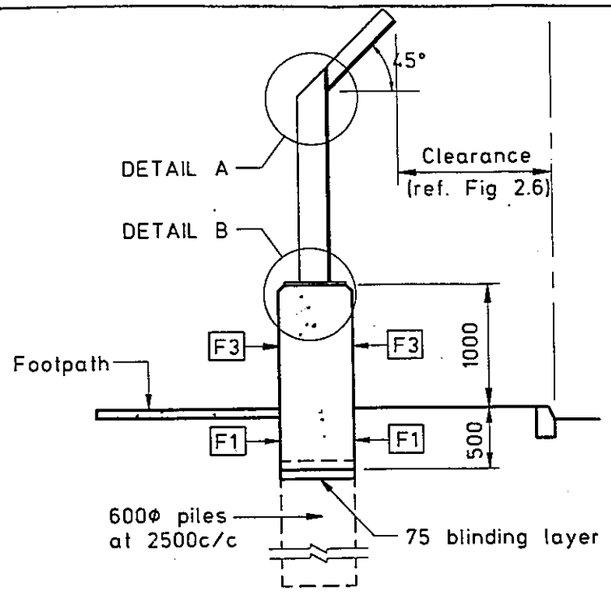
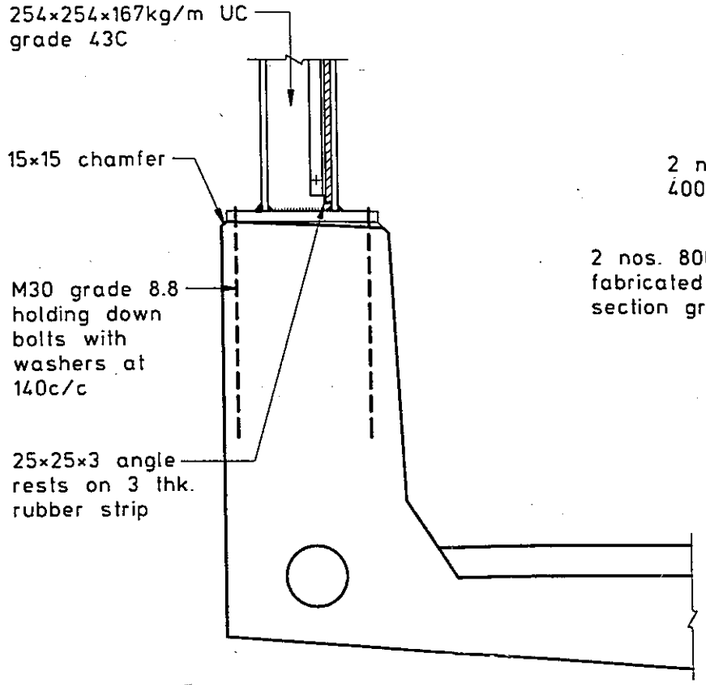


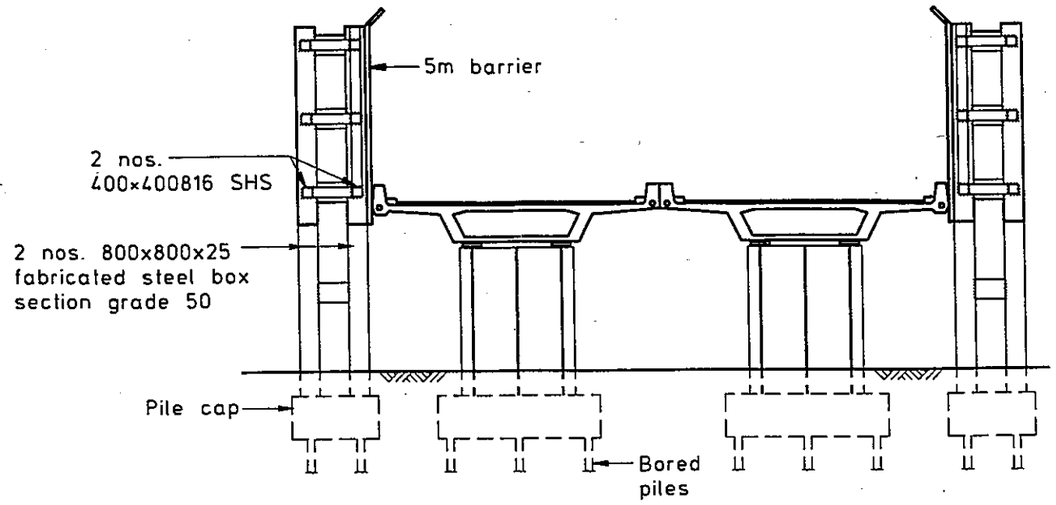
FIGURE 5.5e - NRSs BENEFITED (NOISE REDUCTION) FROM OPTION 4



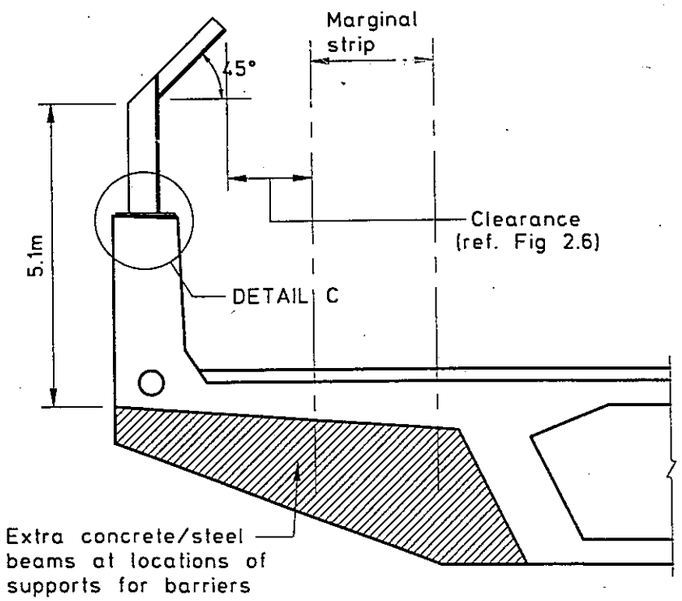
NOISE BARRIER ALONG ROADSIDE
1 : 50



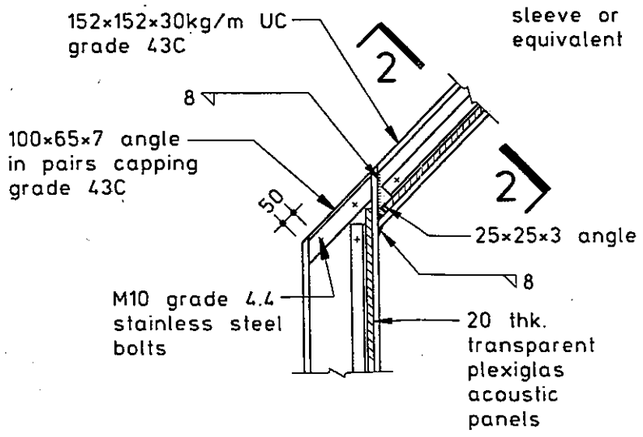
DETAIL C
1 : 20



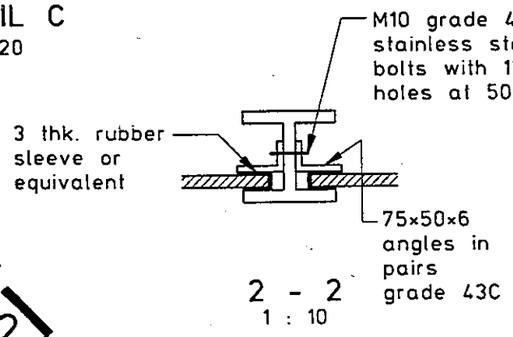
POSSIBLE OPTION FOR NOISE BARRIERS ON EXISTING STRUCTURES REQUIRING INDEPENDENT SUPPORT
(Refer Fig.5.6c for support details)
1 : 250



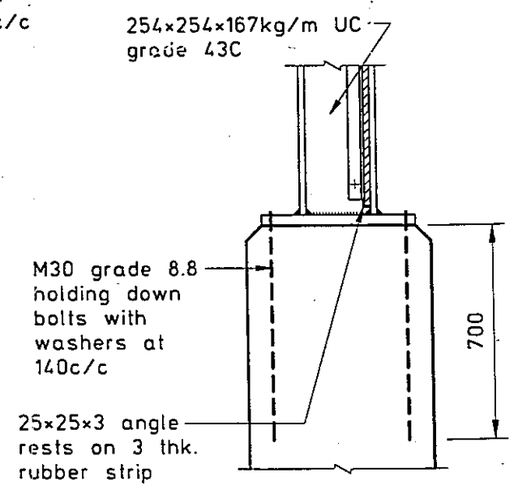
NOISE BARRIER ON PROPOSED ELEVATED STRUCTURES
1 : 50



DETAIL A
1 : 20



2 - 2
1 : 10



DETAIL B
1 : 20

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FIGURE 5.6a – BARRIERS/CANTILEVER BARRIERS CONCEPTUAL DESIGN DRAWING

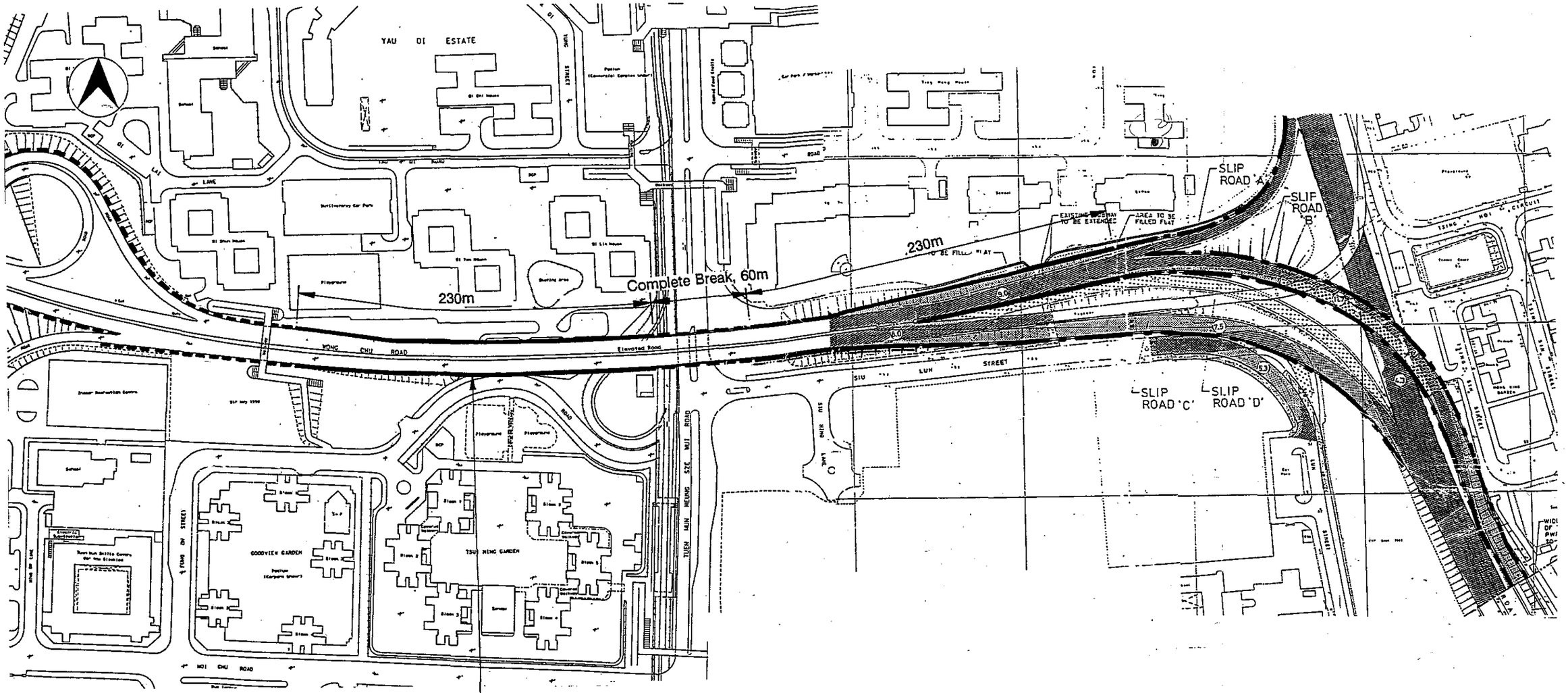

FIGURE 5.6b - NOISE ENCLOSURE ARRANGEMENT - WONG CHU ROAD

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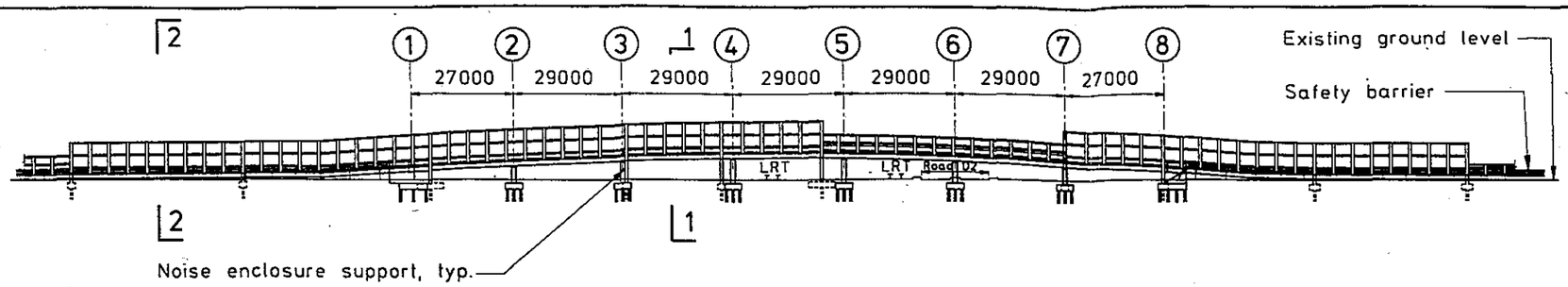
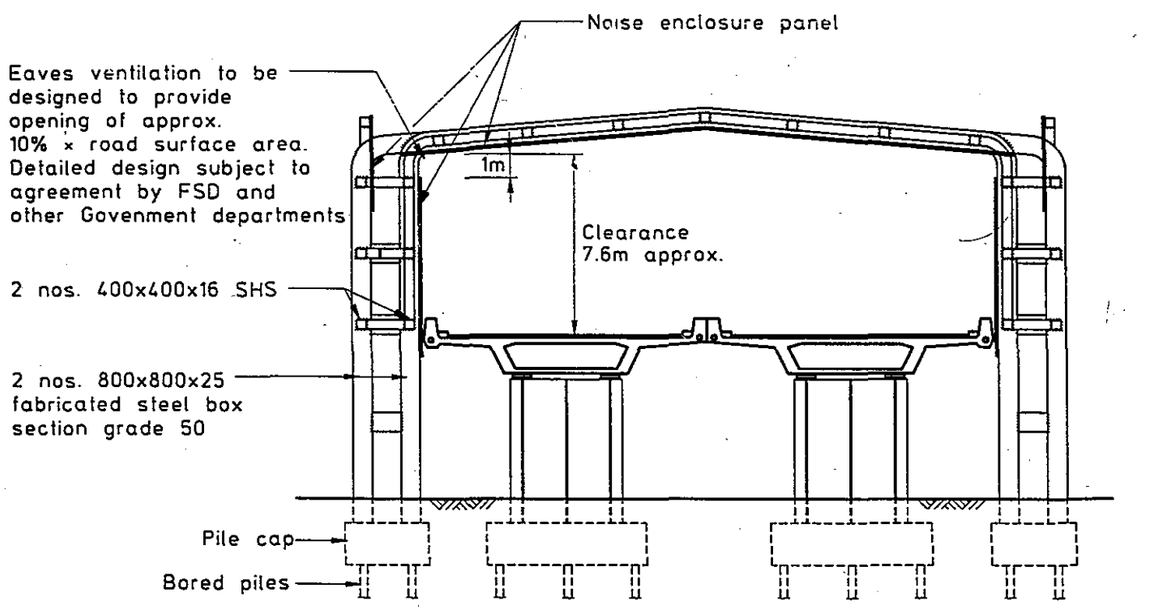
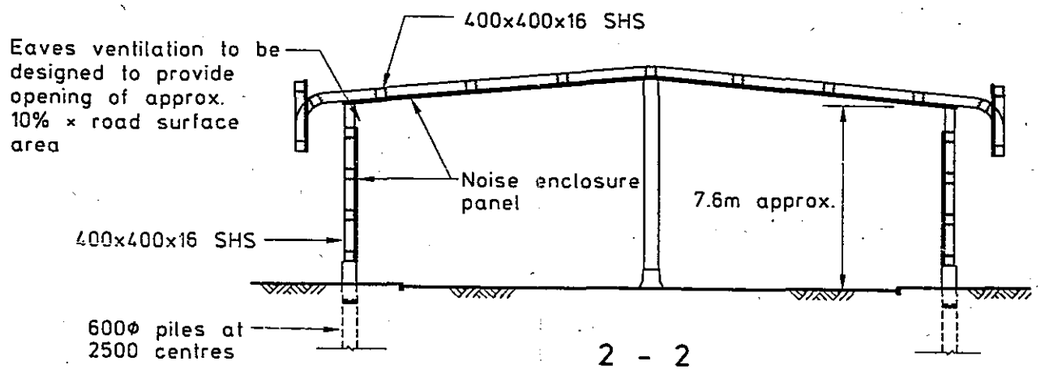


SOUTH ELEVATION OF NOISE BARRIERS
ALONG WONG CHU ROAD
1 : 1500



1 - 1
TYPICAL ARRANGEMENT OF NOISE ENCLOSURE SUPPORT
ON EXISTING ELEVATED STRUCTURE
1 : 250



2 - 2
TYPICAL SECTION OF NOISE ENCLOSURE SUPPORT
ALONG EXISTING CARRIAGEWAY
1 : 250

FIGURE 5.6c - PROPOSED NOISE ENCLOSURE DETAILS

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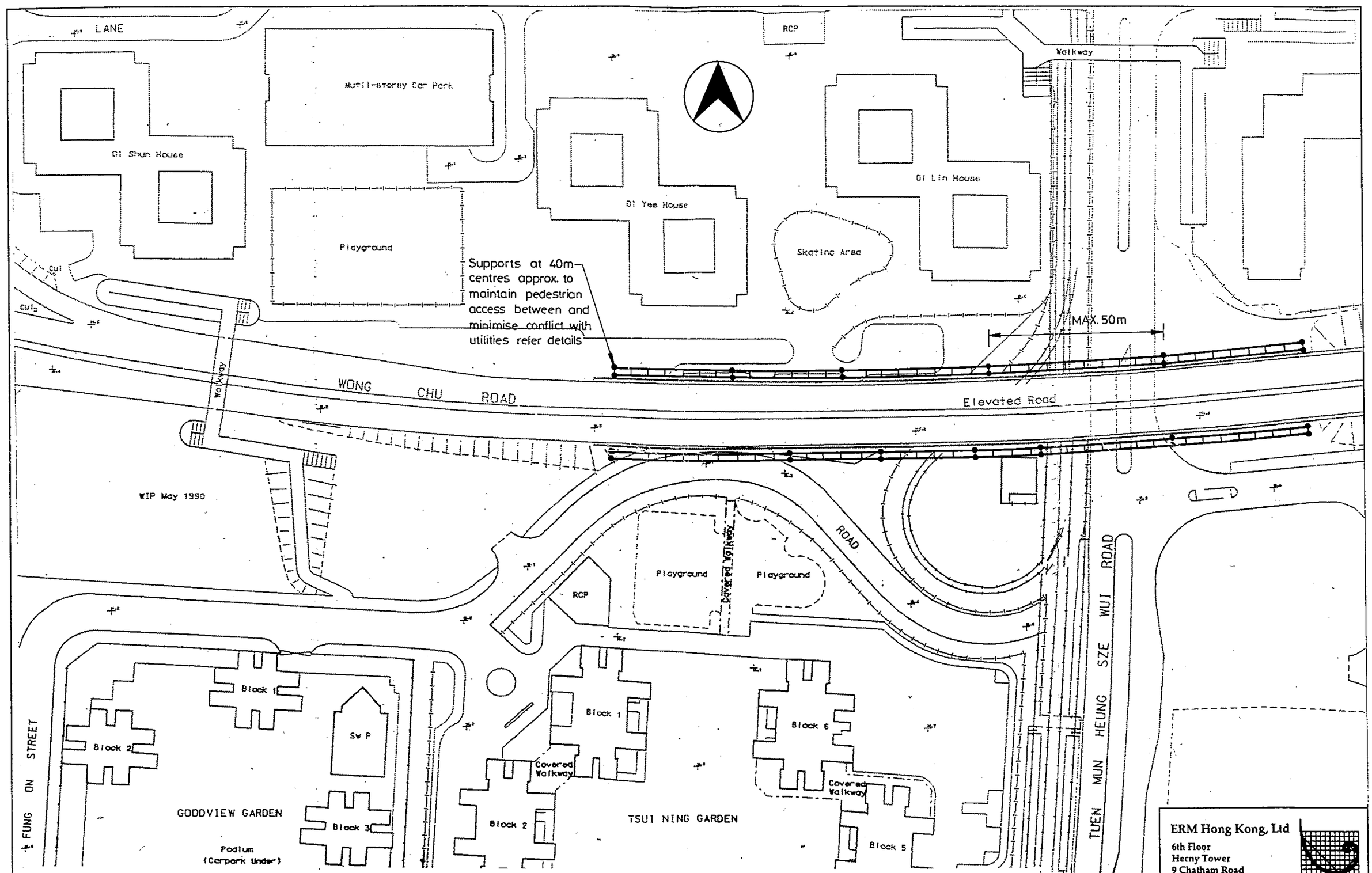

FIGURE 5.6d - LOCATION OF NOISE ENCLOSURE SUPPORTS ALONG ELEVATED SECTION OF WONG CHU ROAD

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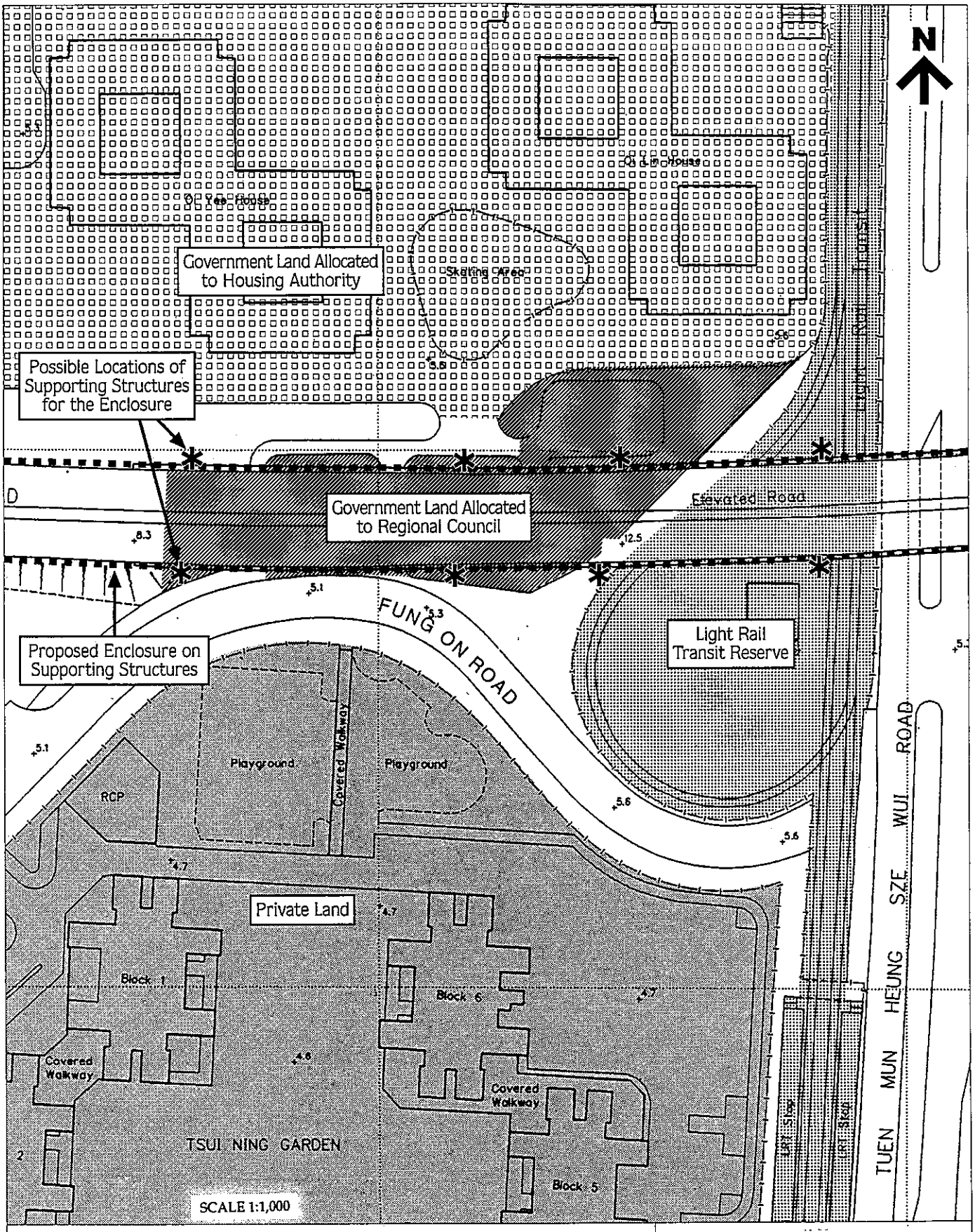

FIGURE 5.6e - LAND STATUS

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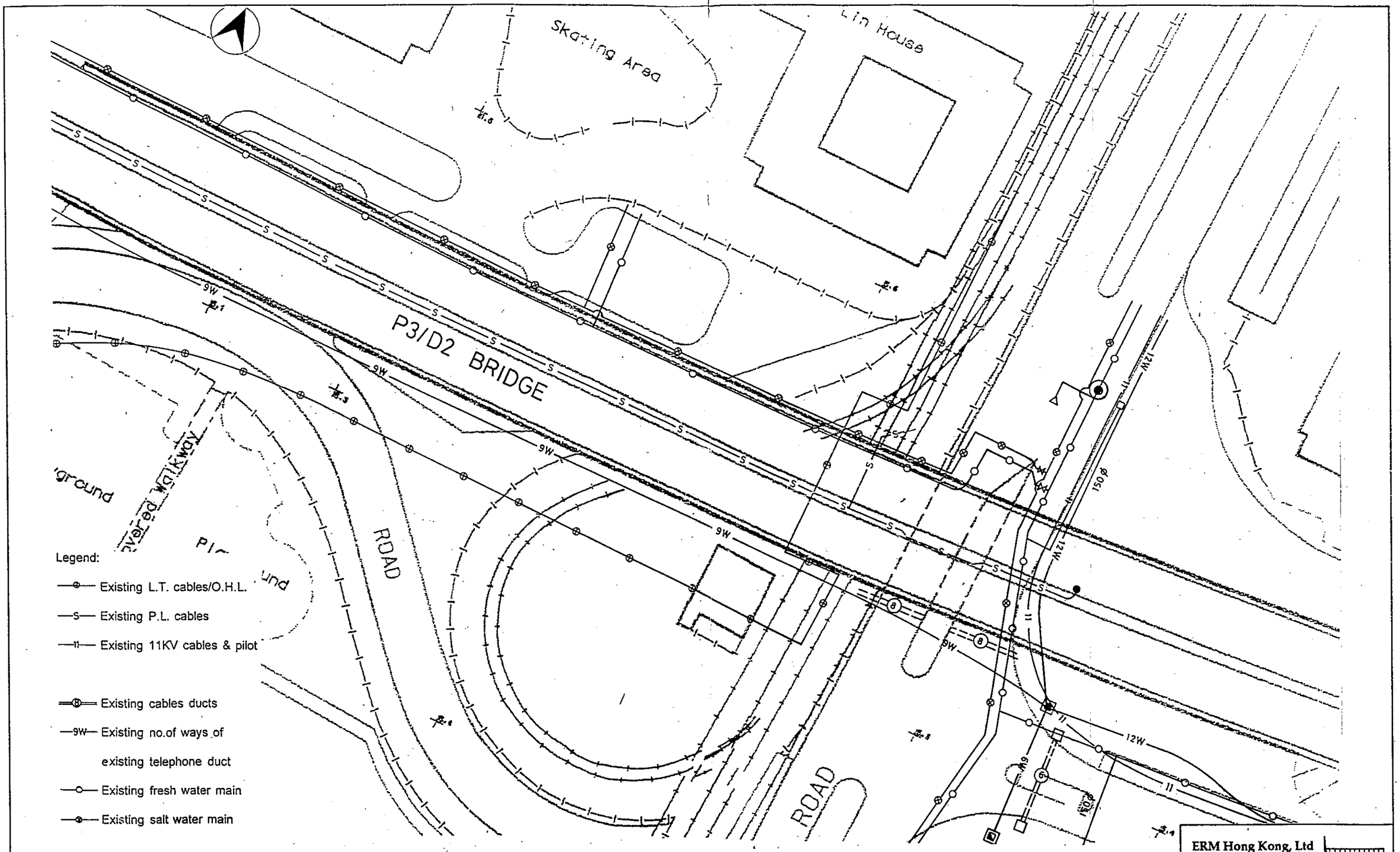

FIGURE 5.6f - UTILITIES IN THE VICINITY OF NOISE ENCLOSURE SUPPORTS - WONG CHU RD P3/D2 BRIDGE

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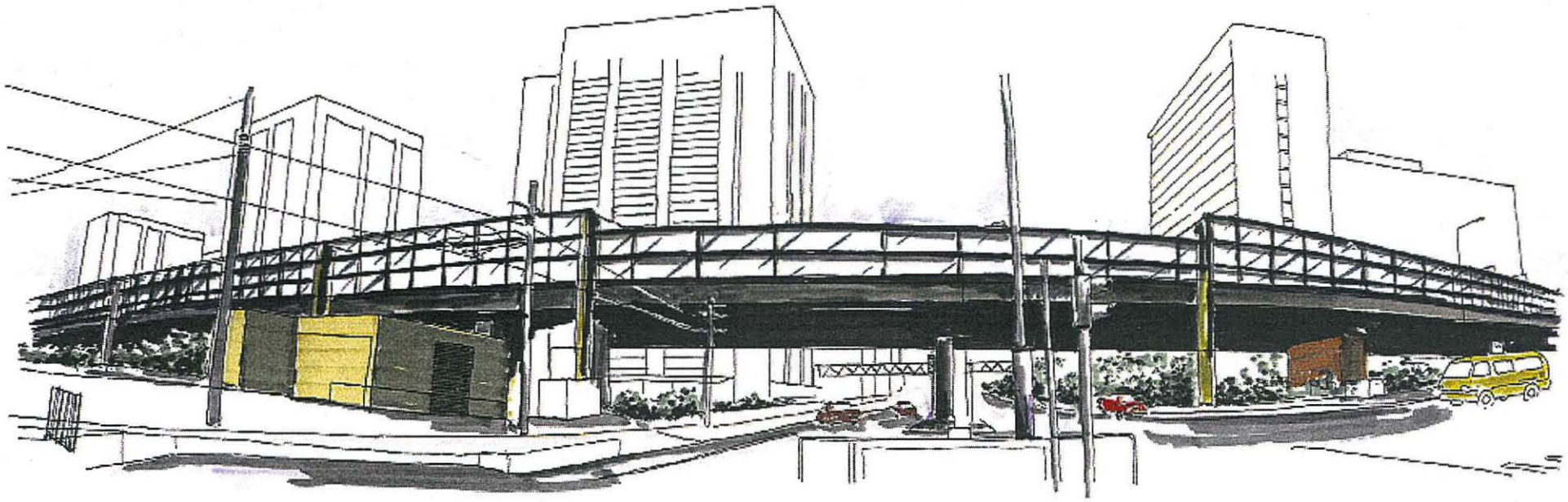

FIGURE 5.6g - A PERSPECTIVE SKETCH OF THE PROPOSED ENCLOSURES AND CANTILEVER BARRIER ON WONG CHU ROAD

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This EIA has assessed the potential environmental impacts associated with the construction and operation of the proposed Roadworks, both under the With and Without TMPD scenarios. The two scenarios are found to have similar impacts.

The construction works are expected to result in exceedance of the noise and dust environmental criteria at certain sensitive receivers. With the implementation of the recommended control measures, the impacts will be reduced to within the acceptable levels, checked by environmental monitoring and audit procedures detailed in the Environmental Schedule in *Annex C*. The Roadworks will not impinge on the concerned San Shek Wan Tsuen watercourse and good construction site practices are recommended to avoid impact on the watercourse and associated riparian habitats.

From the modelling of the potential traffic noise from the Roadworks and the associated traffic, exceedances of the HKPSG noise criteria are predicted at most of the NSRs. A combination of various direct mitigation measures at source has been generated, and their effectiveness, traffic and civil engineering, visual/landscape and cost implications examined. The proposed mitigation are all feasible and will generally reduce the traffic noise levels at NSRs, particularly along Wong Chu Road, up to 16 dB(A) lower than the existing levels. There are residual impacts at some of the NSRs that do not benefit due to engineering constraints to the extent of the mitigation and noise contributions from surrounding existing roads such as Tsing Wun Road and Tuen Mun Road. However the residual impacts from the 'new' roads will have insignificant contribution to the overall traffic noise levels, with less than 1 dB(A) increase. In line with the recommendation in the EDS, Mitigation Option 4 with full enclosures is recommended as the best option as it demonstrates the best practicable means of providing at-source mitigation and offering the most benefit to residents in the Study Area, although it is the most costly option.

The potential air quality impacts of the recommended full enclosures along Wong Chu Road have been assessed. Calculations show that, with the provision of natural ventilation through openings along the eaves of the enclosures, the air quality inside the enclosures will comply with the Tunnel Air Quality Guidelines. Modelling results indicate that the vehicular emission impacts from the open road sections and the two enclosure sections will comply with the AQO requirements at all ASRs. The worst impact would be at Oi Liu House and Oi Shun House where the NO_2 criteria will be approaching the AQO. However, the impact could be further mitigated by good engineering design at the detailed design stage.

Should there be any changes to the design parameters assumed in this EIA study at the following detailed design stage, the acoustic performance of the enclosures and the air quality impact may need to be reviewed in liaison with EPD.

Annex A

Alternative Tentative Construction Programme

ALTERNATIVE TENTATIVE CONSTRUCTION PROGRAMME- ROADS & JUNCTIONS IN TUEN MUN, AREA 38

	ACTIVITY	DURATION (MONTHS)	PLANT
1.0	P3/ D15 INTERCHANGE		
1.1	PRELIMINARIES	3	
1.2	DIVERT NW-BOUND TRAFFIC ON WONG CHU ROAD		
1.3	WIDEN NW-BOUND LANES ON WONG CHU RD.	2	DUMP TRUCKS (25 TRIPS/DAY), DOZER, ROLLER (VIBRATING DRUM), GRADER, MINI BACKHOE, DUMP TRUCK (5 TRIPS/DAY).
1.4	CONSTRUCT SLIP ROAD 'A' INCL. ELEVATED STRUCTURE, RET. WALL AND NORTH WEST ABUTMENT.	8	CRANE, DRILLING RIG, CONCRETE TRUCK (20 TRIPS/DAY) PLUS SEE 1.3
1.5	CONSTRUCT SLIP ROAD 'G', MARRYING INTO EXISTING RH FORK AND DEMOLISHING A PART OF THE LH FORK	2	GRADER, MINI BACKHOE, DUMP TRUCK (5 TRIPS/DAY) HOT MIX APPLICATOR, ROLLER, BACKHOE BREAKER
1.6	FOOTPATH & CYCLE TRACK	5	MINI BACKHOE, CONCRETE TRUCK (5 TRIPS/DAY)
1.7	DEMOLISH ROAD FORK AS SUITS	3	MINI BACKHOE, BACKHOE BREAKER, DUMP TRUCK (5 TRIPS/DAY)
1.8	CONSTRUCT SLIP ROAD 'B' &'C'	4	SEE 1.3
1.9	DIVERT SE-BOUND TRAFFIC ON WONG CHU ROAD		
1.10	CARRY OUT EMBANKMENT WORKS, INCL. SLIP ROAD 'H', BRIDGE, RET. WALL AND REPAVING	6	SEE 1.4
1.11	CONSTRUCT SLIP ROAD 'D'	2	PLANT LISTED UNDER 1.13
1.12	CONSTRUCT SLIP ROAD 'E'	5	PLANT LISTED UNDER 1.13
1.13	FOOTHILLS BYPASS		
1.13.1	PILING	8	CRANE, DRILING RIG
1.13.2	BYPASS SUPERSTRUCTURE	16	CONCRETE TRUCK (20 TRIPS/D), CONCRETE PUMP, TOWER CRANE
1.13.3	EMBANKMENT FOR NORTH SECTION OF FOOTHILLS BYPASS	14	'773' DUMP TRUCKS (125 TRIPS/D), DOZER, ROLLER (VIBRATING DRUM)
1.13.4	PAVING	24	GRADER, MINI BACKHOE, DUMP TRUCK (10 TRIPS/D), HOT MIX APPLICATOR
2.0	P1 / P3 INTERCHANGE		
2.1	PRELIMINARIES	6	
2.2	CONSTRUCT SLIP ROAD 'C'	5	MINI BACKHOE, CONCRETE TRUCK (5 TRIPS/D) DUMP TRUCKS (20 TRIPS/D), DOZER, ROLLER, GRADER,HOT MIX APPLICATOR
2.3	CONSTRUCT TEMPORARY BRIDGE	4	TOWER CRANE, TRUCK (5 TRIPS/D)
2.4	DEMOLISH EXISTING BRIDGE	5	CRANE, BREAKER(BACKHOE), TRUCK (5 TRIPS/D)
2.5	CONSTRUCT SLIP ROAD 'B' BRIDGE	26	DRILLING RIG,TOWER CRANE CONCRETE TRUCK (10 TRIPS/D) CONCRETE PUMP , CRANE
2.6	REMOVE TEMPORARY BRIDGE	2	TOWER CRANE, TRUCK (5 TRIPS/DAY)
2.7	RESURFACE WONG CHU ROAD	1	MINI BACKHOE, CONCRETE TRUCK (5 TRIPS D), DUMP TRUCKS (15 LOADS/D), DOZER, ROLLER, GRADER,HOT MIX APPLICATOR
2.8	RECONSTRUCT TUEN MUN ROAD	6	SEE 1.6

LEGEND

ACTIVITY DURATION

FLOAT

NOTES

1. PRECASTING WORK AREA MAY BE REQUIRED
2. NO SIGNIFICANT EXCAVATION REQUIRED
3. NO CONCRETE BATCHING PLANT , STOCKPILING OR BLASTING OPERATIONS
4. DUMP TRUCK , 16 TONNE CAPACITY, UNLESS INDICATED OTHERWISE

Annex B

Air Quality Modelling Emission Factors for TSP

Emission factors based on USEPA "*Compilation of Air Pollution Emission Factors (AP–42)*" were employed for input to the Fugitive Dust Model.

Average dust density of 2500 kg/m^3 was also assumed. Two classes of particulate size, 10 μm and 30 μm with percentage of 20% and 80% respectively, were assumed in the study where appropriate. Dump truck with 16 tonne capacity was also assumed in the study.

1.1 *BULLDOZING*

$$\textit{Emission Rate} : \frac{26\, s^{1.2}}{M^{1.3}} \textit{kg/hr}$$

where	s =	material silt content (%)	=	6.9
	M=	material moisture content (%)	=	7.9

1.2 *EXCAVATION*

$$\textit{Emission Rate} : 0.4\ \textit{g/Mg}$$

1.3 *MATERIAL HANDLING*

$$\textit{Emission Rate} : k(0.0016)\frac{(\frac{u}{2.2})^{1.3}}{(\frac{M}{2})^{1.4}} \textit{kg/Mg}$$

where	k =	particle size multiplier	=	0.74
	u =	mean speed wind (m/s)		
	M=	material moisture content (%)	=	0.7

Annex C

Environmental Schedule

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1 INTRODUCTION

1.1 BACKGROUND

ERM Hong Kong (ERM), in association with Scott Wilson Kirkpatrick and Townland Consultants Ltd, have been commissioned by the Hong Kong Government Highways Department (HyD) to undertake an Environmental Impact Assessment (EIA) (Phase I) for the improvement to roads and junctions within Tuen Mun in relation to the Reclamation and Servicing of Tuen Mun Area 38 for Special Industries Area (Agreement No. CE 36/94).

The road improvement works (hereafter referred to as the Roadworks) as shown in *Figure A* are required to overcome anticipated traffic problems on Lung Mun Road and Wong Chu Road, which provide the main access for traffic to and from Area 38, and at road junction D3/D11. The Roadworks also include a bypass along the foothills of Castle Peak, namely the Foothill Bypass Northern Section (hereafter referred to as the Foothill Bypass), to cope with the anticipated traffic on Lung Mun Road between Butterfly Estate and Wong Chu Road.

In accordance with the Brief, this document presents a stand alone Environmental Schedule to accompany the EIA report, to prescribe necessary environmental monitoring and audit (EM&A) requirements based on the findings of the EIA. The EIA identifies that construction noise and dust will lead to exceedance of environmental criteria and therefore EM&A at the affected sensitive receivers are recommended.

1.2 CONSTRUCTION DESCRIPTION

The construction works associated with the proposed Roadworks are summarised in the tentative construction programme in *Figure B*.

1.3 OBJECTIVES OF ENVIRONMENTAL MONITORING & AUDIT

This Environmental Schedule provides information, guidance and instruction to site staff who are in charge of environmental issues and are undertaking environmental monitoring works on the Roadworks. The objectives of carrying out an EM&A programme for the Roadworks 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

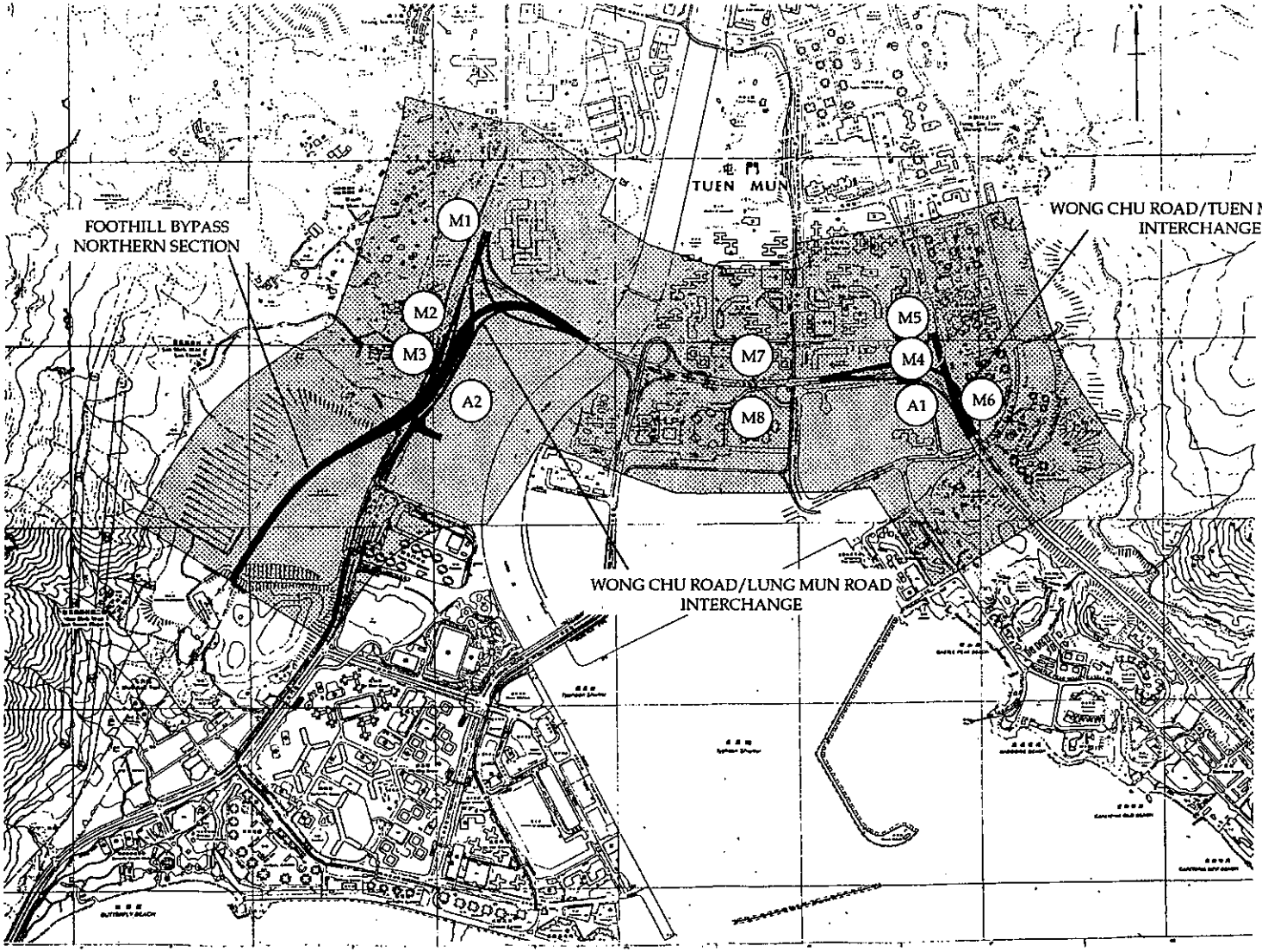

FIGURE A - STUDY AREA AND CONSTRUCTION NOISE & DUST MONITORING LOCATIONS

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	ACTIVITY	DURATION (MONTHS)	1997												1998												1999												2000												2001							PLANT
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	
1.0	P3/ D15 INTERCHANGE																																																								
1.1	PRELIMINARIES	3																																																					
1.2	DIVERT NW-BOUND TRAFFIC ON WONG CHU ROAD																																																						
1.3	WIDEN NW-BOUND LANES ON WONG CHU ROAD AND REPAVE	2																																																					DUMP TRUCKS (25 TRIPS/DAY), DOZER, ROLLER (VIBRATING DRUM), GRADER, MINI BACKHOE, DUMP TRUCK (5 TRIPS/DAY), HOT MIX APPLICATOR, ROLLER
1.4	CONSTRUCT TEMPORARY ON-RAMP ONTO EXISTING FORK (TO BE DEMOLISHED) AND RE-OPEN	2																																																				SEE 1.3
1.5	CONSTRUCT SLIP ROAD 'A' INCL. ELEVATED STRUCTURE, RET. WALL AND ABUTMENTS	8																																																				CRANE, DRILLING RIG, CONCRETE TRUCK (20 TRIPS/DAY) PLUS SEE 1.3
1.6	CONSTRUCT SLIP ROAD 'G', MARRYING INTO EXISTING RH FORK AND DEMOLISHING A PART OF THE LH FORK	2																																																				GRADER, MINI BACKHOE, DUMP TRUCK (5 TRIPS/DAY) HOT MIX APPLICATOR, ROLLER, BACKHOE BREAKER
1.7	FOOTPATH & CYCLE TRACK	5																																																				
1.8	REMOVE TEMPORARY ON-RAMP & DEMOLISH ROAD FORK AS SUITS	3																																																			MINI BACKHOE, CONCRETE TRUCK (5 TRIPS/DAY) MINI BACKHOE, BACKHOE BREAKER, DUMP TRUCK (5 TRIPS/DAY)
1.9	CONSTRUCT SLIP ROAD 'B'	4																																																			
1.10	DIVERT SE-BOUND TRAFFIC ON WONG CHU ROAD																																																					SEE 1.3
1.11	CARRY OUT EMBANKMENT WORKS, INCL. SLIP ROAD 'H', BRIDGE, RET. WALL AND REPAVING	6																																																				SEE 1.5
1.12	CONSTRUCT SLIP ROAD 'D'	2																																																			
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1.14.1	PILING	8																																																				
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1.14.3	EMBANKMENT FOR NORTH SECTION OF FOOTHILLS BYPASS	14																																																			CONCRETE TRUCK (20 TRIPS/D), CONCRETE PUMP, TOWER CRANE '773' DUMP TRUCKS (125 TRIPS/D), DOZER,
1.14.4	PAVING	24																																																			ROLLER (VIBRATING DRUM)
2.0	P1/ P3 INTERCHANGE																																																				GRADER, MINI BACKHOE, DUMP TRUCK (10 TRIPS/D), HOT MIX APPLICATOR
2.1	PRELIMINARIES	6																																																				
2.2	CONSTRUCT SLIP ROAD 'C'	5																																																			MINI BACKHOE, CONCRETE TRUCK (5 TRIPS/D) DUMP TRUCKS (20 TRIPS/D), DOZER, ROLLER, GRADER,HOT MIX APPLICATOR
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2.4	DEMOLISH EXISTING BRIDGE	5																																																		CRANE, BREAKER(BACKHOE), TRUCK (5 TRIPS/D)
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2.8	RECONSTRUCT TUEN MUN ROAD	6																																																		SEE 1.6

LEGEND

ACTIVITY DURATION

FLOAT

NOTES

1. PRECASTING WORK AREA MAY BE REQUIRED
2. NO SIGNIFICANT EXCAVATION REQUIRED
3. NO CONCRETE BATCHING PLANT , STOCKPILING OR BLASTING OPERATIONS
4. DUMP TRUCK , 16 TONNE CAPACITY, UNLESS INDICATED OTHERWISE

FIGURE B – TENTATIVE CONSTRUCTION PROGRAMME

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Annex D

Breakdown Costs for Noise Mitigation Options

Development of Unit Rates for Noise Mitigation Options

1	Low Noise Road Surface	Unit Rate ($HK)
	Additional Cost	
	Supply, lay and compact 10mm NS bituminous wearing course	53/m^2
	Supply, lay and compact 10mm NS modified friction course	77/m^2
	+ 15% for Preliminary & General Items	130/m^2
		19/m^2
		149/m^2

2	3m High Noise Barriers	
	"Plexiglass" screen	9,900/m
	R C Plinth	2,353/m
	Steelwork	5,481/m
		17,734/m
	+15% for Preliminary & General Items	2,660/m
		$20,394/m

3	5m High Cantilever Noise Barriers	
	"Plexiglass" screen	17,068/m
	R C Plinth	2,620/m
	Steelwork	9,869/m
		29,557/m
	+15% for Preliminary & General Items	4,433/m
		$33,990/m

4	Full Enclosures	
	Drainage in structures	265/m
	Excavation	558/m
	Piling	36,000/m
	Formwork	490/m
	Steel Reinforcement	1,815/m
	Concrete	867/m
	Structural Steel Frame	40,940/m
	"Plexiglass" sheet	50,800/m
	Electrical and Mechanical work, including lighting	3,000/m
	Ventilation system	550/m
		135,285/m
	+15% for Preliminary & General Items	20,293/m
		$155,578/m

5 Full Enclosures situated on existing bridge along Wong Chu Road (over Heung Sze Wui Road)

	Unit Rate (HK$)
Drainage in structures	265/m
Excavation	234/m
Piling	6,000/m
Formwork	205/m
Steel Reinforcement	897/m
Concrete	428/m
Structural Steel Supports	133,117/m
"Plexiglass" sheet	50,800/m
Electrical and Mechanical work, including lighting	3,000/m
Ventilation system	550/m
	195,496/m
+ 15 % for Preliminary & General Items, + 5% access mitigation	39,099/m
	$234,595/m

Lengths of Sections Used for Development of Costs

Option 2

3m Barriers	Length (m)
Foothills Bypass North bound including slip Road E	570
Hoi Wong Road/Wong Chu Road Roundabout	170
Wong Chu Road/Tuen Mun Road	
Slip Road A	125
Slip Road B	455
Slip Road C	310
	1,630m

5m Barriers	
Foothills Bypass South bound	600
Wong Chu Road, both sides	1,030
	1,630m

Option 3

3m Barriers	Length (m)
Foothills Bypass North bound including Slip Road E	570
Wong Chu Road/Tuen Mun Road	
Slip Road A	125
Slip Road B	455
Slip Road C	310
	1,460m

5m Barriers	
Foothills Bypass South bound	600
Hoi Wong Road/Wong Chu Road Roundabout	170
Wong Chu Road, both sides	1,670
	2,440

Option 4	Length
3m Barriers	
Foothills Bypass North bound, including Slip Road E	
Wong Chu Road/Tuen Mun Road	570
Slip Road A	125
Slip Road B	455
Slip Road C	310
	1,460
5m Barriers	
Foothills Bypass, South bound	600
Hoi Wong Road/Wong Chu Road Roundabout, incl. west portion of Wong Chun Road	465
	1065m
Full Enclosures	
Wong Chu Road	460
	460

Breakdown Costs for Direct Noise Mitigation Options, HK$

Mitigation	Low Noise Road Surfacing			3 M High Barriers			5 M High Barriers/Cantilever Barriers		
Options	Rate (Per Sq.M)	Area (Sq.M)	Cost	Rate	Length (M)	Cost	Rate	Length (M)	Cost
1	149	57,955	8,635,295	20,394	0	0	33,990	0	0
2	149	57,955	8,635,295	20,394	1,630	33,242,220	33,990	1,630	55,403,700
3	149	57,955	8,635,295	20,394	1,460	29,775,240	33,990	2,440	82,935,600
4	149	55,210	8,226,290	20,394	1,460	29,775,240	33,990	1,065	36,199,350

Mitigation	Full Enclosure			Full Enclosure along P3/D2 Bridge			Slip Road B Widening			Sub Total			Total Cost
Options	Rate	Length (M)	Cost	Rate	Length (M)	Cost	Rate	Length (M)	Cost		Consultant Fees (4.4%)	Resident Site Staff Cost (8.9%)	
1										8,635,295	379,950	768,540	**9,783,785**
2							28,894	220	6,356,680	103,637,895	4,560,065	9,223,775	**117,421,735**
3							28,894	220	6,356,680	127,702,815	5,618,925	11,365,550	**144,687,290**
4	155,578	315	49,007,070	234,595	145	34,016,275	28,894	220	6,356,680	163,580,905	7,197,506	14,558,700	**185,337,165**

Annex E

Response to Comments

2 SUMMARY OF EIA FINDINGS

The EIA study has indicated that there will be significant impacts associated with the construction of the proposed Roadworks at some sensitive receivers, exceeding the noise and dust criteria. This section summarises the findings of the EIA study.

2.1 CONSTRUCTION NOISE

Noise produced during the construction phase will impact upon nearby noise sensitive receivers (NSRs). The primary noise sources include Back hoe breakers, dump trucks, dozens and graders. The Environmental Protection Department's (EPD) construction noise criteria of 75 dB(A) and 70dB(A) will be exceeded at all of the representative residential and school NSRs respectively, if construction noise is unmitigated. These NSRs include:

- Yan Chai Hospital No. 2 Secondary school;
- Girls' Hostel;
- Morning Light School;
- Boy's Hostel;
- Lui Cheng Kwong Lutheran Primary School;
- Ting Fuk House; and
- Hong King Garden Blocks A & B.

Construction noise impact during the installation of horizontal panels of the recommended noise enclosure along Wong Chu Road will affect nearby NSRs. To minimise traffic disturbance and to avoid unacceptable impacts, the installation work should be carried out during non-peak hours at evening time (1900-2300 hours). The construction noise criteria of 70dB(A) will be exceeded at the NSRs below, if unmitigated:

- Oi Yee House
- Oi Shun House
- Ting Tak House
- Goodview Garden; and
- Siu Lun Court

Noise mitigation measures have been recommended in the EIA report to reduce the noise impact to within the acceptable level, as summarised in *Section 3.1* of this Environmental Schedule. Noise monitoring requirements are recommended in *Section 4* in order to ensure compliance with the criteria.

2.2 *CONSTRUCTION DUST*

The construction work will inevitably lead to dust (total suspended particulates (TSP)) emissions, mainly from bulldozing and material handling of soil. It is predicted that the dust generated will exceed the hourly and daily criteria of 500 $\mu g/m^3$ and 260 $\mu g/m^3$ respectively at the following sensitive receptors:

- Siu Lun Street Soccer Pitch;
- the planned Siu Lun Street G/IC;
- Nam Fung Industrial City; and
- the planned Area 18 PSPS development.

Mitigation measures are recommended 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 Hong Kong Air Quality Objectives (HKAQO). Dust monitoring requirements are recommended in *Section 5* to ensure the efficacy of the control measures.

3 MITIGATION MEASURES

3.1 CONSTRUCTION NOISE

Options for mitigating construction noise as recommended in the EIA report include:

- use of silenced equipment;
- scheduling activities to avoid parallel operation of several sets of power mechanical equipment;
- siting of equipment should be located as far as practicable from the noise sensitive receivers; and
- use of mobile noise barrier close to the noise sources to screen specific receivers.

In addition, general good site practice is also recommended as follows:

- machines and plant (such as trucks) 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 programme;
- only maintained plant should be operated on-site and plant should be serviced regularly during the construction programme; and,

Cumulative impacts between operations (see Construction Programme in *Figure B*) can be avoided by scheduling of construction programme. Two operations take place simultaneously in the vicinity of a given NSR should be avoided.

Construction of the Roadworks within the restricted period (ie 1900 to 0700 on weekdays and all days on Public Holidays) is not recommended. These operations could only be carried out with the use of the barrier/enclosure and subject to the conditions imposed by the required Construction Noise Permit (CNP).

It is recommended that the installation of the noise enclosure should be restricted to the evening period (1900-2300 hours). Mitigation measures such as use of silenced equipment and mobile barrier is required and the construction activities will be subject to the conditions imposed by the

required CNP.

It is anticipated that if the above mitigation measures can be successfully applied, the noise levels experienced by the affected receivers (see *Section 2.1*) will be reduced to within the criteria.

3.2 *CONSTRUCTION DUST*

Dust nuisance will be generated with the construction of the Roadworks. The TSP criteria will be exceeded at four ASRs (see *Section* 2.2) without any mitigation measures. The following dust control measures should be implemented to minimise any dust nuisance arising from the works:

- Where breaking of concrete is required, watering should be implemented to control dust.
- The dropping heights for excavated materials should be controlled to a practical minimum 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.
- Effective water sprays should be used on the site at potential dust emission areas such as unpaved area.
- Wheel washing trough should be provided at the exit of site;
- All stockpiles of aggregate or spoil should be enclosed or covered and water applied in dry or windy condition; and

4 CONSTRUCTION NOISE MONITORING

This section presents the noise monitoring requirements during the construction phase of the Roadworks.

4.1 OBJECTIVES

The objectives of noise monitoring include the following:

- to establish the pre-existing baseline noise climate at NSRs, against which any short or long term noise impacts can be judged;
- to provide an early indication if any of the noise mitigation measures specified for the construction phase are failing to achieve the acceptable standards; and
- to provide data to enable an environmental audit of the construction of the project.

4.2 METHODOLOGY

Construction noise levels would be determined by carrying out measurements at the specified monitoring locations. Noise measurements will be made in terms of the A-weighted equivalent continuous sound pressure level (L_{Aeq}) measured with an integrating sound level meter set to "fast" response.

4.2.1 *Monitoring Equipment*

Prior to the commencement of the construction works, a calibrated sound level meter with appropriate calibrator should be supplied to the site. The meter should comply with the *International Electrotechnical Commission Publication* (IEC) 651:1979 (type 1) and 804:1985 (type 1) specification as referred to in the *Technical Memorandum to the Noise Control Ordinance.* The calibrator for routine calibration checking on site should comply with the IEC 651:1979 and 804:1985 Type 1 calibrator requirements.

The sound level meter should be equipped and operated with the manufacturers recommended wind shield, and a suitable tripod. The calibrator and the meter should be kept in good state of repair in accordance with the manufacturers recommendations.

4.2.2 *Calibration Requirement*

Immediately prior to and following each measurement, the sound level meter should be calibrated in accordance with the IEC 651:1979 (type 1) and

804:1985 (type 1) specification as referred to in the *Technical Memorandum to the Noise Control Ordinance*. The measurements should be discarded if the calibrations before and after do not agree to within 1 dB(A), then repeated until the calibrations before and after agree to within 1 dB(A).

4.2.3 *Positioning of Sampler*

Where a measurement is to be carried out at a building, the assessment point would normally be at a position 1 m from the exterior of the building facade. Where a measurement is to be made of noise being received at a place other than a building, the assessment point would be at a position 1.2 m above the ground in free-field.

4.2.4 *Data Collection*

The following procedures should be adopted for all noise monitoring, either of baseline noise levels or of construction noise.

- measurements should be recorded to the nearest 0.1 dB, with values of 0.05 being rounded up.
- weather conditions, including a measurement of wind speed, should be recorded for the measurement. Where the steady wind speed exceeds 5 m/s, or gusts are above 10 m/s, or in the presence of fog or rain, measurements should be treated as invalid, and repeated in more appropriate conditions.
- noise level should be measured at 1 m from the most affected external facade of the nearby noise sensitive receivers during any 30 minute period.
- when noise measurements are taken inside a school during the school examination periods, liaison with the schools and the Examination Authority shall be maintained to ascertain the exact dates and times of all examination periods during the course of the Roadwork.
- noise monitoring data should be recorded in a format as given in *Appendix A*.

4.3 *MONITORING LOCATIONS*

Noise monitoring should be carried out at the monitoring locations listed in *Table 4.3a* and additional locations considered necessary, in agreement with the Environmental Protection Department (EPD). The location of the monitoring stations are marked on *Figure A*.

Table 4.3a Noise Monitoring Stations

Monitoring Station Ref. No. (as on Figure A)	NSR Ref. No. (as used in section 3.2 of the EIA report)	Monitoring Station Description
M1	36	Yan Chai hospital No. 2 Secondary School
M2	39	Girls' Hostel

Monitoring Station Ref. No. (as on Figure A)	NSR Ref. No. (as used in section 3.2 of the EIA report)	Monitoring Station Description
M4	10	Lui Cheng Kwong Lutheran Primary School
M5	12	Ting Fuk House
M6	46	Hong King Garden Blocks A & B
M7	2	Oi Yee House
M8	30	Tsui Ning Garden

Noise measurements should be made 1 m from the nearest part of the building facade, and at a height 12m above the ground that has the clearest view of the area of construction activity. Case should be taken to cause minimal disturbance to the inhabitant during monitoring. For future reference, the measurement location should be photographed and carefully noted in a log.

4.4 *BASELINE MONITORING*

Baseline ambient noise levels should be measured on a weekday and on a Sunday, over full continuous 24 hour periods, at each monitoring location prior to the commissioning of the construction work for a period of at least 2 weeks. There should not be any construction and unusual activities in the vicinity of the stations during monitoring. Measurements of the L_{eq}, L_{90} and L_{10} noise levels shall be made, over 30 minute periods, for the whole of the 24 hour survey.

4.5 *IMPACT MONITORING*

Tables 4.5a and *4.5b* below specifies the noise monitoring stations that must be monitored when particular concurrent activities (as specified in the table) are undertaken during the daytime. Monitoring of $L_{eq(30min)}$ noise levels should be carried out at the monitoring stations on two occasions every week, during normal construction working hours (0700–1900 Monday to Saturday).

In addition, monitoring will be required at all stations if any construction activity is to be carried out during restricted hours. In this case noise levels of $L_{eq(5min)}$ should be measured at the noise monitoring stations, for three consecutive 5 minute periods, in each restricted period (ie daytime (Sundays and holidays only) evening or nighttime), twice a week.

Further, monitoring at stations M1, M3 and M4 (ie the schools) will be required during examination periods to ensure the recommended noise criteria of $L_{Aeq,30\ min}$ 65 dB is not exceeded. In this case noise levels of $L_{eq(5min)}$ should be measured at the noise monitoring stations, for six consecutive 5 minute periods on every day that an examination is held.

Monitoring will be required at stations M7 and M8 during the installation of horizontal panels of the noise enclosure to ensure the evening noise criteria of 70dB(A) is not exceeded. It this case, noise levels of $L_{eq(5min)}$ should be measured at the noise monitoring stations, for three consecutive 5 minute

periods, in the evening time (1900–2300 hours), twice a week.

The monitoring may trigger action as specified in *Section 4.8* to ensure that the noise criteria listed in *Table 4.7a* are not exceeded.

Table 4.5a Concurrent Activity Noise Monitoring Requirements for the P1/D15 Interchange & Foothill Bypass

Activity combination – based upon proposed schedule (*Figure B*)	Expected Duration (m/yr, inclusive) – based upon proposed schedule (*Figure B*)	Stations that need to be monitored during the daytime
1.3, 1.4	10/97 – 11/97	M1, M2
1.5, 1.14.1	12/97 – 4/98	M2, M3
1.5, 1.14.1, 1.14.2	5/98 – 7/98	M2, M3
1.5, 1.7, 1.14.2	8/98 – 9/98	M2, M3
1.6, 1.7, 1.14.2	10/98 – 11/98	M2
1.7, 1.8, 1.9, 1.14.2	12/98	M1, M2, M3
1.8, 1.9, 1.14.2, 1.14.3	1/99 – 2/99	M1, M2, M3
1.9, 1.14.2, 1.14.3	3/99 – 5/99	M2, M3
1.11, 1.14.2, 1.14.3	6/99 – 7/99	M1, M2, M3
1.11, 1.14.2, 1.14.3, 1.14.4	8/99 – 11/99	M1, M2, M3
1.12, 1.14.2, 1.14.3, 1.14.4	12/99 – 1/00	M2, M3
1.13, 1.14.2, 1.14.3, 1.14.4	2/00 – 4/00	M2, M3, M4
1.13, 1.14.2, 1.14.4	5/00 – 6/00	M2, M3, M4
1.14.2, 1.14.4	7/00 – 2/01	M2, M3
1.14.4	3/01 – 7/01	M2, M3

Table 4.5b Concurrent Activity Noise Monitoring Requirements for the P1/P3 Interchange

Activity combination – based upon proposed schedule (*Figure B*)	Expected Duration (m/yr, inclusive) – based upon proposed schedule (*Figure B*)	Stations that need to be monitored during the daytime
2.2	9/97 – 12/97	M5
2.2, 2.3	1/98	M5
2.3	2/98 – 4/98	
2.4	5/98 – 7/98	
2.4, 2.5	8/98 – 9/98	
2.5	10/98 – 9/00	
2.6	10/00 – 11/00	
2.7, 2.8	1/01	M5, M6
2.8	2/01 – 6/01	

4.6 COMPLIANCE MONITORING

In case of non-compliance with the recommended noise level, more frequent noise monitoring as specified in the Action Plan should be carried out. This additional monitoring should be continued until the recorded noise levels are rectified.

4.7 COMPLIANCE CHECK

The noise monitoring data should be checked against the trigger/action/target levels as agreed with EPD and as defined below:

The *trigger* and *action* levels for construction noise monitoring are based on monitored levels as well as complaints that might have been received from the local NSRs, as follows:

- *Trigger* level – Receipt of a single documented complaint of construction noise level.
- *Action* level – Receipt of more than one documented complaint of construction noise in any two week period on the same event or at the same location.

The *target levels* for construction noise, measured at the facade of the NSRs, are given in *Table 4.7a*.

Table 4.7a Construction Noise Target Levels

Time Period	Noise Level (dB) for M2, M5, M6, M7 & M8,	Noise Level (dB) for M1, M3, M4
Daytime (0700 to 1900), Monday through Saturday excluding Public Holidays	$L_{aeq,\ 30min}$ 75	$L_{aeq,\ 30\ min}$ 70 $L_{aeq,\ 30\ min}$ 65 (during examination eriods)
All evenings (1900 to 2300)	$L_{Aeq5\ min}$ 70	NA*
General holidays (including all Sundays) during the daytime and evening (0700 to 2300)	$L_{Aeq5min}$ 70	NA*
All night time periods (2300 to 0700)	$L_{Aeq5\ min}$ 55	NA*

* There are no target levels for monitoring stations M1, M3 and M4 during evenings, general holidays and night time periods since these NSRs are schools and will only be occupied during the daytime.

4.8 ACTION PLAN

An action plan which outlines details of appropriate responsibilities by relevant parties in the event of exceedance of the recommended trigger/action/target levels is given in *Table 4.8a*.

Table 4.8a Event & Action Plan for Noise Monitoring

Event	Actions		
	Environmental Team Leader	Engineer's Representative (ER)	Contractor
Trigger			
when a complaint is received	· Notify Contractor · Conduct Measurement · Investigation noisy operations		
Action Limit			
When more than one compliant are received received within 2 weeks on the same event or at the same location	· Notify Contractor · Analyse investigation · Require Contractor to propose measures for the analysed noise problem · Increase monitoring frequency to check mitigation effectiveness		· Submit noise mitigation proposals to Environmental Team Leader/Engineer's Representative · Implement noise mitigation propsals
Target Limit			
Non-statutory - 75* dB(A) exceeded between 0700-1900 hrs on normal weekdays; Statutory – 60/65/70** dB(A) exceeded between 0700-2300 hrs on holidays and 1900-2300 hrs on all Statutory other days; 45/50/55** dB(A) exceeded between 2300-0700 hrs of next day	· Notify Contractor · Notify EPD# · Require contractor to implement mitigation measures increase monitoring frequency to check mitigation effectiveness		· Implement mitigation measures. Prove to Environmental Team Leader · Prove to Environmental Team Leader/ER effectiveness of measures applied

* reduce to 70dB(A) for schools and 65dB(A) during school examination periods.
** to be selected based on Area Sensitivity Rating
\# only applicable to projects of significant scale.

5 CONSTRUCTION DUST MONITORING

This section presents the dust monitoring requirements during the construction phase of the road improvement works. Total suspended particulates (TSP) is the major pollutant during construction. TSP monitoring is recommended at the ASRs.

5.1 OBJECTIVES

The objectives of TSP monitoring are to demonstrate the:

- extent of construction dust impacts on sensitive receivers;
- effectiveness of mitigation measures to control dust from construction activities; and
- the requirement of further mitigation measures if found to be necessary.

5.2 METHODOLOGY

Dust monitoring would be determined by carrying out measurements at the specified monitoring locations. Measurements will be made in terms of the TSP.

5.2.1 *Monitoring Equipment*

TSP levels should be measured by High Volume Sampler (HVS) using a standard high volume sampling method as set out in the Title 40 of the Code of Federal Regulation, Chapter 1 (Part 50), Appendix B. The HVS should be in compliance with the specifications as follows for regular calibration:

- 0.6 – 1.7 m^3/min (20–60 SCFM) adjustable flow range
- equipped with a timing/control device with 5 minutes accuracy for 24 hours operations
- installed with elapsed–time meter with 2 minutes accuracy for 24 hours operations
- capable of providing a minimum exposed area of 406 cm^2
- flow control accuracy: 2.5 % deviation over 24 hr sampling period
- equipped with shelter to protect the filter and sampler
- incorporated with an electronic mass flow rate controller or other equivalent devices
- equipped with a flow recorder for continuous monitoring
- provided with peaked roof inlet

- incorporated with manometer
- able to hold and seal the filter paper to the sampler housing at horizontal position
- easy to change filter
- capable of operating continuously for 24-hr period

A direct reading dust meter capable of achieving results comparable to a high volume air sampler for 1-hr sampling in the range of 0.1-100 mg/m^3 should also be used as an alternative provided that the instrument is to be calibrated against a traceable primary standard at regular intervals.

A sufficient number of high volume air samplers with an appropriate calibration kit should be provided for the baseline monitoring, regular impact monitoring, and ad hoc monitoring for the 24-hr and 1-hr measurements of the identified monitoring stations.

The HVS should be equipped with an electronics flow controller and be calibrated against a traceable standard at regular intervals.

All the equipment, the calibration kits, filter papers, etc should be clearly labelled. The samplers, equipments and shelters should be constructed so as to be transferable between monitoring stations.

The samplers should be properly maintained and calibrated. Prior to dust monitoring, appropriate checks should be made to ensure that all equipment and necessary power supply are in good condition.

5.2.2 *Calibration Requirement*

Initial calibration of dust monitoring equipment should be conducted upon installation and thereafter at bimonthly intervals. The transfer standard should be traceable to the internationally recognised primary standard and be calibrated annually. The calibration data should be properly documented for future reference. All the data should be converted into standard temperature and pressure condition.

5.2.3 *Positioning of Sampler*

When positioning the samplers, the following points should be noted:

- a horizontal platform with appropriate support to secure the samplers against gusty wind, should be provided.
- no two samplers should be placed less than 2 meters apart.
- distance between the samplers and an obstacle, such as buildings, must be at least twice the height of the obstacle protruding above the samplers.
- a minimum separation of 2 meters should be provided from walls, parapets, and penthouses for rooftop samplers.
- a minimum separation of 2 meters should be provided from any supporting structure measured horizontally.

- there should not be any furnace or incinerator flues nearby.
- there should be unrestricted airflow around the sampler.
- a minimum separation of 20 meters should be provided from the dripline.
- any wire fence and gate employed to protect the sampler should not cause any obstruction during monitoring.

5.2.4 *Data Collection*

Monitoring results should be recorded in the monitoring record sheet. New sheet should be used per sampling occasion should be used.

The flow-rate of the sampler before and after the sampling exercise, with the filter in position, should be verified to be constant and be recorded down in the monitoring record sheet.

5.2.5 *Wind Data Monitoring Equipment*

Wind data monitoring equipment should be set up at a conspicuous location for wind speed and wind direction capturing near to the dust monitoring locations. The wind sensor should be installed on marts, at an elevated level 10m above ground, so that they are clear of obstructions or turbulence caused by buildings.

The wind data should be captured by a data logger and be downloaded to a computer for processing at least once a month. Wind direction should be divided into 16 sectors of 22.5 degrees each. The wind data monitoring equipment should be recalibrated at least once every six months.

5.2.6 *Laboratory Measurement Requirements*

Sample analysis and equipment calibration and maintenance should be carried out in a clean laboratory with constant temperature and humidity control, and equipped with necessary measuring and conditioning instrument to handle the dust samples.

The filter paper, measuring 10" x 8", should be labelled before sampling, pre-dried in a clean oven for over 24-hr and pre-weighted before use for the sampling. After sampling, the filter paper loaded with dust should be kept in a clean and tightly sealed plastic bag. The filter paper is then returned to the laboratory for reconditioning in the humidity controlled chamber followed by accurate weighting with an electronic balance with a readout down to 0,1 mg. The balance should be regularly calibrated against a traceable standard. The controlled chamber should be able to maintain the chamber temperature between 15 °C and 30°C with less than ±3°C variation and less than a constant 50 percent relative humidity within ±5 percent.

Additional conditioned and weighted filter papers should be ready for immediate use whenever necessary.

5.3 *MONITORING LOCATIONS*

Monitoring stations should be set up at two locations at Siu Lun Street Soccer Pitch and the planned Area 18 PSPS development (or Morning Light School should the PSPS development be behind schedule) as shown in *Figure A*.

5.4 *BASELINE MONITORING*

Ambient TSP levels should be established prior to the start of the construction works. TSP levels should be measured at the air monitoring station for at least two consecutive weeks. The following parameters and frequencies should be measured at the monitoring station:

- 24-hour TSP samples taken daily; and
- 1-hr TSP samples taken at least three times per day, which should be taken when the highest dust impact is expected. (The highest dust impact is to be predicted based on the types of works scheduled to be carried out in the works programme.)

During baseline monitoring, there should be not be any construction of dust generation activities in the vicinity of the stations during the baseline monitoring.

5.5 *IMPACT MONITORING*

Regular 24-hr TSP monitoring should be conducted once every six days at the air monitoring stations. In case of non-compliance with the air quality criteria, more frequent monitoring exercise should be conducted.

1-hour TSP sampling should be taken 3 times for every 6 days at the highest dust impact occasion.

The specific time to start and stop the 24-hr TSP monitoring should be clearly defined for each locations and be strictly followed by the operator. Dust monitoring data should be recorded in a format as given in *Appendix A*.

5.6 *COMPLIANCE MONITORING*

In case of non-compliance with the air quality criteria, more frequent monitoring, as specified in the Action Plan, should be conducted within 24 hours. This additional monitoring should be continued until the excessive dust emission or the deterioration in air quality is rectified.

5.7 *COMPLIANCE CHECK*

The air quality monitoring data should be checked against the trigger/ action/ target levels as listed in *Table 5.7a*.

Table 5.7a Trigger/Action/Target Level for Air Quality Monitoring

Level	TSP level in ug/m^3
Trigger	30% above baseline
Action	Average value of the trigger and target levels
Target	1-hr TSP : 500 ug/m^3 24-hr TSP: 260 ug/m^3

5.8 ACTION PLAN

An outline action plan which outlines details of appropriate responsibilities by relevant parties in the event of exceedance of the recommended level is given in *Table 5.8a.*

Table 5.8a Action Plan for Air Quality Monitoring

Event	Actions		
	Environmental Team Leader	Engineer's Representative (ER)	Contractor
Trigger Limit			
Exceedance for one sample	· Identify sources · Inform ER · Repeat measurement to confirm finding	· Notify contractor · Check monitoring data and Contractor's working methods	· rectify any unacceptable practices
Exceedance for two or more consecutive samples	· Identify source · Inform ER · Repeat measurement to confirm findings · Increase monitoring frequency · Discuss with ER for remedial actions required · If remedies required, contact ER to make arrangement. · If problem is short term, continue monitoring · If exceedance stops, cease additional monitoring	· Notify Contractor · Check monitoring data and Contractor's working methods · Discuss with Contractor for remedial works, if necessary	· Rectify any unacceptable practice · Consider changes to working method
Action Limit			
Exceedance for one sample	· identify source · Inform ER · Repeat measurement to confirm finding · Increase monitoring frequency to daily	· Notify Contractor · Check monitoring data and Contractor's working methods	· Rectify any unacceptable practice · Amend working methods if appropriate
Exceedance for two or more consecutive samples	· Identify source · Inform ER · Repeat measurements to confirm findings · Increase monitoring frequency to daily · Discuss with ER for remedial actions required · If exceedance continues, arrange meeting with ER · If exceedance stops, cease additional monitoring	· Confirm receipt of notification of failure in writing · Notify Contractor · Check monitoring data and Contractor's working methods · Discuss with Environmental Supervisor and Contractor on potential remedial actions · Ensure remedial actions properly implemented	· Submit proposals for remedial actions to ER within 3 working days of notification · Implement the agreed proposals · Amend proposal if appropriate

Event	Actions		
	Environmental Team Leader	Engineer's Representative (ER)	Contractor
Target Limit			
Exceedance for one sample	· Identify source · Inform ER and EPD verbally · Repeat measurement to confirm finding · Increase monitoring frequency to daily · Assess effectiveness of Contractor's remedial actions and keep EPD and ER informed of the results	· Confirm receipt of notification of failure in writing · Notify Contractor · Check monitoring data and Contractor's working methods · Discuss with Environmental Team Leader and Contractor potential remedial actions · Ensure remedial actions properly implemented	· Take immediate action to avoid further exceedance · Submit proposals for remedial actions to ER within 3 working days of notification · Implement the agreed proposals · Amend proposal if appropriate
Exceedance for two or more consecutive samples	· Identify source · Inform ER and EPD the cause and actions taken for the exceedances · Repeat measurement to confirm findings · Increase monitoring frequency to daily · Investigate the causes of exceedance · Arrange meeting with EPD and ER to discuss the remedial actions to be taken · Assess effectiveness of Contractor's remedial actions and keep EPD and ER informed of the results. · If exceedance stops, cease additional monitoring	· Confirm receipt of notification of failure in writing · Notify Contractor · Carry out analysis of Contractor's working procedure to determine possible mitigation to be implemented · Discuss amongst Environmental Team Leader and the Contractor potential remedial actions · Review Contractor's remedial actions whenever necessary to assure their effectiveness · If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated.	· Take immediate action to avoid further exceedance · Submit proposals for remedial actions to ER within 3 working days of notification · Implement the agreed proposals · Resubmit proposals if problem still not under control · Stop the relevant portion of works as determined by the ER until the exceedance is abated.

6 REPORTING PROCEDURES

6.1 MONITORING RESULTS

Monitoring data shall be reported on record sheets and should contain the following information:

- sampling points
- sampling parameter
- number of measurement
- weather condition
- brief description of the construction activities (e.g. position of piling operations)
- brief description of special phenomena concerning the work progress of the site and the measurement
- trigger/action/target level
- checks on compliance

Sample record sheets for noise and dust monitoring are illustrated in *Appendix A*.

6.2 ENVIRONMENTAL EXCEEDANCES

For environmental exceedance, in addition to notifying the contractor immediately and repeated monitoring, the EPD should also be informed by fax, where appropriate, if action/target levels are exceeded. Action(s) taken should be reported in the monthly progress report. The monitoring and auditing programme should be continued to the end of the agreed period. Meanwhile, there may be a need for ad hoc liaison meetings with the EPD, and for briefings and presentations to the Advisory Council on the Environment, District Boards and other interested parties.

6.3 BASELINE MONITORING REPORT

A baseline monitoring report should be prepared and submitted to EPD two weeks after the completion of the baseline monitoring programme. The report should include at least the following:

- up to half a page executive summary;
- brief project background information;
- drawings showing locations of the baseline monitoring stations;

- monitoring results (in both hard and diskette copies) together with the following information;

    - monitoring methodology;
    - equipment used and calibration details
    - parameters monitored;
    - monitoring locations (and depth)
    - monitoring date, time, frequency and duration;

- details on influencing factors, including:

    - major activities, if any, being carried out on the site during the period;
    - weather conditions during the period;
    - other factors which might affect the results:

- determination of the Trigger, Action and Target Levels for each monitoring parameter;

- comments and conclusions

6.4 *PERIODIC EM&A REPORT*

A monthly EM&A report should be prepared and submitted to EPD on the tenth working day of each month in an agreed format (printed and/or magnetic media form). The report should include the following:

- summary of major points;
- summary of the construction activities for the month;
- monitoring data;
- audit/review of the monitoring results;
- compliance check and report on exceedances;
- remedial measures adopted to restore the adverse condition;
- record of complaints and remedial measures;
- forecast of work programme and monitoring schedule;
- proposal for changes to monitoring requirements, as appropriate;
- comments and conclusions.

Appendix B shows a list of items to be included into the monthly EM&A reports, as recommended by EPD.

In addition, a quarterly EM&A summary report should be prepared and submitted to EPD every four months starting from the first day of the project programme. The quarterly report should generally be around 5 pages including about 3 pages of text and tables and 2 pages of figures. *Appendix C* shows a list of items to be included into the Quarterly EM&A reports, as recommended by EPD.

7 ENVIRONMENTAL AUDIT REQUIREMENTS

Environmental auditing is recommended to test the adequacy of the overall environmental management systems and the effectiveness of the environmental monitoring programme adopted.

These audits should be carried out by an independent body on a regular basis, e.g. at monthly interval. The audit should cover the following:

- inspection and validation of the monitoring procedures and results;
- organisation and presentation of the monitoring data;
- analysis and interpretation of the monitoring results to establish an environmental profile at the time of audit;
- verification that the monitoring results are in compliance with established environmental quality limits (trigger/action/target levels and/or any regulatory requirements) and documentation of any exceedances;
- on-site inspections and investigations to identify sources and causes of non-compliance and unacceptable impacts;
- recommendations to rectify the non-compliance;
- inspections to ensure the Contractor fulfils the contractual and statutory requirements, licensing conditions etc, relating to protection of environment. Such inspections may or may not involve sampling for analysis which is not covered by the regular monitoring. (Should non-compliance associated with the works be proven through sampling and testing, the Contractor shall be liable for all such expenses incurred).
- inspection to ensure that all environmental mitigation measures are properly and effectively implemented, and review the adequacy of the implemented measures;
- comparison of impact predictions with the actual impacts measured to assess the accuracy of predictions;
- assessment of the environmental management systems, practices and procedures;
- identification of potential environmental problems or impacts associated with the programmed works and the works method statement and identify solutions to avert or minimise these impacts;
- investigation of complaints from residents/sensitive receivers and action taken when the complaints are received; and
- a review of the overall monitoring philosophy in terms of procedure, location of monitoring stations, frequency, parameters measured, test methods, acceptance criteria etc.

In the event that a complaint, whether direct or indirect, is received, the Engineer Representatives (ERs) should be informed immediately so that he can take appropriate action. The Engineer shall liaise with respective organisations and parties and to investigate the complaints and initiate appropriate action as deemed necessary.

The ERs should assume responsibilities of the following to rectify the situation:

- identify source of impacts;
- take necessary action to mitigate the situation;
- undertake monitoring with respect to air quality and noise;
- check compliance with trigger/action/target levels and environmental regulations;
- if monitoring results show exceedances repeat review procedures, identify possible areas of improvement and checking procedures;
- document all complaints in the monthly EM&A report to EPD and include details of mitigation measures taken and the additional monitoring results for the period; and
- prepare a formal reply to complaints notify the concerned person(s) that action has been taken.

Figure C is an illustration of the procedures recommended to be undertaken in the event of complaints.

In addition to the above, audit of environmental complaints handling procedures should also be carried out to verify that complaints are properly channelled and addressed.

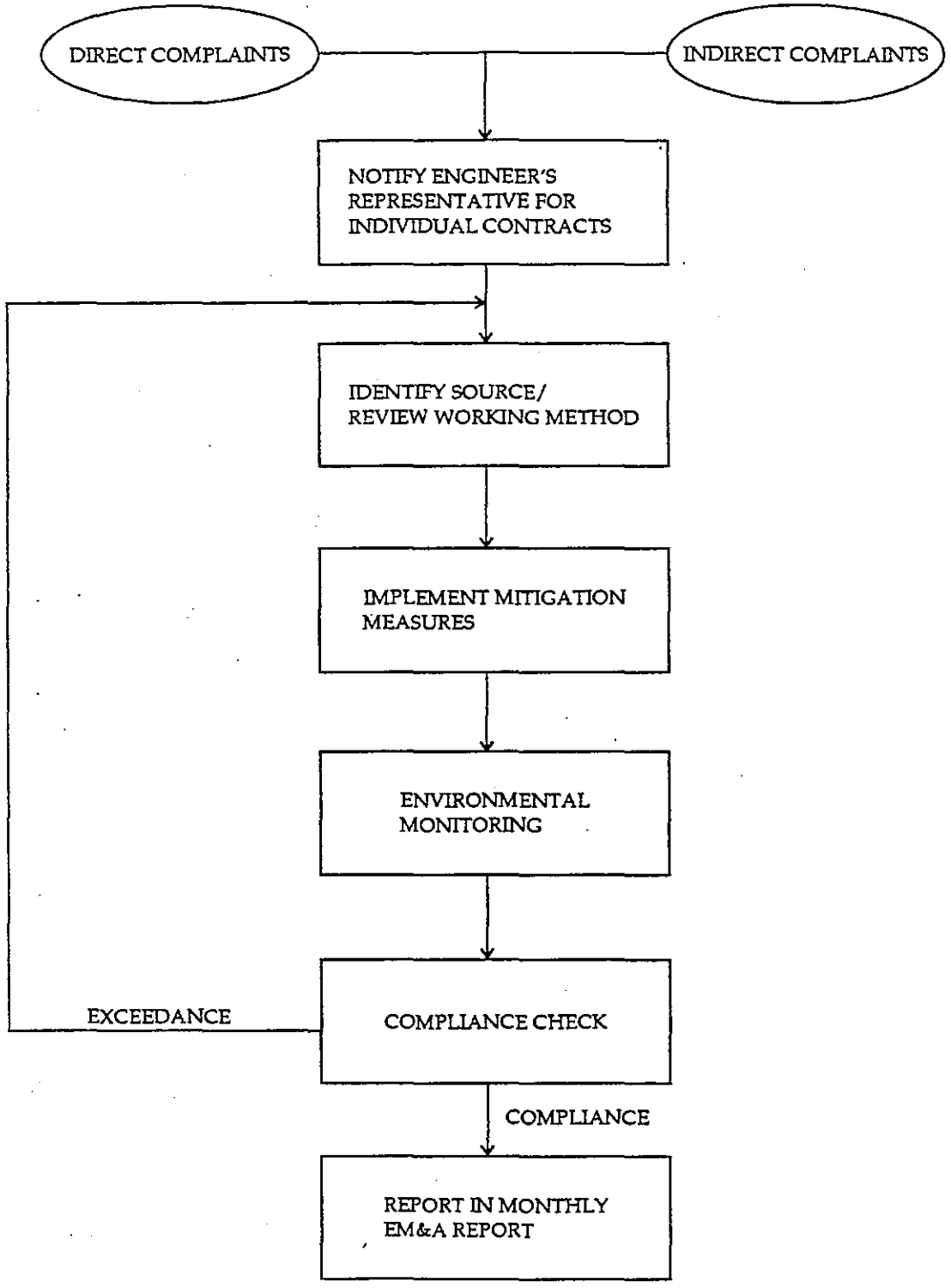

FIGURE C - COMPLAINTS HANDLING PROCEDURE

ERM Hong Kong

10-11th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

Appendix A

Examples of Monitoring Record Sheets

Table A1 *Dust Monitoring Record Sheet – Total Suspended Particulates (TSP) Level*

Monitoring Location		
Details of Location		
Sampler Identification		
Date & Time of Sampling		
Elapsed–time	Start Stop	(min) (min)
Total Sampling Time		(min)
Weather Conditions		
Wind Speed		(km/hr)
Wind Direction		
Site Conditions		
Initial Pressure	Pi	(mmHg)
Initial Temperature	Ti	(°C)
Initial Flow Rate	Qsi	(std. m^3/min)
Final Pressure	Pf	(mmHg)
Final Temperature	Tf	(°C)
Final Flow Rate	Qsf	(std. m^3/min)
Average Flow Rate		(std. m^3/min)
Total Volume		(std. m^3)
Filter Identification No.		
Initial Wt. of Filter		(g)
Final Wt. of Filter		(g)
Measured TSP Level		(ug/m^3)

Remarks:

	Name & Designation	Signature	Date
Field Operation :	_____	_____	_____
Lab. Staff :	_____	_____	_____
Checked by :	_____	_____	_____

Table A2 *Noise Monitoring Record Sheet*

Monitoring Location and reference
Date and day
Personnel reference
Weather conditions (general)
Wind Speed – average/peak (m/s)
Background noise level
Calibration before measurement
Calibration after measurement
Start and finish time of measurement
Duration of measurement
L_{90} level
L_{10} level
L_{eq} level
Principal Noise Sources
Other comments

	Name & Designation	Signature	Date
Field Operation :			
Lab. Staff :			
Checked by :			

Appendix B

Items to be Included in the Monthly Progress Report

ITEMS TO BE INCLUDED INTO THE MONTHLY EM&A REPORTS

Monthly EM&A reports shall include at least the following:

- 1 -2 pages executive summary;
- basic project information including a synopsis of the project organisation, programme and management structure, and the work undertaken during the month;
- A brief summary of EM&A requirements including:
  - all monitoring parameters;
  - environmental quality performance limits (trigger/action/target levels);
  - Event/Action Plans;
  - recommended environmental mitigation measures; and
  - environmental requirements in contract documents.
- Sketches showing environmental sensitive receivers and locations of the monitoring and control stations;
- Monitoring results (in both hard and diskette copies) together with the following information:
  - monitoring methodology
  - solid and liquid waste management study
  - graphical plots of the trends of monitored parameters over the past 4 reporting periods for representative monitoring stations annotated against:
    (a) the major activities being carried out on site during the period;
    (b) weather conditions during the period; and
    (c) any other factors which might affect the monitoring results.
  - advice on the implementation status of environmental protection and pollution control measures as recommend in the EIA study report
  - equipment used and calibration details
  - parameters monitored
  - monitoring locations
  - monitoring time, frequency, duration and period
- A summary of non-compliance (exceedances) of the environmental quality performance limits (trigger/action/target levels) taking into account established precision and/or detection limits (where appropriate) and statistical significance of the data;
- A brief review of the reasons for the non-compliance including review of pollution sources and working procedures;
- A summary description of the action taken in the event of non-compliance and any follow-up procedures related to earlier non-compliance;
- A record of all complaints received for each media (written or verbal) including locations and nature of complaints, liaison and consultation undertaken, action and follow-up procedures taken;

- a forecast of the works programme, impact predictions and monitoring schedule for the next three months; and

- comments, recommendations and conclusions for the month

Appendix C

Items to be Included in the Quarterly Progress Report

ITEMS TO BE INCLUDED INTO THE QUARTERLY EM&A REPORTS

The quarterly EM&A summary report should contain at least the following information:

- up to half a page executive summary;
- basic project information including a synopsis of the project organisation, programme, contacts of key management, and a synopsis of work undertaken during the quarter,
- a brief summary of EM&A requirements including:
  - monitoring parameters;
  - environmental quality performance limits (Trigger, Action and Target levels); and
  - environmental mitigation measures, as recommended in the project EIA study final report;
- advice on the implementation status of environmental protection and pollution control (mitigation) measures, as recommended in the project EIA study report, summarised in the updated implementation schedule;
- drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations;
- graphical plots of the trends of monitored parameters over the past 4 months (the last month of the previous quarter and the present quarter) for representative monitoring stations annotated against;
  - the major activities being carried out on site during the period;
  - weather conditions during the period; and
  - any other factors which might affect the monitoring results
- advice on the solid and liquid waste management status;
- a summary of noncompliance (exceedances) of the environmental quality performance limits (Trigger/Action/Target levels)
- a brief review of the reasons for and the implications of non-compliance including review of pollution sources and working procedures;
- a summary description of the action taken in the event of non-compliance and any follow-up procedures related to earlier non-compliance;
- a summary record of all complaints received (written or verbal) for each media, liaison and consultation undertaken, action and follow-up procedures taken;

- comments, recommendations and conclusions for the quarter; and
- contacts and any hotline telephone numbers for the public to make enquiries

Agreement No. CE 36/94
Reclamation and Servicing of Tuen Mun Area 38 for Special Industries
Improvement to Roads and Junctions within Tuen Mun
Environmental Impact Assessment (Phase 1)
Environmental Impact Assessment Report
Responses to Comments

No.	Department	Reference	Comments	Consultants' Response
1	Agriculture & Fisheries Dept	(15) in AF DVL 11/6 VII Annex C	I have no comment on the captioned report.	Noted.
2	Fire Services Dept	(4) in FSD 21/7596/93 II	2.4.1, Page 6-7 My concern on the traffic arrangement is mainly about the extent of influence on the response of emergency vehicles. Presently, the vicinity are covered by Tuen Mun Fire Station and Castle Peak Bay Fire Station. Depending on the degree of traffic congestion at Pui To Road and Tuen Mun Heung Sze Wui Road arising from the banning of both left and right turn movements from Wong Chu Road to Lung Mun Road/Tsing Wun Road for a period of two months, I would think that this proposed traffic arrangement will still be better than having to bann the left turn traffic from Wong Chu Road for around 10 months under the alternative construction programme.	Noted. Since there is an easier diversion route for left turning traffic the alternative may still be preferable. However, this would need to be assessed further at detailed design stage, but we agree the Final Report should highlight that the influence on the response of emergency vehicles will be a significant factor in determining the preferred traffic management measure at this interchange.

No.	Department	Reference	Comments	Consultants' Response
3			2.6, Page 8 The first paragraph should be amended as follows: "The requirements of Fire Services Department (FSD) should be sought preliminary to the detailed design of noise barriers, partial or full noise enclosures. Consideration of adverse effects on fire fighting operation such as access to fire hydrants and radio communication etc should be given. The effect on the structural integrity of the proposed barriers and enclosures in case of fire should also be addressed. The final design will also be subject to FSD's approval." The effect on operation of large recovery vehicle will perhaps be a concern of the Police.	Agreed. Text to be reworded accordingly.
4			Mitigation 4, Page 63 Full Fire Services Installations requirements will be imposed for the proposed full enclosures of 500m and mechanical ventilation will be required for the 305m enclosures.	Agreed. Although these requirements are indicated on Figure 5.6b, we will clarify in the text of the Final Report.
5			5.6.1, page 69 In the design of the barriers/enclosures, the structural integrity of the structure should be sound enough so that they will not collapse in case of fire.	Noted. The consideration of fire resistance and structural integrity of the barriers/enclosures to avoid collapse in case of fire, will be added.
6	HK Housing Authority	HD(P) 7/2/TM6	Figs 1.3(a), 2.3(b) at al The Area 18 PSPS site will not extend as far north as shown. I enclose for your reference a copy of Plan No. E/TM94/11D from DPO/TM&YL's approved Planning Brief. You will also notice that other landuses are proposed in the northern part of Area 18, including a commercial site and a neighbourhood community centre (NCC). The wedge-like configuration of the PSPS site's northern boundary may not lend itself to a high-rise structure. This should expose much of the NCC site to noise from the Foothills Bypass and associated works.	Noted. According to HKPSG, NCC is not classified as a NSR.

No.	Department	Reference	Comments	Consultants' Response
7			Para 2.3 I agree that the proposed pedestrian footbridge over Lung Mun Road serving the PSPS should be regarded as a design/construction constraint on your proposed works. A pedestrian connection to the LRT stop must be available upon completion of the first phase of this PSPS.	Noted. This will be further highlighted in the text.
8			Para 3.1.4 Table 3.1 (c) does not match Fig 3.1(a), while Fig 3.1(b) is missing from my copy. Please clarify. It is currently proposed that the PSPS will be completed in four phases as follows:- Invite Tender / Award Tender / Completion Lot A, Ph 1 10/95 3/96 5/98) north of central Lot A, Ph 2 10/95 3/96 8/98) drainage reserve Lot B, Ph 1 5/96 10/96 12/98) south of central Lot B, Ph 1 5/95 10/96 3/99) drainage reserve	The Figure numbers for this paragraph should be 3.1b & 3.1c. The two figures will be included in the Final Report. Noted.
9			Para 3.1.8 I support the need for the roadworks agency to undertake environmental audit and monitoring of the PSPS site to ensure that dust is controlled during road construction works. Please advise on access implications within the PSPS site.	Noted. The Housing Authority will be approached by an appointed monitoring agent to get permission to set equipment at an appropriate location within the PSPS site.

No.	Department	Reference	Comments	Consultants' Response
10			Para 3.2.3 The final sub paragraph on page 20 states that because the Area 18 PSPS will incorporate single aspect façades, construction noise from the Foothills Bypass will not cause exceedance at the NSR. However, I must stress that is not the PSPS developer's responsibility to achieve a permanent building design to mitigate temporary highway construction noise. It is your responsibility to demonstrate that this construction noise can be dealt with at source without constraining the PSPS development. You have not shown whether the construction noise sensitive receiver takes account of the gap in the single aspect building façade imposed by the vehicular entrance to the PSPS development.	Noted and agreed. Reference to the Planning Brief, the single aspect building blocks along the north and west site boundaries of the Area 18 PSPS site recommended to mitigate the high traffic noise impact from Lung Mun Road and Foothill Bypass have also a screening effect of the construction noise from the roadworks. However, a worst case representative NSR at the development will be assessed in the Final Report.
11			Paras 5.4 and 5.5 The last subparagraph of para 5.4 implies that the single aspect building requirements for the Area 18 PSPS will, in themselves, ensure that the PSPS will not be impacted by the roadworks. This is not so in that the agreed Traffic Impact and Environmental Assessment Study for the PSPS also incorporated low road noise surfaces for the Foothills Bypass. para 5.5 indicates that low road noise surfacing is only an option. Its implementation should be confirmed to reflect the previous TIEAS, otherwise the critical noise contour will push further through the vehicular access gap on the western PSPS boundary, adversely affecting layout flexibility and flat yields in the agreed TIEAS concept. The position of ASR 57 in Fig 5.5(a) does not assess this gap.	Noted and text clarified accordingly. Reference to last paragraph of para 5.8, it has been recommended by the Consultants that mitigation option 4 are the preferred option which has incorporated low noise road surface on all new roads including on Foothill Bypass. The low noise road surface, together with the the mitigation measures recommended in the *Traffic Impact and Environmental Assessment Study,* are adequate to mitigate the traffic noise levels to the HKPSG criterion. The location of NSR 57 are chosen such that it gives a comparison between the noise levels predicted in *Traffic Impact and Environmental Assessment Study* of the PSPS development and this assessment.

No.	Department	Reference	Comments	Consultants' Response
12	Highways Dept (Str)	(35) in STR 5/30/322	(a) I do not support the use of noise enclosures as noise mitigation measures because of their high initial cost and the subsequent maintenance commitments as well as the visual impact in providing these massive structures. You have not identified the requirements for FSD, PED and HyD in respect of the fire fighting operations, provision of ventilation and lighting. Their requirements should be sought at this stage as they will affect the viability and cost effectiveness of the Enclosure Option.	Noted. In the Conclusion in Section 5.8 we have highlighted that the use of noise enclosures is the most costly option but is however the most effective and practical means of direct mitigation. In Section 5.6.1 we have detailed the constraints to mitigation options as being the fact that the enclosures will be subject to requirements for fire fighting, emergency operations, lighting, ventilation etc. We should perhaps add specifically that the 500m long enclosure will require full fire services installations and the 305m long enclosures would require mechanical ventilation and lighting.
13			(b) In Annex C, please provide the breakdown details of the unit rates for the different mitigation measures.	Noted. Unit rate breakdowns will be added.
14			(c) In the Tuen Mun Road/Wong Chu Road Interchange, the provision of the mitigation measures along the inner curve of Slip Road A will incur sight line problem, which will entail the carriageway to be widened by 2m. Please confirm whether or not such widening will have any encroachment upon the lot boundary of On Ting Estate.	Certainly the widening of Slip Road A will shift the extent of permanent road improvement works closer to the boundary of On Ting Estate but our preliminary assessment on the basis of the engineering proposals so far provided by Government, is that the permanent works when widened by 2m will not encroach into the Estate. However, it will need to be reassessed at detailed design stage whether any part of the works will encroach into the estate when more details will have been established.
			Similarly, in the existing Hoi Wong Road/Wong Chu Road Interchange, the slip road adjoining Yau Oi Estate will have to be widened by 2.4m. Please confirm whether or not such widening will have any encroachment upon the lot boundary of Yau Oi Estate.	At the Hoi Wong Road/Wong Chu Road interchange the road widening to provide slight clearance adjacent Yau Oi Estate should not result in any encroachment into the lot of the estate.

No.	Department	Reference	Comments	Consultants' Response
15			(d) A Section of the existing Wong Chu Road over the Tuen Mun Heung Sze Wui Road is on elevated road. I have reservation on the structural feasibility of erecting noise barrier or enclosure on this existing bridge. Please investigate and report the finding in the report.	A design check has been carried out on the Wong Chu Road P3/D bridge indicating the additional loads brought about by connecting the enclosure to the bridge would result in excessive torsion and uplift. Measures to counteract these effects, including replacement with uplift bearings, have been considered, none of which appear feasible. It therefore appears that an independent supporting structure is required. A possible arrangement is given on *Figures 5.6d & 5.6e.*
16			(e) I do not agree that the visual impact due to the erection of any noise barrier or enclosure along Tuen Mun Road in the Wong Chu Road/Tuen Mun Road Interchange can be minimized to any acceptable level even with proper design techniques and landscape treatment. This is because of the complexity of the Interchange and the site constraints imposed by the four slip roads.	The constraint for alleviating the potential visual impact which may be caused by noise mitigation structures is noted. However, the existing visual quality of the area, which is typically urban and dominated by roads and interchanges, is low and the 'additional' impact due to the proposed mitigation structures is not expected to be high. In the circumstance, there are possible design and landscape techniques to minimize the impact, which will be developed after the optimum mitigation package is endorsed and reported in the Final Report.
17			(f) In Section 5.6.1, consultation with KCRC and the Regional Council to resolve the land matters should be made at this stage, as this may affect the viability of the Mitigation Options.	The definite requirement for, and exact location of any additional supports or columns within the LRT reserve which are required to provide additional support for the enclosures to elevated road section crossing over the LRT, cannot at this stage be established. Such details cannot be determined until detailed design stage and it is therefore considered premature to commence further consultations with KCRC. It is not believed that this would affect the viability of the options as the general requirements and constraints of KCRC are known. Initial consultation with RSD has indicated that they have no specific comment [RSD Ref: (78) in RSD 1/HQ 712/84(8)X].

No.	Department	Reference	Comments	Consultants' Response
18			(g) Figure 5.2a mentioned in Section 5.2 is not enclosed within the report.	The figure will be included in the Final Report.
19			(h) Referring to Section 5.5, just the 5m high barrier along the southbound section of the Foothill Bypass is adequate to contain the noise impact. The 5m cantilever barrier shown in Figure 5.5b and Figure 5.5c for this section of the Bypass should be amended to be consistent with the text.	Agreed. The figures will be amended accordingly.
20	Highways Dept (SLA)	HYDT 12/6/44	(a) General Visual/Landscape Considerations These issues are not adequately addressed in the Report. Please note that the road scheme plus the proposed noise mitigating structure will destruct the existing roadside amenity planting which is of significant importance to provide visual buffer and dust filter to the neighbourhood. Removal of them will severely degrade the existing landscape quality and amenity value. Please therefore look into this matter in details and information such as the number of existing trees affected by the scheme, the proposed compensatory scheme to improve the landscape quality and amenity value should be provided. Please note that despite noise and air pollution addressed in the Report, visual, landscape and amenity issues are also important aspects in environmental consideration and what we are after is a comprehensive assessment on the total environment affected by the scheme.	As stated in the Inception Report (para 3.2.7), visual/landscape considerations will be given to conceptual design of the mitigation structure to ensure that these structures will be aesthetically compatible with the surrounding land uses and will provide a comfort environment to pedestrians. The requested comprehensive landscape and visual impact assessment is outside the scope of this EIA study.
21			(b) Visual impact and landscape treatment for noise barriers Noise barriers are recommended as the most feasible option in the Report, more details about the proposed barriers and the resultant visual impact of them on the surrounding environment should be addressed in the Report.	As indicated above, detailed assessment is outside the study scope.

No.	Department	Reference	Comments	Consultants' Response
22			(c) Proposed noise barrier (Fig 5.6a) i. I have reservation on the effectiveness of Detail C to minimise the colliding impact of vehicles with the design of the proposed plinth.	Noted. Detail C in Figure 5.6a will be revised to a more substantial concrete plinth support for the barrier frame and will be proposed to be set back to minimize any adverse effect on resistance to colliding impact.
23			ii. The arrangement of noise barriers along roadside is unacceptable. The gap between the slope and the wall will become a dumping corridor of rubbish. It is very undesirable to expose the pedestrian as using the footway to be bombarded by the traffic noise, which is exponentially exaggerated by reflection from the noise barrier. It is more appropriate to locate the footway outside the noise barrier, if technically feasible.	Agreed. The arrangement of the noise barrier along roadside in Figure 5.6a will be revised to show the footway outside of the noise barrier.
24			(d) Proposed enclosure design (Fig 5.6b) The arrangement of putting the footway between the enclosure wall and the existing boundary wall is entirely unacceptable. Please note that the human scale will be totally lost with such arrangement. In particular, the "enclosed corridor" will become a crime spot. At this stage I would suggest: i. negotiation should be made with other relevant parties to replace the existing boundary wall with appropriate landscape measures;	Noted. Agreed. Typical sections only are given in Figure 5.6b. For the actual locations finally proposed for noise enclosure (Option 4), there is no footway alongside the road carriageways and so no "crime spot" problem would exist. Figure 5.6b will be revised to clarify this.
25			ii. footing of the enclosure structure should be designed to avoid intrusion into the footway area so that the chance of providing appropriate landscape measures along the future footway will not be exploited.	Agreed. Similar response to comment (i) above, there will be no footways alongside the road. Figure to be revised.

No.	Department	Reference	Comments	Consultants' Response
26			iii. Steps along the footway should be avoided.	Agreed. Similar response to comment (i) above, there will be no footways alongside the road. Figure to be revised.
27	Highways Dept, PMT	(2) in HYD MWPMO 2321CL/WGV	Section 2.3, Utilities a. As there is a number of major utilities along the roadworks, please prepare a drawing to locate them for clarity.	Noted. As there are a large number of utilities along existing Lung Mun Road, these will be indicated on a figure to illustrate the extent of the problem.
28			b. The programming of diversion/relocation of utilities should be planned well in advance. Also, the diversion of WSD/DSD's installations is subject to the agreement of the corresponding Departments and it would have time/cost implication. These factors should be considered as constraints to design and construction.	Agreed. Lead times and cost implications of utilities/services diversions are constraints to design and construction that will be added to Section 2.3.
29			c. Please indicate where is the emergency vehicular access (EVA) road as stated in Para 3 of Utilities.	Noted. The EVA is located in between the future PSPS Development in Area 18 and Lung Mun Road.
30			Section 2.4.1, para 3 Please prepare an alternative construction programme as mentioned above for easy reference.	An alternative construction programme for alternative traffic management measure option will be added.
31			Section 2.6 The location of the footbridge on Wong Chu Road should be indicated in the drawing.	The footbridge on Wong Chu Road is shown on Figure 2.6.2. This will be clarified in the text.
32			Section 3.1.4 Figure 3.1b is missing.	As responded in item 8, the figure will be included in the Final Report.

No.	Department	Reference	Comments	Consultants' Response
33			Section 3.1.5, para 3 Although significant excavation is not expected for the roadworks, there is a large filling embankment expected for the northern section of the foothill bypass as indicated in the construction programme. Will the filling work affect the air quality during construction?	Dust impact of the filling works have already been included in the assessment. Text clarified.
34			Section 3.2.3, Table 3.2a Further to my previous comment on the working paper concerning "rock piling" work at monitoring location M1, please clarify whether there is a "rock piling" works in the vicinity.	The text will be amended to "nearby general construction noise".
35			Section 3.2.5, para 5 line 5 Please clarify who are the "Engineers".	Text amended to "... trip frequencies given in Figure 2.2a Tentative Construction Programme".
36			Section 4.6, para 2 It seems that you do not indicate whether the pollutant levels at the ends of the enclosure is acceptable or not. Please clarify.	A more detailed assessment will be followed if the enclosure option is adopted. However, it is expected that the AQO criteria will not be exceeded. Should there be any exceedances, recommendations will be made to the ventilation design, whcih is to be undertaken at the next stage, to mitigate the impact to acceptable levels.
37			Section 5.3, para 2 Fig 5.3a is not the digitized road scheme as HFA Noise graphical output. Please rectify.	Agreed. The digitized road scheme as HFA Noise graphical output was not included in the report, and will be added to the Final Report.

No.	Department	Reference	Comments	Consultants' Response
38			Section 5.5, Mitigation 4 It appears that the recommended solution, Mitigation 4, could not solve the problem completely. Is it still the best solution?	Given the physical constraints of the roads, mitigation option 4 is the best practicable solution of mitigating the impact at source.
39			Section 5.6.1 a. Land Matters It seems that there is no reprovisioning of the affected facilities at Tuen Mun Recreation Sports Centre required. Please consult PM/NTW on it.	PM/NTW will be consulted to confirm that the Sports Centre has land provision for the Foothill Bypass.
40			b. Installations, Utilities and Right of Ways In addition to the serving agents mentioned above, WSD and the Gas Company should be consulted too.	Both WSD and HK and China Gas Co Ltd has been consulted. The information obtained from the Gas Company shows that their installations are unlikely to be affected by the proposed mitigation structures whilst the WSD indicated that it is difficult to comment in the absence of details of the mitigation measures [WSD Ref: (4) in WWO/M1224/1744/93II TJ1]. The two utilities companies should be consulted at the detailed design of the Roadworks. Text amended.
41			Section 5.7 It appears that the estimated cost did not include the recurrent cost. In addition, please clarify the nature of the bridge widening as mentioned in Annex C.	The Consultants will clarify out in the text that for Mitigation Option 4, no account has been taken of the recurrent operating costs for fire services installations, lighting and ventilation for the noise enclosures. The bridge widening referred to in Annex C refers to Slip Road B on the P1/P3 Interchange. This will be clarified in the text.

No.	Department	Reference	Comments	Consultants' Response
42	TDD, NTW Office	(52) in NTW/TM 2/CL/321/4 Pt 2	*Section 4.6* The Consultants should carry out quantitative assessment to verify that he ASRs near the proposed noise barriers/portals, if provided, are within the AQO.	A quantitative assessment will be carried out if the barriers or enclosures are adopted.
			Section 5.5 This section is grossly lack of innovative ideas and technical details. I request the consultants to issue a supplementary Technical Notes to cover the followings:- a) Various types (eg shape, height, material etc) of noise barriers/covers adopted worldwide and in Hong Kong;	The study has taken into consideration various noise mitigation possibilities that are applicable to the Roadworks. The Consultants will prepare a Technical Note and circulate to interested Working Group members, detailing descriptions and general schematics of types of noise/covers barriers used in Hong Kong and overseas. The types of materials available will be discussed. The relative advantages/disadvantages of the options including cost/construction considerations will be included
43			b) Cost implication due to (a); c) Construction implication due to (a); d) Advantages and disadvantage over various types of barriers/covers; e) Why the barriers/covers are arranged as shown on figures 5.5a-c? Why barriers/covers cannot be installed elsewhere? f) Confirmation, on engineering ground, that the barriers/covers can be constructed at the locations recommended by the consultants.	The location of the barriers and enclosures shown in Figures 5.5a-c were based on the findings of the operational noise assessment (reference para 5.4), these barriers and enclosures were recommended in order to mitigate the unacceptable noise impacts caused by 'new' roads at the affected NSRs. In the report it will be confirmed that it is generally feasible on engineering grounds to construct noise barriers/covers at the locations shown, the exact details will be subject to detailed design.

No.	Department	Reference	Comments	Consultants' Response
44			*Table 5.5 a–d* Please clarify on the term "N/A". In many case, the previous mitigation measures are insufficient to reduce the noise levels to acceptable levels while "N/A" is inserted.	Noted. Where "N/A" has been inserted, the previous mitigation measures is sufficient to reduce the noise levels below the "Noise insulation Criterion". For clarity, noise levels for all NSRS will be included in the Final Report.
45			*Section 5.6.1 Traffic* Traffic diversion necessitated by construction of noise barriers/covers need to be addressed fully, as it would affect the cost estimate and the technical viability. Please elaborate.	Traffic diversions should only be necessary where noise barriers are proposed along Wong Chu Road, from the existing bridge over Heung Sze Wui Road westwards. This is a dual two lane carriageway and traffic may be reduced to a single lane over off-peak hours whilst the noise barrier/covers are erected. All other barriers/covers are indicated along roads which are either proposed or require upgrading works and the noise mitigation measures can be installed at the same time as the works are carried out.
46			*Section 5.6.1 Utilities* Again, the issue regarding utilities diversion needed to be elaborated, as it would affect the cost estimation.	Noted. This will be discussed in more detail in the Final Report. It will be stated that where conflicts between utilities and the piling/concrete wall supporting the noise barriers are encountered these may be resolved by either realigning the utilities or the barrier slightly or altering the spacing of the piles. Such conflicts can only be identified during the construction stage when the exact locations of the utilities can be confirmed on site with respect to be detailed design.

No.	Department	Reference	Comments	Consultants' Response
47			*Figure 5.6 a & b* Please indicate clearly how barriers/covers can be built over Wong Chu Road (both bridge section and embankment section) and Tuen Mun Road. As the Wong Chu Road and Tuen Mun Road are existing roads, please be specific and avoid referring to standard details.	Noted. The Consultants will include sketches specifically for these sections in the Final Report.
48			*5.7 and Annex C* Please provide full details of construction and insulation costs breakdowns. Please advise the residual noise level at NSRs upon completion of the insulation works. Please also advise which party will be responsible for paying the electricity charges in case A/C units are provided.	Noted and agreed. Full details of cost breakdowns will be provided in the Final Report. However insulation is no longer required according to the revised noise modelling assumptions agreed with EPD.
49	TDD	NTW/TM2/CL/321 /4 Pt 2	Tables 5.3a–h, tables 5.4a–d & Tables 5.5a–d Please indicate the numbers of dwellings affected at each NSRs, ie the building up of the total number of dwellings affected.	Noted, this information has already been presented in Table 5.5e.
50			Table 5.5e Please describe briefly the locations/positions of the dwellings that will not be benefited from the various mitigation schemes. As the final assessment year is 2011, should this study also take into account the variation of dwellings affected due to possible re-development of buildings in the study areas?	Noted. The NSRs locations benefiting from the various mitigation options has already been discussed in the mitigation measures section. This study is based on the current OZP and has already taken into account the main planned NSR in the study area, ie the Area 18 PSPS housing development.
51	HyD (D&M)/NT	(61) in HNT/713/TM/35 XIII	No comment.	Noted.

No.	Department	Reference	Comments	Consultants' Response
52	EPD	( ) in Annex (2) to EP2/N4/34	*General Comments* (a) There are significant discrepancies between the results of traffic noise modelling conducted by the consultant and our spot check. The consultant should review the situation and liaise with our Noise Policy Group (NPG).	Subsequent to meetings with EPD NPG to discuss noise modelling assumptions and results in detail, the noise model was revised in minor ways and the predictions now agree within 2 dB of the NPG's predictions.
			(b) The Consultant should relate the recommendations in this study with those in the Expanded Development Study of Tuen Mun Area 38. A summary of the recommendations of the EDS in regard to the Study Area should be provided. The Consultant should then review the course of actions.	The noise levels predicted in the EDS of Tuen Mun Area 38 uses the 2001 traffic flow condition, and hence it is not relevant to make direct comparison between the recommendations in this study.
			(c) The Consultant should demonstrate that the mitigation measures proposed are engineering feasible and are acceptable to all concerned departments.	Comments received from concerned departments have been responded to and text/drawings amended where appropriate
			(d) I notice that the Consultant has proposed some traffic diversion schemes during construction. The Consultant should clarify whether these traffic management schemes will be specified in the contract for implementation.	Yes, it is recommended that these traffic management schemes for construction are specified in the Contract for implementation.

No.	Department	Reference	Comments	Consultants' Response
			(e) It is very confusing to locate the NSRs as a location plan to delineate these receivers are not provided in the report.	This Figure was omitted in error, and has been incorporated into the Final Report.
			(f) As a consultancy for the Phase 2 of the Foothill Bypass is going to be implemented soon, ERM should identify the cumulative impacts to be further studied, and any follow-up works if necessary.	With regard to traffic noise impacts, the 2011 flow forecasts have allowed for all future developments. It is noted that the detailed design of the Foothill Bypass is not available at this stage of the assessment, and a detailed operational impact assessment will be required.
			(g) We are still receiving the EM&A section of the FR and will provide you with the comment once available.	Noted.
			(h) The Consultant is required to identify which section of the road is classified as "existing" or "new".	Figure 5.5a will be updated to show the road classifications as agreed with the NPG.
			(i) Enclosed please find the guidelines of EM&A. ERM should ensure that the requirements are fully incorporated into the EIA report.	Consultant will incorporate the requirements into the Final Report.
53			*Noise Impact – General* (a) The Study Area and the proposed roadwork for the Lung Mun Road Bypass as shown on Figure 1.1a extend beyond those indicated in Figure 2.1b and the noise model. The Consultants should clarify.	As indicated in Section 2.1, scheme plans used for Figures 2.1a & 2.1b were provided by HyD and there is no details on the Foothill Bypass Northern Section apart from the alignment shown in Figure 1.1a.
			Construction Noise Impact (b) Section 3.2.2 The Consultant should note that percussive piling is controlled all day and a CNP is required for such works.	Noted, text amended.

No.	Department	Reference	Comments	Consultants' Response
54			(c) Section 3.2.6 We are particularly concerned that, even with the use of quiet plants and the implementation of mobile barriers, two schools NSR 36 and 40 would still be exposed to noise levels above the established limits. The consultant should recommend additional mitigation measures and consider providing building insulation to these schools as a last resort in accordance with EPD's Practice Note for Professional persons ProPECC DP2/93. The Consultant should also confirm the extent of insulation for the schools (including NSR 9 & 10) to ensure that the existing insulation is adequate in protecting the students against noise form the construction activities.	Education Department have recently given further information on the status of noise insulation on these schools. This information will be added to the Final Report and additional noise insulation will be recommended if required for construction noise mitigation. Noted, although this would require detailed site survey work to check every window, we will indicate those facades that require insulation to allow the exact extent of additional insulation to be established at a later date.
			Operational Traffic Noise Impact (d) Section 5.2 Figure 5.2a is missing in the report. (e) Table 5.2 and Table 5.2b The Consultant is required to indicate the PD levels of the receiver points in the report.	 Noted, Figure 5.2a will be included in Final Report. These tables will be included in the Final Report to show PD levels.

No.	Department	Reference	Comments	Consultants' Response
			(f) Section 5.3 It was agreed in a meeting between EPD/NPG and ERM on 6.7.95 that for the purpose of traffic noise calculation, the traffic flow on the eastern part of Wong Chu Road will be used for the whole length of Wong Chu Road until it reaches the Wong Chu Road/Foothill Bypass interchange. (Please see notes of this meeting issued by ERM on 11.7.95 for details). In view of the aforesaid, the calculated noise levels at the NSRs may need to be revised. "We spot checked the predicted traffic noise levels with our own noise model based on the Consultant's information and the agreed traffic data and noticed some significant discrepancies at some NSRs as shown in the attached tables. The Consultant is required to check their calculations."	Noted and the noise levels revised. See response to comment 52(a) above.
			(g) Figure 5.5a–c Some of the road sections are coloured black. What do they mean? Secondly, it will be useful if the "new" road sections for the purpose of noise modelling are shown on these figures. (h) Section 5.5 & Annex C Table 1 Option 4 contains 2745 m^2 less of Low Noise Road Surface. Where are the savings?	Noted, see response to comment 52(h) above. The reduced area is due to the assumption that roads under enclosures will not need Low Noise Surfacing.

No.	Department	Reference	Comments	Consultants' Response
			(i) Tables 5.5a–d The noise mitigation measures should be designed to meet the HKPSG criterion as far as practicable. It appears from these tables that the consultant has only aimed to reduce the noise levels to below the "Noise Insulation Criteria" only. The consultant is required to clarify. Furthermore, the consultant should show the predicted noise level at all the identified NSRs for each mitigation options even if the noise levels are below the acceptable levels (ie those entries denoted "N/A").	With a road improvement scheme of this type, it is likely that prevailing noise levels or noise level from unaltered roads in 2011 are responsible for noise levels above the HKPSG. ERM have developed a reporting format in conjunction with EPD NPG through three previous projects of this type (WKR focused EIA on Roadworks, Chai Wan Road Widening EIA, and Route 16 EIA) in recent months that most clearly lays out the assessment of traffic noise impacts in such cases. This same reporting format has been adopted in this case, and in our view is the clearest way of presenting the assessment. This reporting format does consider all direct measures to achieve the HKPSG, although it does not dwell on this area, as in some areas no direct measures are available to achieve this. Noted, for clarity, noise levels for all NSRs will be included for the recommended mitigation option (4).
			(j) Section 5.5 & Table 5.5e The Consultant is required to confirm that the numbers on Table 5.5e represent those dwellings exceeding the HKPSG criterion as a results of the proposed roadwork. The no of dwellings meeting the eligibility criteria for insulation for each option should be stated. Normally, we would expect the numbers to be different with the no of dwellings meeting the eligibility criteria less than the no of dwellings exceeding the HKPSG criterion. The Consultant should also indicates, preferably on Figures 5.5a–c, the locations of the dwellings which still meet the eligibility criteria for insulation for each mitigation options and the Without Mitigation option. (Additional figures may be needed).	The Consultants confirm that the numbers on Table 5.5e represent those dwellings exceeding the HKPSG criterion. According to the revised noise modelling, none of the dwellings are qualify for insulation. See response above.

No.	Department	Reference	Comments	Consultants' Response
53			(k) Section 5.6.1 The consultant should recommend practicable and feasible mitigation measures. Due considerations on constraints such as fire fighting, emergency access, lighting, ventilation and effects on sign distance, should be given in the Consultant's recommendations.	The recommended mitigation measures are considered to be engineeringly feasible, subject to detailed design. (see response to comment 12 above)
54			*Aerial Emission Impact* (a) Figure 3.1b is missing. This figure that shows the locations of ASRs should be incorporated in the report. (b) Section 3.1.6 last paragraph Please justify that the assumption of RSP generation is approximately 20% of the TSP. (c) Section 3.1.8, last paragraph (ie 1st paragraph of Page 18), 2nd line Should the phrase "to ensure the" be place after "Area 18 PSPS". Please clarify. (d) Section 4.6 By examining Figure 5.5a, 5.5b & 5.5c, the NSRs 13, 17, 18, 47, 48, 49 & 57 may be subject to higher air quality impacts due to the aerial emission from noise enclosures/barrier & portal, the consultants should demonstrate that the cumulative air impacts (ie impacts due to emissions of the portal and open roads plus background air pollution) on the NSRs will not exceed the AQOs.	Noted and Figure included in Final Report. The assumption was an indicative figure used in previous studies, based on the emission information on RSP for different activities in AP 42: Drilling (10%TSP), bulldozing (25%TSP) Noted. The sentence will be rephrased. Pollutant levels at the ASRs are low. It is expected that the additional impacts from barrier/enclosure will comply with the AQO. Even if, very unlikely, the criteria has exceeded the AQO, mitigation measures could be adopted to reduce the impacts (eg. by directing pollutants using upward ventilation fan)

No.	Department	Reference	Comments	Consultants' Response
55	DO/TM	(21) in TM 230/5/23 IX	No comment.	Noted.
56	DLO/TM	DLOTM LNT 119/MPG/74 XVI	No comment.	Noted.
57	Comm. of Police (CSP Traffic)	(28) in CP/T/TMB 151/4 Pt. 40	Subject to the traffic management arrangements for both the Road P3/D15 and Road P1/P3 Interchange being discussed in full at a later stage I have no particular comments to make in respect to this report.	Noted.
58	EPD	Annex (2) to EP2/N4/34	We are concerned about the implementation of noise barriers/enclosures might have adverse aerial emission impacts onto the surrounding environment. We therefore put forth our comments/observations to the consultants on the potential air quality impacts in respect of the proposed mitigation measures.	Noted.
59			The Consultants had advised that, due to the low concentration of pollutants predicted at sensitive receivers, no significant air quality impacts would be anticipated if the barriers (either 3m or 5m high) are to be built. We would remind ERM to document this prediction in detail in the EIA report.	Noted
60			If the enclosure option is implemented, the consultants shall demonstrate that the cumulative impact from the portals emissions, ventilation system of the enclosures, open road sections and the background concentration will meet the established criteria. Otherwise, the consultants must propose mitigation measures to achieve these criteria.	Noted.
61			We would remind ERM to submit the modelling methodology for the enclosure for our agreement before the commencement of modelling. They should present the predicted concentrations of air emission in contour diagrams and demonstrate that the air quality inside enclosures would comply with the requirements in the EPD's "Practice Note on Control of Air Pollution in Vehicle Tunnels".	Noted.

No.	Department	Reference	Comments	Consultants' Response
62			We understand that ERM is revising the traffic noise modelling. I would take this opportunity to remind the consultants to complete the draft EIA for our agreement in the first instance.	Noted.
63	EPD	Annex (2) to EP2/N4/34 Pt3	Re ERM's fax dated Nov 7, 9, 10 & 14, 1995 regarding the modelling methodology and results assessed for the enclosure to be erected for the captioned project.	
64			The Consultant advised that NO_2 level would be marginally exceeded at the ground level of Oi Shun House as reflected from the assessment. Could the consultant please demonstrate that those proposed mitigation measures, ie "discharging the vehicle emissions upward" and "reducing the pollutant discharges at the west postal" could be engineering feasible to mitigate the situation effectively, and meanwhile, would not thus cause exceedance of AQO at the nearby ASRs at high levels as a result of this diversion.	The Consultants will discuss the methodology and assumptions with EPD based on the new enclosure arrangement to accommodate FSD requirements.
65			The consultant assumed in the model that the TAQG limits would be the worst scenario. Whilst details of the mechanical ventilation is not yet available, the consultants have assumed the flowrates of vitiated air from the tunnel portals. Would the consultant please advise the base of assumption for the flowrates and confirm that the assumed flow will be adequate to ensure the TAQG being achieved inside the enclosure. Have the flowrates at the portal taken into account the worst scenario such as bi-directional traffic flow? In addition, if the consultants expect that there will be no ventilation shaft for the full enclosure, they should also state this assumption in the study report.	See response above.
66			Table 4.6(a) & (b) have not incorporated the cumulative impacts at the sensitive receivers due to the portals emissions, open road sections and background concentrations. I suggest the consultants to compile the cumulative impact assessment results in separate tables to reflect the pollutant concentrations with the full enclosure installed.	Noted and agreed.

No.	Department	Reference	Comments	Consultants' Response
67			The contour diagrams 4.6(a), (b), (c) & (d) have not fully indicated the relative positions of the sensitive receivers under consideration. The exact location of the proposed enclosure has also not been marked in the diagrams. In addition, the concentration values of pollutants should be clearly labelled.	Noted and agreed.
68			It is noted in Section 4.4, second para, that the consultants stated that "With a barrier, ... and ASRs located along the road alignment might receive a higher air quality impact." The consultants are reminded that they had stated that they did not anticipated significant air quality impact due to these barriers and would state this in the report. please refer to EPD's memo – Annex (2) to EP2/N4/34 dated 11.9.95. The final report should thus reflect the consultant's view.	Noted.
69			Figure 3.1b, the location of various air sensitive receivers have not been clearly shown. Suggest to have this figure printed on A3 size paper in the final report. Also, Tables 4.6a & 4.6b should also be revised to include ASRs' codes in the first column for ease of reference.	The figure will be revised to improve clarity.
70			Section 4.5, second para, second line, ... in Figures 2.3b & 2.3c should be read as Figures 2.5b & 2.5c.	Text amended.

No.	Department	Reference	Comments	Consultants' Response
71	TDD/TMDB	(12) in NTW/TM/ 2/CL/321/4 Pt.3	To solve the traffic noise problem along Wong Chu Road, District Board members suggested that traffic diversions, in addition to noise barriers, should be investigated together with the noise mitigation measures for the areas where Wong Chu Road joins Tuen Mun Road.	Wong Chu Road was designed as a primary distributor to link the western part of Tuen Mun with Tuen Mun Road so as to avoid high traffic volumes passing along the multi-purpose roads and through the many signal-controlled junctions in the town. On safety grounds alone it would not be appropriate to divert traffic from this purpose-designed high capacity route onto other roads within the town. Furthermore, any such diversion would also impose increased traffic noise on these other routes which would probablty be less amenable to any noise mitigation measures than Wong Chu Road. In these circumstances, the study considered that diversion of traffic should be avoided as far as practicable, even during the construction stage of the project. Direct traffic noise mitigation measures on slip roads joining Tuen Mun Road and Wong Chu Road have already been assessed and recommended in the EIA report. It has been considered that the recommended mitigation measures on the slip roads as described in the EIA report are sufficient in protecting the residential building nearby from unacceptable levels of traffic noise.
72	EPD	Annex (2) to EP2/N4/34 Pt3	*General Comments* You should outline the status of Wong Chu Road, ie it is an "existing" road; and the existing policy, or absence of one, for the provision of noise mitigation measures of an "existing" road.	Noted and agreed. TDD's commitment to the implementation of the recommended noise mitigation option 4 along Wong Chu Road should be confirmed in the SMG.
73			The rationale behind the provision of direct noise mitigation measures in the Wong Chu Road must be highlighted. To do so, you should recap the findings and recommendations of the EDS.	The findings and recommendations of the EDS will be highlighted again in Section 5.

No.	Department	Reference	Comments	Consultants' Response
74			You must outline that with the development of TMP additional roadwork will be built.	Text in Sections 1.2 & 2.5 will be clarified.
75			You should consult HyD in regard to the acceptability of the absorptive noise panel proposed.	The information was sent to HyD on 23 January 1996. Referring to HyD's response dated 24 January 1996, the consultants confirm that the absorptive noise panels recommended to fulfill the designed acoustic performance of the noise enclosures are available in the market.
76			In the light of the predicted severe noise and air quality impacts during the construction stage, you should remind PM/NTW to implement a stringent monitoring programme to rectify any potential exceedance of the established criteria.	Noted. TDD's attention is drawn to the recommendations in the report.
77			*Section 2.6, Page 5, third paragraph, first sentence* You might consider to rephrase "In order that full enclosure do not require full fire fighting service ..." as this might misrepresent the safety standards are compromised.	The paragraph is amended as: "In order that full enclosures fulfill all FSD requirements and do not restrict the passage of certain classifications of DGVs, it will be necessary to limit their length to not greater than 230m. In addition openings for natural ventilation with an open area equal to or exceeding 6.25% of the road surface area must be provided. The clear ....."
78			*Section 3.2.6, Page 35, last paragraph* As Type II insulation are recommended to the Primary School during construction, you should ensure PM will specify this in the contract.	PM's attention is drawn to response no. 14 and 17.

No.	Department	Reference	Comments	Consultants' Response
79			*Section 4.8, third paragraph* "... The NO_2 criteria will be marginally acceptable at Oi Liu House ...". The consultants should consider to rephrase the sentence to delineate the modelling results succinctly and to avoid generalizing the situation. It appears that the NO_2 level at ground level with 7.6m headroom enclosure is 279 $\mu g/m^3$ and the concentration will be reduced at higher levels.	Text clarified.
80			*Section 6, para 2* The sources of residual noise exceedance should be quoted as examples.	The sources of residual noise exceedance from surrounding roads will be added, including Hoi Wong Road, Tuen Mun Road, Lung Mun Road and Tsing Wun Road.
81			*Section 6, last paragraph* It was mentioned that a detailed EIA will be taken at the detailed design stage. As discussed, further EIA studies will not be expected unless there are material deviations in the detailed design. Even so, the studies will be termed as part of the environmental auditing. Please amend the text to reflect.	Text clarified.
82			You should advise the estimated number of Dangerous Goods Vehicle that will be using the Wong Chu Road after the development of the SIA and RTT.	Without undertaking a survey of the existing DGV using Wong Chu Road, a realistic estimate of predicted DGV traffic flows on Wong Chu Road after development of the SIA and RTT cannot readily be made. Even with some limited traffic survey information, any forecast that would be made at this stage would be based on significant assumptions concerning, growth rates, nature of Area 38 SIA/RTT operations and routes that DGV traffic would take.

No.	Department	Reference	Comments	Consultants' Response
83			*Noise Impact* *Figure 1.1a* At the western end of the roadworks (ie the Foothill Bypass), the Study Area as shown on Figure 1.1a terminates at the end of the roadworks. ERM should note that the Study Area, for the purpose of the noise impact assessment, should at least cover an additional 300m after the termination of the roadworks. Figure 1.1a should be amended accordingly.	The noise assessment was based on the Study Area defined in the Study Brief.
84			*Section 2.6 Noise Barriers and Enclosures, 4th paragraph* ERM should justify in the report why full fire fighting services cannot be provided for a full enclosure longer than 230m. Secondly, the phrase "of a minimum total floor area of 6.25%" would be better rephrased to "with an open area equal to or exceeding 6.25% of the road surface area".	See response no. 6.
85			*Section 3.2.6* To alleviate the construction noise impact on the schools, ERM proposed Type II window insulation for some schools, namely Liu Cheung Kwong Primary School (NSR 10) and Morning Light School (NSR 40). ERM should check with ED on the provision under the Noise Abatement Measures in School Programme (NAMISP). Additional funds and work would be needed to upgrade the existing provision to Type II window.	As advised by ED via HyD, the noise insulation for Liu Cheung Kwong Primary School and Morning Light School will be completed before 1996 and 1999 respectively. However detailed information such as the type of insulation and exact timing of installing the insulation was not provided. The Consultant can only recommend that Type II window be provided to both schools and that the insulation for Morning Light School be completed by 1997 summer prior to commencement of the main construction activities of the Roadworks.
86			*Table 5.2a* There appears to be a mismatch between the stated PD levels and the representative floors of some NSRs. For example, the level difference between 1st and 3rd floor is only 7.8m for some NSRs. ERM is requested to recheck.	Table revised. As explained to NPG/EPD, the PD levels for the Low Level should be 2.8m lower than that given in the table. However the heights used in the noise model are correct.

No.	Department	Reference	Comments	Consultants' Response
87			*Section 5.3* The three "noise insulation criteria" are only applicable to residential premises. Schools need not be subjected to these three criteria. ERM should make clear in the 3rd paragraph.	Text clarified.
88			*Section 5.4* The predicted traffic noise levels at some schools would exceed over 10dB above the HKPSG criterion of 65dB(A). As such, Type II and Type III window insulation would be required for, these schools. ERM should check with Education Department on the existing provisions under the Noise Abatement Measures in School Programme (NAMISP). Additional funds and work would be needed to upgrade the existing provision to Type II and Type III windows.	As mentioned in response no. 14, the Consultant has no information on the insulation details of these schools. The Consultant can only recommend the appropriate type of insulation for these schools.
89			*Section 5.5 Number of Dwellings Benefited* ERM is requested to state the total number of dwellings in the Study Area still exceed HKPSG criterion after implementation of the recommended mitigation measures.	There will be approximately 7044 dwellings.
90			*Table 5.5e* The heading "Approximate No and % of the Dwellings Benefited" appears to be incorrect. ERM to clarify.	Text revised accordingly.
91			*Section 5.5 Noise Insulation* Some schools would require additional window insulation (ie in addition to the existing window type or the existing provision under the NAMISP). PM should remind ED of the need.	See response no. 14 and 17.

No.	Department	Reference	Comments	Consultants' Response
92			*The Noise Enclosures* ERM should note that NSRs near the enclosure portals may be subjected to higher noise levels due to the sound reflecting from the hard surfaces of the enclosures and breakingout at the portal openings. ERM should consider lining the enclosure ceiling with sound absorbing material as well as the enclosure side walls. (ERM is advised to make reference to a paper by Helmut Wochner, "Sound propagation at Tunnel Openings", 1992). Also, to minimize the noise breakout from the side openings of the enclosures, ERM should consider to line the interior surfaces of the overhang portion of the top member with sound absorbing material as well.	With reference to the calculation in Annex F, the use of sound absorptive materials on enclosure ceiling has been assumed. The drawing in Annex F will be amended accordingly.
93			*Recommended Mitigation Option 4* To avoid ambiguity, the report should clearly show the recommended extent of the low noise road surface on a drawing.	Drawing added.
94			*Air Quality Impact* The modelling methodology and results presented by the Consultants for assessing the air quality both inside and outside the noise enclosures are acceptable. However, the enclosures parameters, stated under Section 4.5.2, should also include the percentage of side openings (ie 12.5%) as one of the major assumptions for the assessment. The report should also state that should any of those assumed parameters subsequently change in the detailed design stage, the overall air quality impacts on various ASRs, in particular the one at ground level of Oi Shun House and Oi Liu House, have to be re-assessed in order to confirm whether or not the criterion pollutants concentration wills till be within AQO standards.	Noted and text added. In the calculation, the consultant has assumed the size of openings to be 0.875m long (see Section 4.5.2), ie. 8.8% of total road surface area.

No.	Department	Reference	Comments	Consultants' Response
95			In Chapter 4, the proposed sketched design for the noise enclosure has not been shown, in particular the position of side openings. The consultants should attach a diagram to this chapter to illustrate the detailed configurations.	Text added to refer to Figures 5.6b & c which present the enclosure arrangements.
96			The contour diagrams 4.6 (a), (b), (c) & (d) should be printed on A3 size papers so as to give clear indication of the various ASRs under consideration. The exact location of the proposed enclosures should also be marked in the diagrams.	Our printer can only print out A4 size papers but we will improve the quality of the figures including the enclosures.
97			Figure 3.1b, the location of various air sensitive receivers have not been clearly shown. Suggest to have this figure printed on A3 size paper in the final report. Also, Tables 4.6a, 4.6b and 4.6c should also be revised to include ASRs' codes in the first column for ease of reference. Besides, for assessing the air quality with incorporation of noise enclosures, the newly added air sensitive receivers – ie Oi Shun House, Siu Hing Lane G/IC etc, have not been shown in Figure 3.1b. Please amend the Figures accordingly to include these ASRs.	As responded above we cannot produce A3 drawings but we consider that the figure is sufficiently clear to show the ASR locations. The ASRs' codes will be added to the tables. The newly added ASRs will be added to the figure.
98	Housing Dept	HD (P) 7/2/TM6	*Para 3.1.4 on page 12* I have indicated in my previous comment on the draft Final Report (dated 29.6.95 ref HD(P) 7/2/TM6) that the Tuen Mun Area 18 PSPS development will be completed in phases between 5/98 to 3/99. However, it is noted that the Final Report still assumes a completion date of 1999 for the PSPS development. I presume the latest completion dates of the development will be taken into consideration in detailed design stage and Environmental Monitoring and Audit program.	Dates amended.

No.	Department	Reference	Comments	Consultants' Response
99			*Para 3.2.6 on page 35 and Para 5.4 on page 57* It is noted that the mitigation measure to ameliorate excessive noise on Tuen Mun Area 18 PSPS development at both the construction and operation phases will largely depend on the provision of single aspect building blocks at the western and northern site boundary. I wish to clarify that the ultimate mitigation measures have yet to be established and the final design for the development will be dependent on the prospective developer. The tender for Lot A of this PSPS development is scheduled to be awarded in March 96. Please keep me informed of the progress of your project.	Noted.
100	TDD PM/NTW	24 in NTW/TM 2/CL/321/4 Pt3	i) Table 5.4a-d Is "2011 Noise Levels No Mitigation" the baseline noise level without the Area 38 development? If not, please provide the data separately.	The tables provide the predicted noise levels in 2011 with the Area 38 development. The noise assessment methodology agreed with EPD does not include considerations of the without Area 38 development condition. Anyhow the Area 38 development is a committed development and it is unrealistic to take this condition into consideration.
101			ii) Section 5.7 The costs should include consultant's fees and site supervision costs. The consultant should advise the costs of fire services installation and ventilation, if there is any.	Noted. The costs given are construction costs only and consultant fees and site supervision costs can be added if required. There is not expected to be any requirement for major fire services installations or ventilation for the enclosures, and costs for nominal E&M provision have been included in the unit rates given in Annex D.

No.	Department	Reference	Comments	Consultants' Response
102			iii) Section 6, last paragraph There will be no further detailed EIA study to cover the same study area during the detailed design stage. All environmental issues associated with the road works should be properly assessed in this EIA study.	The consultant considers that the EIA has properly assessed the environmental issues as required in the Brief, based on the level of details available at this preliminary design stage.
103			iv) Response to comment no. 42 The relevant technical details mentioned in the consultant's responses should be presented in the Final EIA report.	Noted and agreed.
104	HyD, PMT	(1) in HYD MWPMO 2321CL/WGV(IV)	a) Section 2 i) Figure 2.2a as mentioned in para 2.4.1 is missing. ii) The footbridge on Wong Chu Road is not shown on Figure 2.3a.	Noted and figure to be included. The reference to the location of the footbridge on Wong Chu Road should refer to Figure 2.6b. Text amended.

No.	Department	Reference	Comments	Consultants' Response
105			b) Section 5 i) Section 5.6.1 Constraints a) First sentence of para 7 of page 80 It seems that the "bridges" are referring to the existing ones. Please clarify. b) Para 2 of page 81 Please state clearly whether the proposed barrier/enclosures would clash with the footbridge or not. If yes, please propose remedies. c) Last sentence of para 4 page 81 Is there any major traffic impact on Wong Chu Road during the complete closure of the carriageway for installing infill panels?	Agreed. The reference to "bridges" refers to existing bridges. As shown on Figure 5.6b at this stage enclosures are anticipated to terminate just short of the footbridge. Barriers will be designed to pass under or be integrated with the footbridge. All subject to detailed design. Wong Chu Road will never be completely closed. Either the eastbound or the westbound lanes will only be closed during off-peak hours for short durations. That is, the covers over each carriageway (westbound or eastbound) will be constructed independently.

No.	Department	Reference	Comments	Consultants' Response
106			ii) Section 5.7 Financial Implications a) Recurrent operating costs for Mitigation 4 should be taken into account for the cost estimation. iii) Section 5.8 Conclusion and Recommendation The justifications of mitigation 4 as the best option are inadequate. You should compare the cost effectiveness of the mitigation measures of each option.	There is anticipated to be only minimal E&M requirements for the enclosures under Option 4 such as lighting etc. and recurrent costs will not be significant. Mitigation Option 4 is much better than the barriers/cantilever barriers options in terms of reducing the degree and extent of the noise impact, particularly providing protection to higher floor residents that otherwise will not be protected by the barriers/cantilever barriers options. The dwellings along Wong Chu Road that will benefit from noise reductions (refer to Figure 5.5d) as a result of the recommended option 4 are estimated to be 4786, approximately 99% out of the 4839 dwellings affected. Therefore option 4 is recommended despite the relatively higher cost.
107			c) The layout of the enclosure should be sent to ACABAS for comment. d) Is there any further ground investigation required for the proposed mitigation measures? If yes, please recommend. e) Is there any mitigation measures required during the construction of the enclosure? Please clarify.	Noted and agreed. Additional structures will be required to be constructed to support sections of the mitigation measures, in particular, the enclosures along Wong Chu Road. In order to carry out the detailed design preliminary geotechnical investigation will require to be carried out, the extent of which will depend on the design to be adopted. Yes, noise mitigation measures and restricted hours of construction are recommended as discussed in Section 3.2.6, Enclosure Installation, page 36.

Annex F

Calculations for Wong Chu Road Noise Enclosure

Noise calculations for Wong Chu Road Noise enclosure

2011 am peak hour traffic for Wong Chu Road are taken as 5057, with 29% heavy vehicles and a speed of 70 kph.

The Basic Noise Level (BNL)of Wong Chu Road has been calculated using CRTN (1988) and –3.5 dB correction has been applied to the BNL as Pervious Bitumens is the adopted road surface. The corrected BNL is calculated to be 80 dB(A).

Taking the traffic noise as line source at the notional centre 3.5m from carriageway edge and propagated uniformly in semi–cylindrical noise field, the results of the equivalent sound power level (SWL) are 123 dB(A). The SWLs can be modified, based on an typical traffic noise spectrum in the Transport and Road Research Laboratory Report, 896, 1979 to allow refinement of the calculation in octave frequency bands.

Reverberant field inside noise enclosure is assumed and has been calculated using the following formulae:

$$SPL_{rev} = L_w + K_{rev}$$

where

$$K_{rev} = 6 - 10 \log K_v - 10 \log V - 10 \log (K\bar{\alpha})$$

$$K_v = \frac{\text{total surface area}}{\text{volume}}$$

V = volume of enclosure

$$K\bar{\alpha} = \frac{\bar{\alpha}}{1 - \bar{\alpha}}$$

Assuming there is no transmission loss from the air opening, the SWL of the opening is calculated by

$$SWL = SPL + 10 \log (\text{area})$$

The SPL_{rev} inside the small void has been calculated using the methodology as described previously and to determine the SPL at the opening of the enclosure.

Assuming near field attenuation from the opening to the NSR, where

$$\text{Distance loss} = 10 \log \frac{d}{3}$$

Resultant noise levels at the receiver have been then calculated with the distance correction added to the SPL_{rev} of opening and other correction factors as listed below:

- Directivity Index is –6 dB;
- Correction factor from reverberant field to direct field is –6 dB;
- Transmission loss correction through the right angle opening is –3 dB; and
- Facaded corrections at NSR is + 3 dB.

Details of the calculations are presented in *Tables F1 & 2.*

Table F1

13-Jan-96	Tuen Mun Road Junctions Improvement - Wong Chu Road Noise Enclosure									
Frequency		125.00	250.00	500.00	1k	2k	4k	A		
SWL IN ENCLOSURE										
A weighed		102.30	114.70	119.10	118.20	112.40	104.40	122.98		
TO CALCULATE SPLrev INSIDE ENCLOSURE										
enclosure surfaces	S = area									
road - per/bit	3966.00	0.02	0.02	0.02	0.03	0.03	0.04			
Ceiling/acoustic cladding	3966.00	0.72	0.91	0.95	0.92	0.98	0.86			
vertical panels/acoustic claddin	3496.00	0.72	0.91	0.95	0.92	0.98	0.86			
Tunnel Entrance (S5) alpha	721.00	1.00	1.00	1.00	1.00	1.00	1.00			
alpha bar	12149.00	0.51	0.62	0.65	0.63	0.67	0.60			
Kalpha = alpha bar/(1-alpha bar)		1.032952	1.665271	1.852025	1.733811	2.040092	1.503895			
Lprev=Lw-Krev										
Krev=6-10logKv-10logV-10log(Kalpha bar)										
V=volume	29716.00									
S=total area	12149									
Kv=S/V	0.41									
Krev		-34.99	-37.06	-37.52	-37.24	-37.94	-36.62			
Lprev (Lw+Krev)		67.31	77.64	81.58	80.96	74.46	67.78	85.64		
SWL = SPL +10LOG230		90.93	101.26	105.20	104.58	98.08	91.40	109.25		
TO CALCULATE THE SPLrev WITHIN THE OPENING										
enclosure surfaces	S = area									
Ceiling/acoustic cladding	460.00	0.02	0.02	0.02	0.03	0.03	0.04			
vertical panels/acoustic claddin	490.00	0.72	0.91	0.95	0.92	0.98	0.86			
opening from enclosure	230.00	0.72	0.91	0.95	0.92	0.98	0.86			
opening to outside	460.00	1.00	1.00	1.00	1.00	1.00	1.00			
alpha bar	1640.00	0.60	0.69	0.70	0.69	0.72	0.67			
Kalpha = alpha bar/(1-alpha bar)		1.513795	2.18076	2.36894	2.25526	2.560573	2.023599			

Table F1

Lprev=Lw-Krev										
Krev=6-10logKv-10logV-10log(Kalpha bar)										
V=volume	460.00									
S=total area	1640									
Kv=S/V	3.57									
Krev		-27.95	-29.53	-29.89	-29.68	-30.23	-29.21			
Lprev (Lw+Krev)		62.98	71.72	75.30	74.90	67.84	62.19	79.51		
assuming near field attenuation		The noise transmission through the right angle ventilation opening								
Distance loss = 10log d/3		will experience an additional 3 dB attenuation, -6 dB correction for reverberant to direct								
where d = distance of NSR										
17		7.53	7.53	7.53	7.53	7.53	7.53			
SPL at nsr		43.45	52.19	55.77	55.37	48.31	42.66	59.98		

Table F2

13-Jan-96	Tuen Mun Road Junctions Improvement - Wong Chu Road Noise Enclosure									
	Calculations showing the transmission loss of the enclosure panels									
Frequency		125.00	250.00	500.00	1k	2k	4k	A		
SWL IN ENCLOSURE										
A weighed		102.30	114.70	119.10	118.20	112.40	104.40	122.98		
TO CALCULATE SPLrev INSIDE ENCLOSURE										
enclosure surfaces	S = area									
road - per/bit	3966.00	0.02	0.02	0.02	0.03	0.03	0.04			
Ceiling/acoustic cladding	3966.00	0.72	0.91	0.95	0.92	0.98	0.86			
vertical panels/acoustic claddin	3496.00	0.72	0.91	0.95	0.92	0.98	0.86			
Tunnel Entrance (S5) alpha	721.00	1.00	1.00	1.00	1.00	1.00	1.00			
alpha bar	12149.00	0.51	0.62	0.65	0.63	0.67	0.60			
Kalpha = alpha bar/(1-alpha bar)		1.032952	1.665271	1.852025	1.733811	2.040092	1.503895			
Lprev=Lw-Krev										
Krev=6-10logKv-10logV-10log(Kalpha bar)										
V=volume	29716.00									
S=total area	12149									
Kv=S/V	0.41									
Krev		-34.99	-37.06	-37.52	-37.24	-37.94	-36.62			
Lprev (Lw+Krev)		67.31	77.64	81.58	80.96	74.46	67.78	85.64		
Assuming near field attenuation										
where d = distance of nsr = 17m										
SPL at nsr = Lprev -SRI -10logd/3 -reverberant correction+facade correction										
SPL at nsr	42.34228	dB(A)								

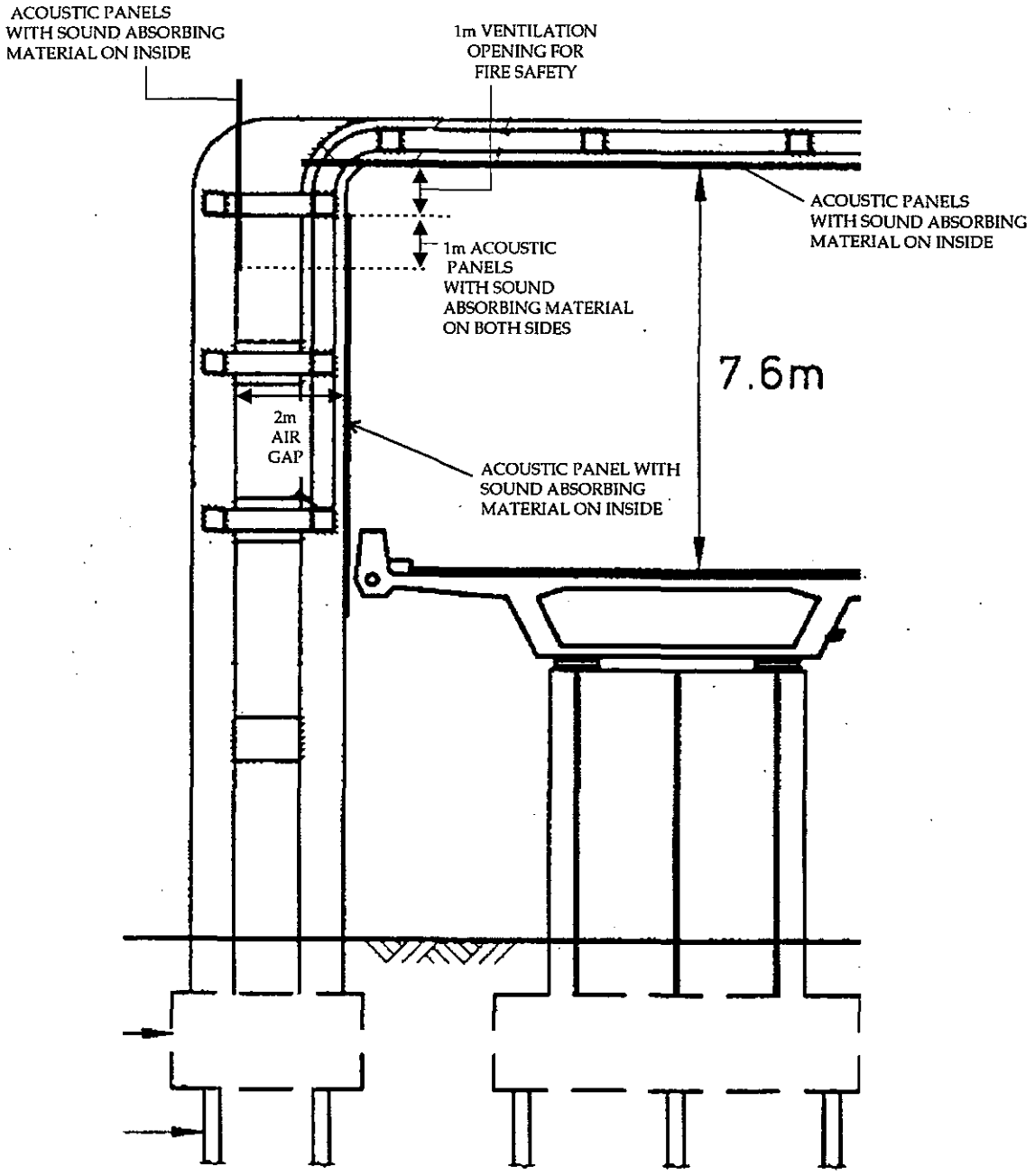

FIGURE A - SCHEMATIC DRAWING TO ILLUSTRATE ENCLOSURE DETAILS

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