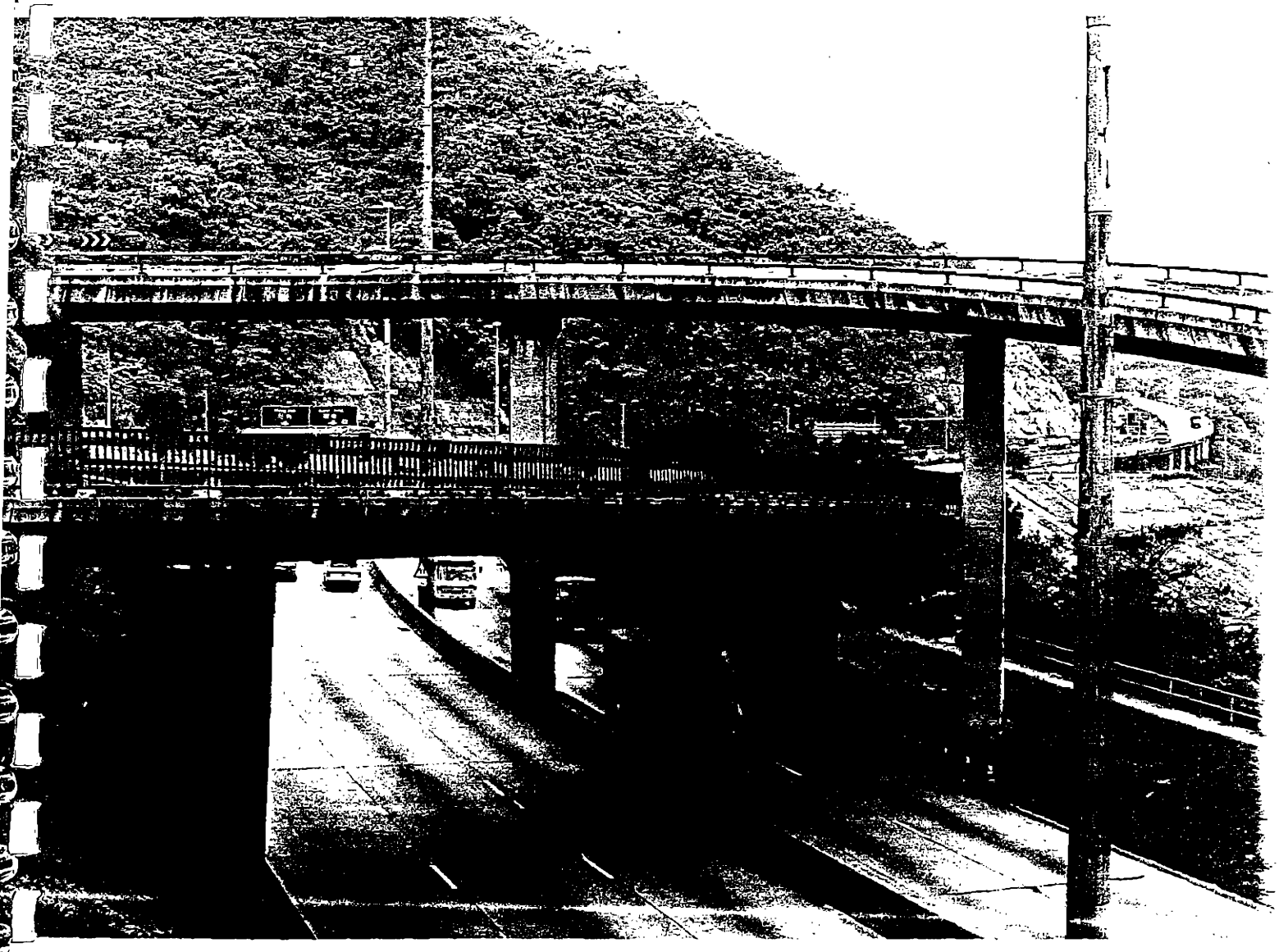
Highways Department
Western Harbour Link Office

Lung Cheung Road and Ching Cheung Road Improvements

Report No 6

Environmental Impact Assessment Report



PYPUN-HOWARD HUMPHREYS LTD

ARUP
Ove Arup & Partners

PHH / ARUP CONSULTANTS

Lung Cheung Road and
Ching Cheung Road Improvements

Report No 6

Environmental Impact Assessment Report

January 1992

ERL (Asia) Limited

Brian Clouston and Partners Hong Kong Limited
Hong Kong

3/F Asian House, 1 Hennessy Road, Wanchai, Hong Kong

AGREEMENT NO. CE 4/90
LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

CONTENTS

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CONTENTS

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

LIST OF FIGURES

CHAPTER 1

1 INTRODUCTION

1.1 Background

1.1.1 Lung Cheung Road and Ching Cheung Road (LCR/CCR) is to be improved in order to provide a road with adequate capacity to serve traffic flows forecast up to the year 2011. The road is already the major commercial route across Kowloon, but with the development of Kwun Tong as an industrial area and the development of further container ports to the west the pressure on the route is expected to increase further; much of the increased traffic being made up of heavy commercial vehicles. Additional infrastructure developments identified since CTS-2 first recommended the upgrading of the route will further add to the capacity demands on this road corridor.

1.1.2 ERL (Asia) Limited has been retained by PHH/Arup to carry out the environmental assessment to identify and assess the nature and extent of environmental impacts associated with the construction and operation of the Road Improvements, whilst Brian Clouston and Partners Hong Kong Limited is responsible for assessing the visual impact.

1.1.3 An important feature of this scheme is the fact that it is not proposed to construct a new road in a green field environment. The existing road already carries high traffic volumes and is visually intrusive. An assessment has been carried out into the existing environmental situation and this is described in each relevant chapter. As well therefore as relating environmental impacts to the Hong Kong Planning Standards and Guidelines as required by the brief, it is important to compare expected future impacts against those observed at present.

1.1.4 As stated in the Inception Report, the road design has taken as fundamental the need to minimise adverse environmental impact in the vicinity of the road. This approach was put forward because it is evident that the existing Lung Cheung Road and Ching Cheung Road carry environmental disadvantages and areas of possible improvements can already be identified without first making a detailed appraisal of the proposals to improve the road.

1.1.5 For instance wherever cut slopes have been found necessary for engineering purposes, the Landscape Consultants have been closely involved in decisions regarding the form of cut slope and its treatment before a recommendation has been made. The same is true of decisions regarding the form of many of the structures. The effect of the scheme on noise sensitive developments has been taken to be a factor in the alignment and construction form at the outset. Where an option has existed to resolve traffic queuing and its associated noise and air pollution problems, then this has again been a factor in the decision to recommend any particular solution.

1.1.6 Thus an integrated design approach to all aspects of the engineering, involving the Environmental and Landscape Consultants has been adopted. As a result of this approach, the Landscape Strategy and Environmental considerations for noise, air and water are incorporated at design stage into the recommended scheme, rather than mitigating the effect of a road scheme which could be developed independently of environmental considerations. The design of the road has been developed to reduce the environmental impact at the outset wherever possible.

1.2 Objectives of the Environmental Assessment

1.2.1 Annex 1.A of the head brief presents the Consultancy Brief for this Environmental Assessment Study for the proposed road scheme. The objectives of the assessment are as follows:-

(i) to describe the proposed installations and related facilities and the requirements for their development;

(ii) to identify and describe the elements of the community and environment likely to be affected by the proposed development;

(iii) to minimize pollution and nuisance arising from the development and its operation and environmental disturbance during construction and operation of the project;

(iv) to identify and evaluate the nett impacts expected to arise during the construction and operation phases of the development in relation to the community and neighbouring land uses;

(v) to identify methods and measures which may be necessary to mitigate these impacts and reduce them to acceptable levels;

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

(vii) to identify any additional studies which may be necessary to fulfil the objectives or requirements of this Environmental Assessment.

1.3 Scope of Work

1.3.1 This Environmental Assessment study focuses on the following issues:

(i) For the construction phase:-
- air quality with regard to Total Suspended Particulates (TSP);
- noise from general construction works and percussive piling;
- water quality impacts associated with storm water drainage;
- disposal of construction waste; and
- visual assessment.

(ii) For the operational phase:-
- air quality with regard to carbon monoxide (CO), nitrogen oxides (NO_x) and particulates;
- noise associated with road traffic;
- water quality with regard to effluent discharges to storm water drains; and
- visual assessment.

The assessment has made reference to the Air Pollution Control Ordinance (APCO), Noise Control Ordinance (NCO), Water Pollution Control Ordinance (WPCO), Waste Disposal Ordinance (WDO) and the Hong Kong Planning Standards and Guidelines (HKPSG).

1.4 Structure of the Report

1.4.1 As it is expected that readers of the report are likely to be concerned with specific specialisations the report has been structured accordingly. After a general description of the proposed scheme, the issues of noise, air quality, visual impact and water quality have been separately dealt with, including the effect of these impacts on surrounding uses.

CHAPTER 2

2 ROAD SCHEME DESCRIPTION

2.1 Proposed Alignment

2.1.1 Lung Cheung Road and Ching Cheung Road is to be improved to current trunk road standards as far as practicable with sufficient capacity to serve traffic flows forecast for the years 2001 and 2011. The improvement works would be carried out largely on the existing alignment, from the western end of Lai Chi Kok to Waterloo Road, as shown in Figure 2.1.1.

2.1.2 The proposals are shown in greater detail on figures 2.1.2 to 2.1.9. It can be seen that, with the exception of the Off Line Link, the proposals are essentially that the existing road be widened by one lane in each direction. Most of the road improvements works would involve widening and realigning of the existing road corridor by means of retaining wall, open structure, or an extension to existing earthworks. An exception to this would be the Off Line Link between Tai Po Road and the eastern end of the Beacon Heights development, where, at least over a part of its length, an additional traffic corridor would be created.

2.1.3 The proposals would bring the edge of the road closer to adjacent sensitive land uses in a number of instances. Most of the deterioration in environmental quality at sensitive uses surrounding Lung Cheung Road and Ching Cheung Road would however be due to the increase in traffic volume and in particular, the increase in the number of heavy vehicles which has been forecast. A part of this increase would take place in any event, even if the road were not improved. The consequences of this would be an increase in traffic delays along the route leading to a worsening of both the traffic and the environmental situation.

2.1.4 The proposed off line link would have two implications to the air and noise environment of certain sensitive uses. For those sensitive buildings close to the proposed off line link, a new source of air and noise pollution would be introduced in their vicinity. On the other hand, the diversion of traffic from the mainline to the off line link would mean that certain sensitive buildings along the mainline would face lower increases in noise and air pollutants levels than would be the case if the link were not constructed.

Future Traffic Flows

2.1.5 Morning and afternoon peak traffic flows along the main line and off line link have been forecast for 2001 and 2011. These figures were presented to Government in June 1991. Because of future network and planning expectations, 2001 traffic flows are for the most part higher than those forecast for 2011. Hence, 2001 traffic data has been adopted as the basis of this study for assessing the operational impacts of the completed scheme. For convenience, the traffic flow diagrams for 2001 and 2011 are reproduced in this document as figures 2.1.10 to 2.1.13.

2.1.6 The design speed of the main road is 70 kph with constant through flow, minimum braking and acceleration, and no stopping except under extreme conditions. The design speed on the associated side roads, slip roads and access roads is 35-50 kph, but where there are grade-separated junctions, braking and acceleration are likely to be more than along the main alignment. Traffic mix of the improved scheme in 2001 is predicted to be 29% for cars/taxi, 26% for light buses/goods vehicles and 45% for heavy goods vehicles.

2.2 Adjacent Land Uses

2.2.1 The existing and planned land uses and developments surrounding the proposed alignment were investigated by consulting District Lands Office, Planning Department and District Offices of City and New Territories Administration. This information was used to identify the sensitive uses likely to be affected by the construction and operation of the road scheme.

2.2.2 The existing mainline is built along the northern boundary of the Kowloon urban area and it forms a clear dividing line between this and the steep terrain to the north. Hence, most development is found to the south of the existing corridor and is mainly residential except at Cheung Sha Wan where factory blocks are located. To the north of the corridor, terrain is much steeper and mainly reserved for urban fringe parks, but lower rise and more sparsely spaced residential lots are also found. The Project Office has built up a database of land uses in the surrounding area, and lot boundaries associated with these are shown in outline on the scheme layout drawings.

Sensitive Uses

2.2.3 Identification of various sensitive receivers to noise, air and water along the alignment were based on the definition laid down in HKPSG and Technical Memoranda of the relevant pollution control ordinances. A selection of specific receivers for analysis was set out in the Environmental Criteria Report of May 1991, and a number were added as a result of comments received from Government. Figure 2.4.1 is a simplified depiction of that information.

2.2.4 The air quality sensitive receptors (ASRs) for vehicle emissions are:

- o residential areas;
- o nurseries;
- o homes for the aged;
- o schools;
- o active recreational activities.

Similarly, sensitive uses to road traffic noise along the alignment are as follows:

- o all domestic premises including temporary housing;
- o institutional uses;
- o country park.

2.2.5 In addition to the existing land uses, known future plans along the alignment have been investigated and District Planning Office was consulted in order to identify any planned sensitive developments in the proximity of the road scheme.

2.2.6 The following future developments, which would be in close proximity to the mainline and the proposed new off line link, are included in the air and noise impacts assessment in this study.

a) Kau Wa Keng Comprehensive Development Area
b) Caritas Lok Yan School (proposed school for the severely mentally handicapped)
c) Tai Woh Ping Residential Development
d) Proposed Private Hospital Development
e) Cornwall Street Development Area
f) Tai Woh Ping THA (reserved as schools development)

2.2.7 A list of specific receivers sensitive to air and noise impacts surrounding the proposed scheme is presented in Annex 2.A. It is essentially similar to that of the Environmental Criteria Report but is modified with the new information on land use and the road design. The modifications are that:

- o as the road segment fronting Lai Chi Kok Bay Garden would not have any roadworks, the Garden was dropped from further assessment;
- o the improvement works at Waterloo Road Interchange are no longer a part of the main scheme and therefore Lung Cheung Court and residential lots on Broadcast Drive were deleted from the assessment list;
- o Lei Cheng Uk Estate is likely to be affected by the new off line link and is added to the list.

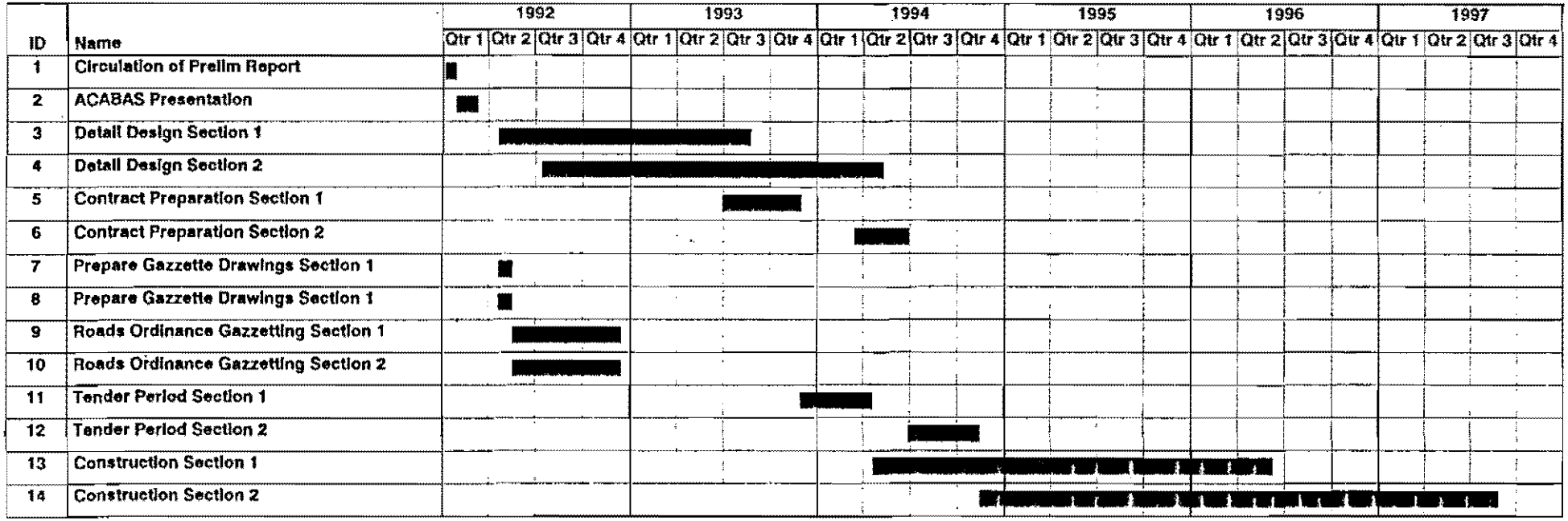
2.3 Construction Methods

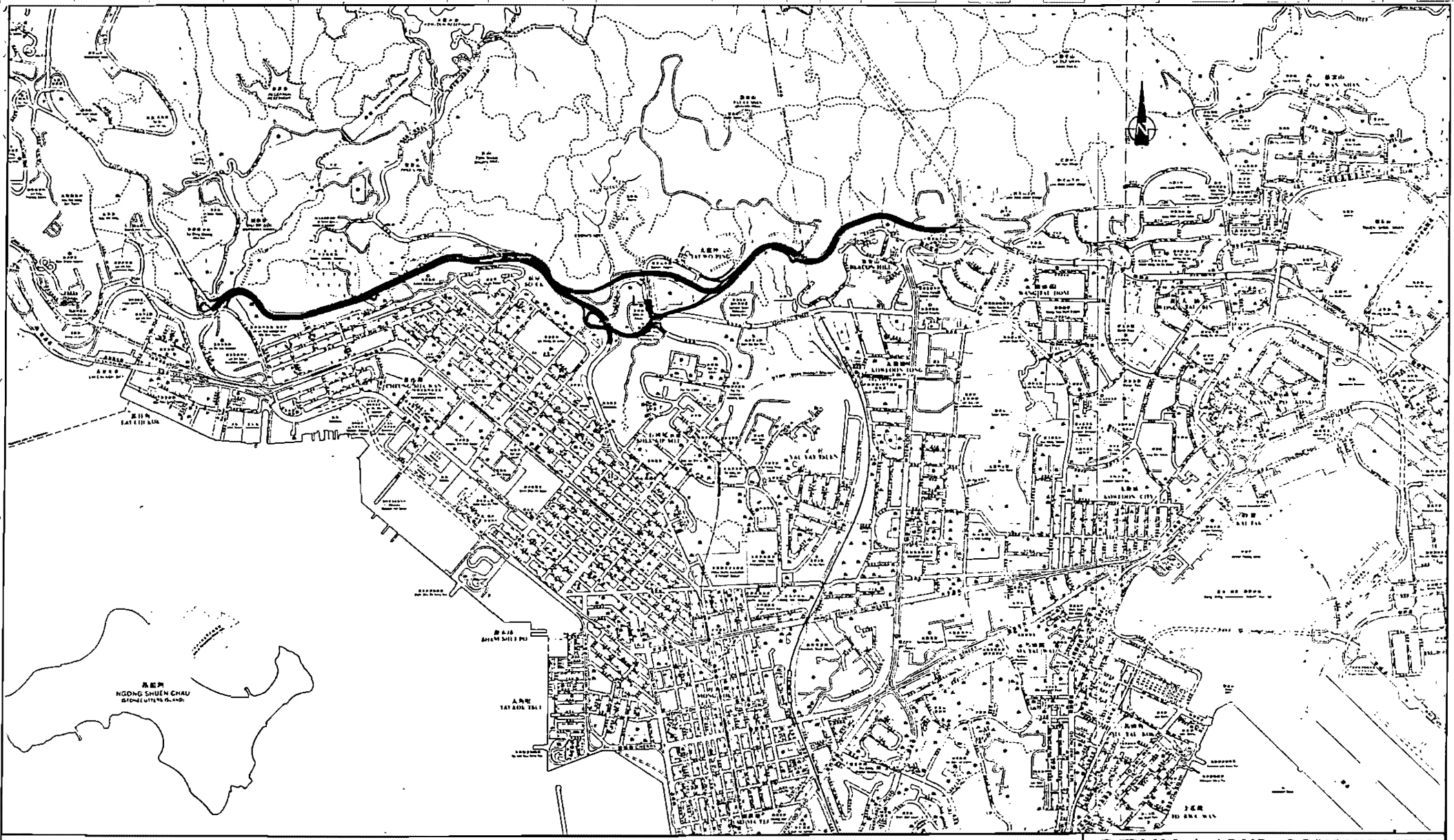
2.3.1 Except for the new off line link, the road improvements would basically follow the existing corridors. The road improvement works are expected to be carried out in two sections as shown on the implementation programme reproduced overleaf.

2.3.2 There are few opportunities to divert traffic onto other parallel routes and so the existing road would be kept open throughout the construction period. Indeed the brief requires that the road be able to carry two lanes of traffic in each direction throughout construction, in effect maintaining its current dual two lane role at all times. This has been a major consideration in choosing methods of road widening along the route, and this requirement of the brief has been met. As a result impacts away from the existing route which might arise from the introduction of traffic diversions have been avoided.

2.3.3 Occasional night work might be necessary for activities such as formwork erection, and the placing of bridge beams over the carriageway, but this would be very infrequent and would be subject to the strictest possible control.

Lung Cheung Road and Ching Cheung Road Improvements
Implementation Programme





SCALE 200 0 200 400 METRES

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LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS

潘衍壽－亨富利／奧雅納聯營工程顧問

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

PROPOSED ROAD ALIGNMENT

DESIGNED	M. W. C.	DRG. NO.	FIG
DRAWN	K. W. F.	PR/H622/500P/003	2.1.1
CHECKED	H. K. L.		
APPROVED	R. R.		
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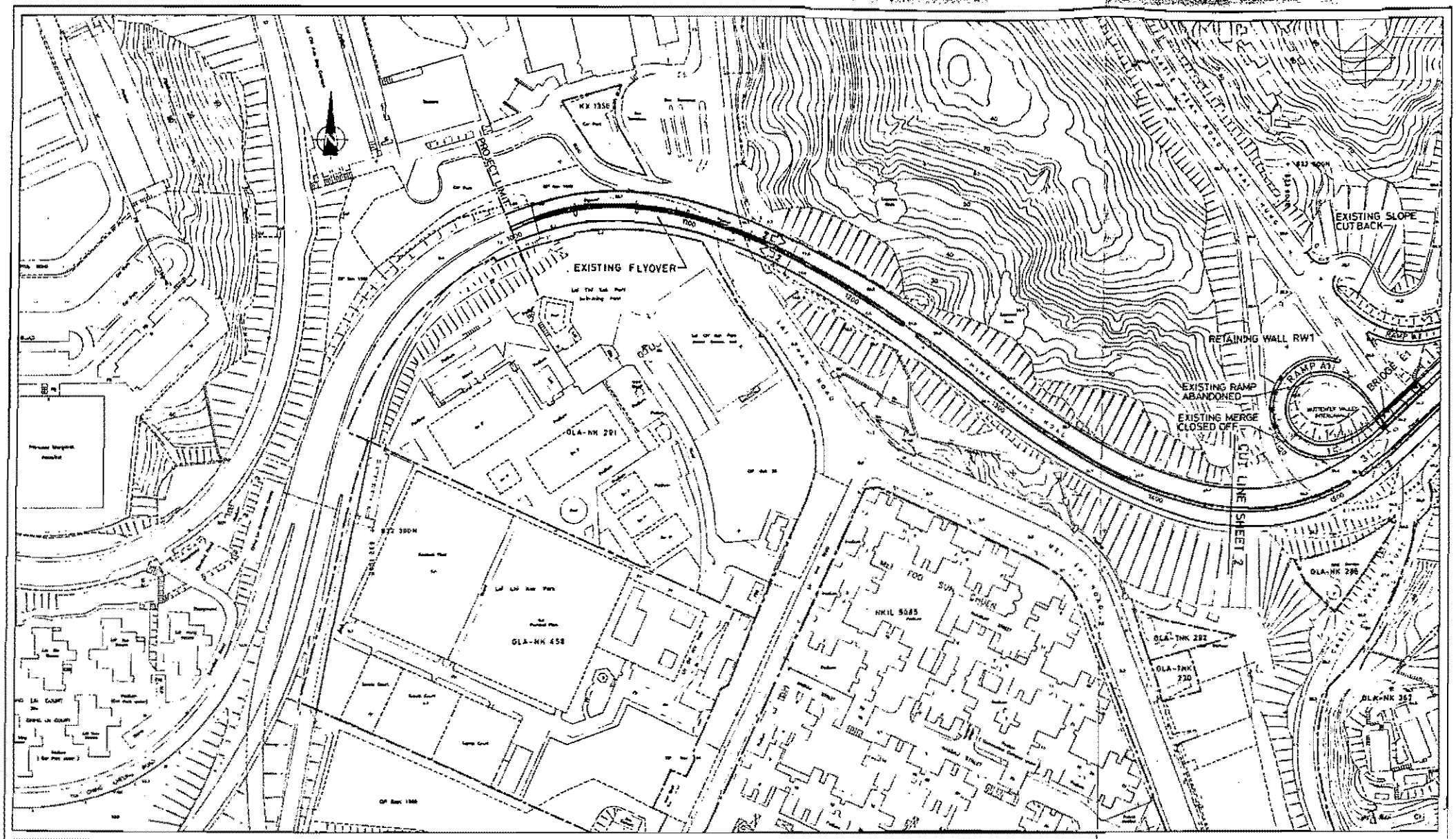

Note:-
1. Alignment from chainage 1000 to 1500 unshaded.

KEY:-

1. Proposed carriageway edge
2. Proposed structure edge
3. Proposed retaining wall
4. Existing made slope
5. Proposed made slope
6. Limit of proposed earthworks
7. 3 No. of traffic lanes
8. Lot boundary
9. Open structure

SCALE 10 0 10 20 METRES

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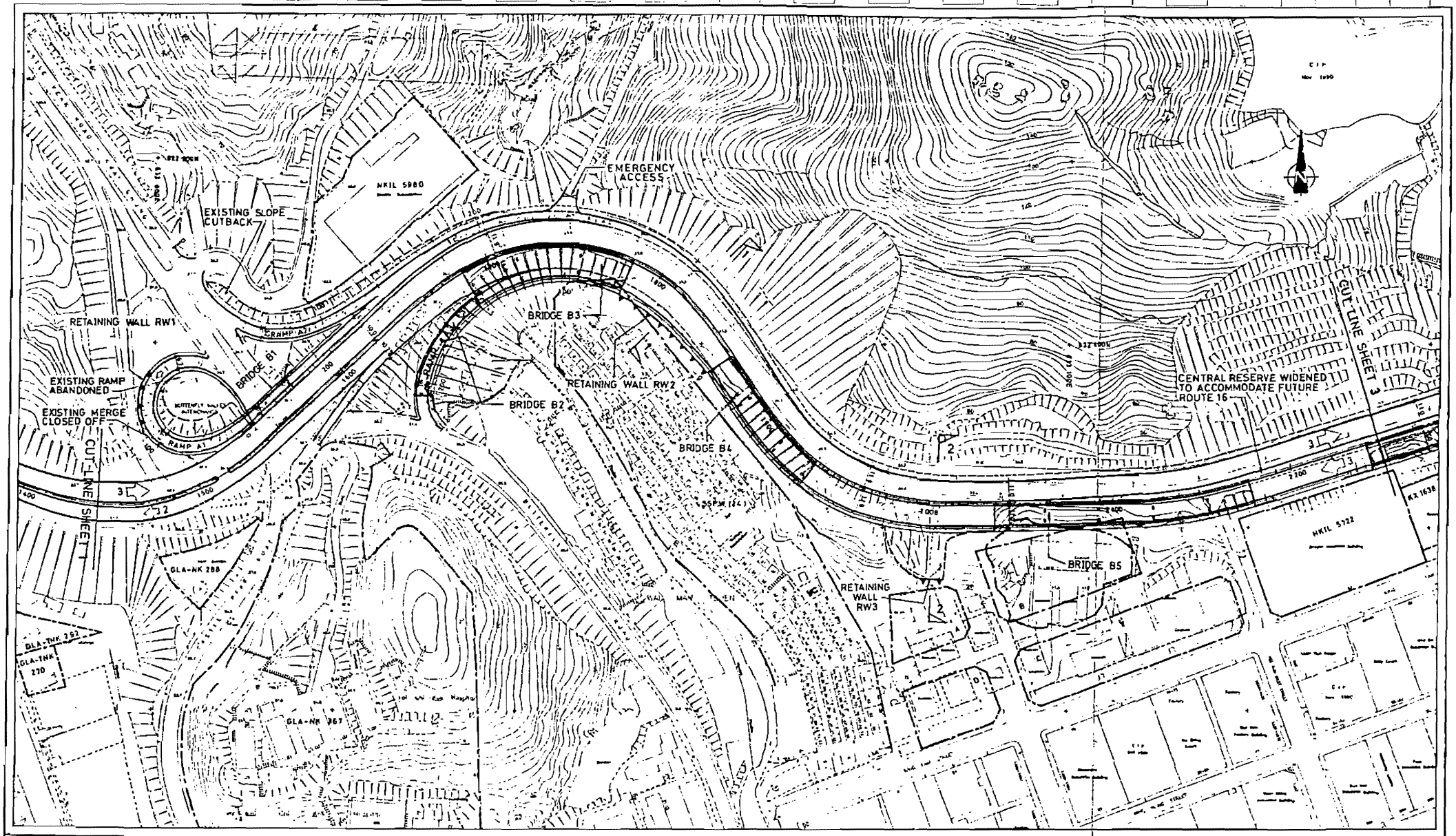
LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS

獅衝路－亨富利／奧雅納聯營工程顧問

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

LAYOUT PLAN
CH. 1000 TO CH. 1450
SHEET 1 OF 8

DESIGNED	H. W. C.	DRG. NO.	FIG.
DRAWN	A. K.	PR/H622/101P/012	2.1.2
CHECKED	H. K. L.		
APPROVED	A. R.		
DATE	DECEMBER, 1991.	SCALE AS SHOWN	



Note:-
See figure 3.4.22 to 3.4.26 for section details.

KEY:-

1. Proposed carriageway edge
2. Proposed structure edge
3. Proposed retaining wall
4. Existing made slope
5. Proposed made slope
6. Limit of proposed earthworks
7. 3 No. of traffic lanes
8. Lot boundary
9. Open structure

SCALE 20 0 20 40 METRES

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LAYOUT PLAN
CH. 1450 TO CH. 2250
SHEET 2 OF 8

DESIGNED	M. W. C	DRG. NO.	FIG
DRAWN	A. K.	PR/H622/101P/013	2.1.3
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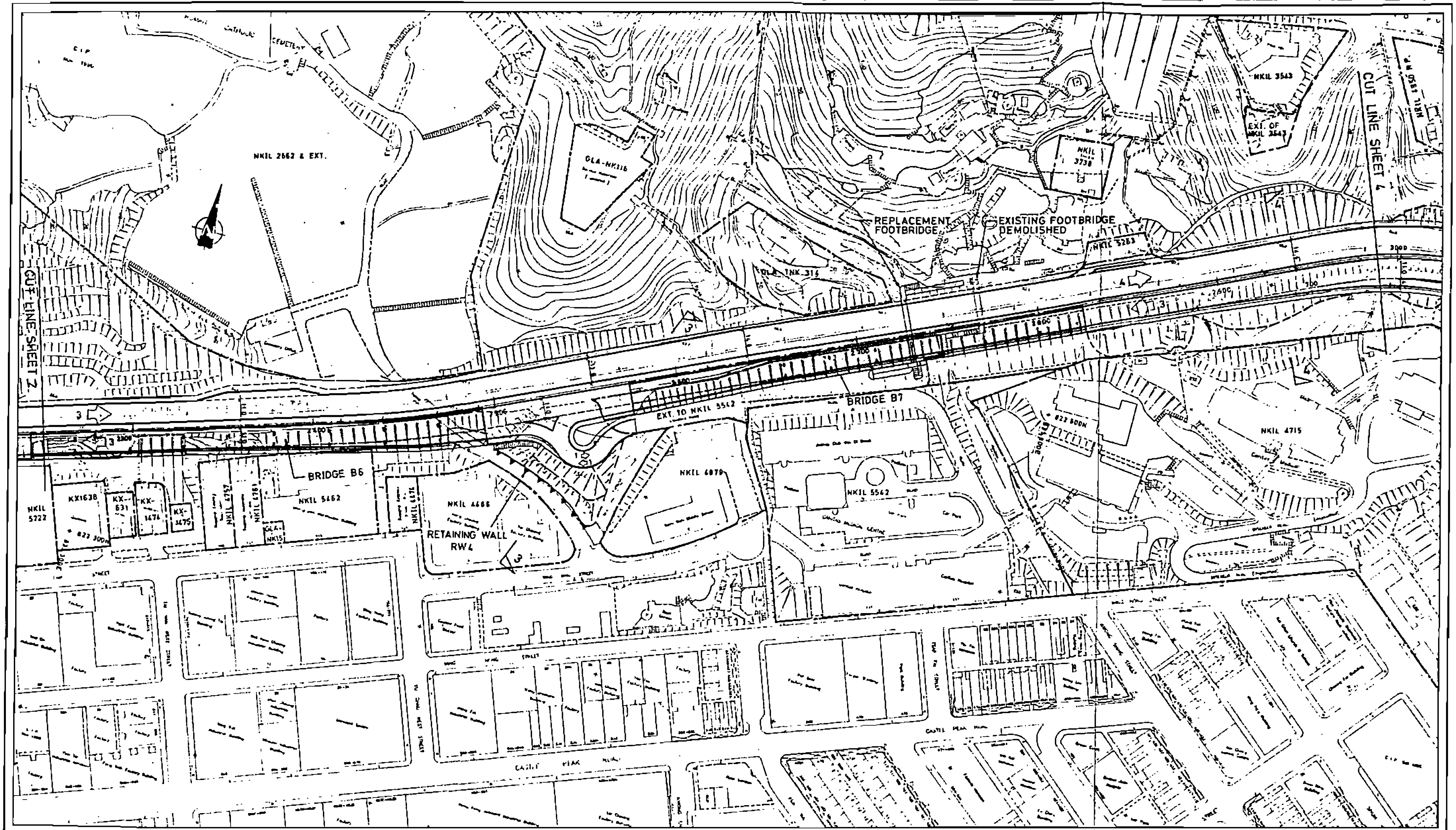
APPROVED	R. R.		
DATE	DECEMBER, 1991.	SCALE AS SHOWN	



Note:-
See figure 3.4.22 to 3.4.26 for section details.

KEY:-

1. Proposed carriageway edge
2. Proposed structure edge
3. Proposed retaining wall
4. Existing made slope
5. Proposed made slope
6. Limit of proposed earthworks
7. 3 No. of traffic lanes
8. Lot boundary
9. Open structure

SCALE 20 0 20 40 METRES

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WESTERN HARBOUR LINK OFFICE

LAYOUT PLAN
CH. 2 250 TO CH. 3 000
SHEET 3 OF 8

DESIGNED	C. N. A.	DRG. NO.	FIG.
DRAWN	A. K	PR/H622/101P/014	2.1.4
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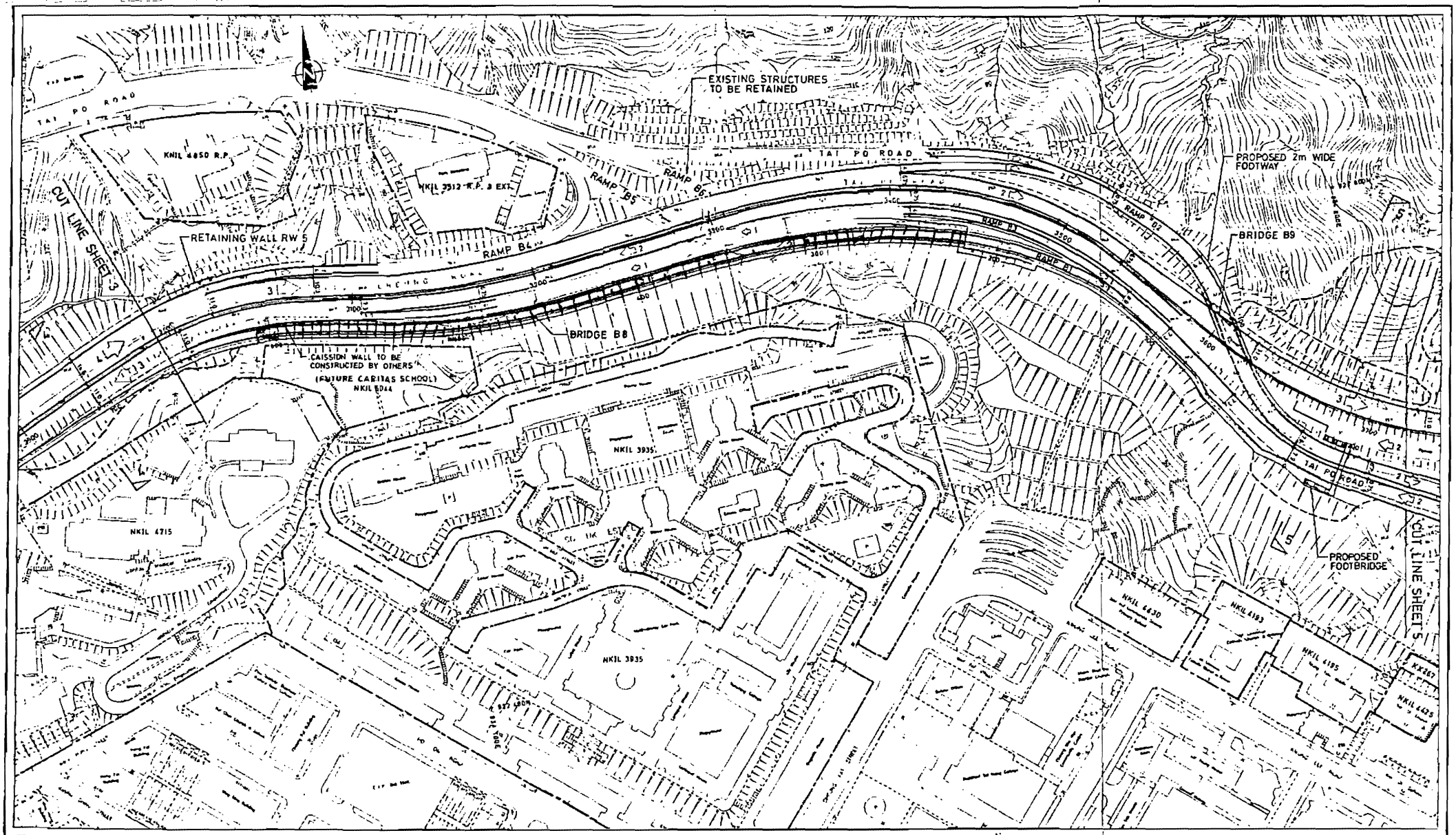
APPROVED	R. R.		
DATE	DECEMBER, 1991.	SCALE AS SHOWN	



Note:-
See figure 3.4.22 to 3.4.26 for section details.

KEY:-

1. Proposed carriageway edge
2. Proposed structure edge
3. Proposed retaining wall
4. Existing made slope
5. Proposed made slope
6. Limit of proposed earthworks
7. 3 No. of traffic lanes
8. Lot boundary
9. Open structure

SCALE 20 0 20 40 METRES

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HIGHWAYS DEPARTMENT
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LAYOUT PLAN
CH. 3000 TO CH. 3700

SHEET 4 OF 8

DESIGNED	M. W. C.	DRG. NO.	FIG
DRAWN	A. K.	PR/H622/101P/015	2.1.5
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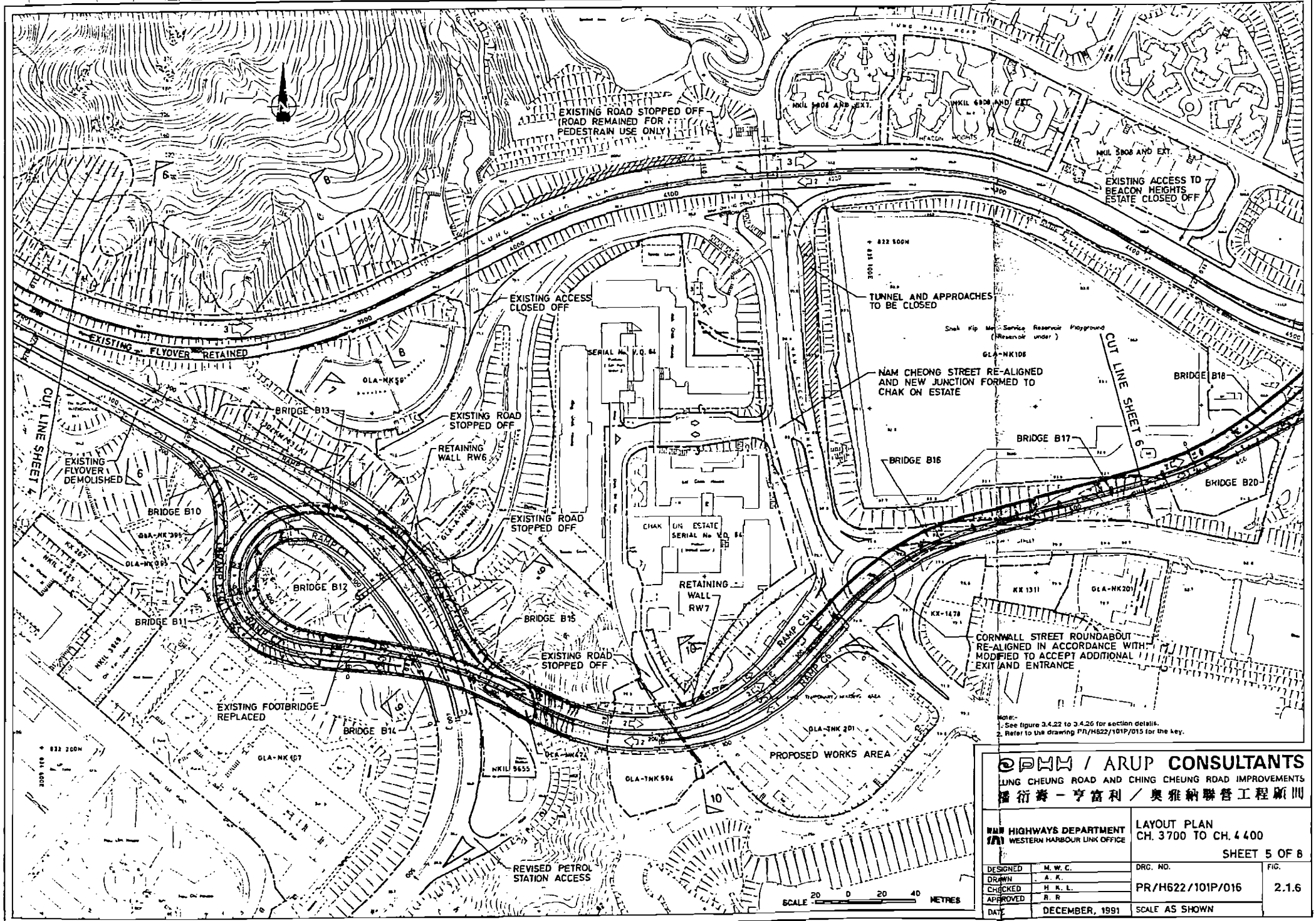

Note:-
1. See figure 3.4.22 to 3.4.26 for section details.
2. Refer to the drawing PR/H622/101P/015 for the key.

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榕嶺道－亨富利／奧雅納聯營工程顧問

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

LAYOUT PLAN
CH. 3700 TO CH. 4400

SHEET 5 OF 8

DESIGNED	M. W. C.	DRG. NO.	FIG.
DRAWN	A. K.	PR/H622/101P/016	2.1.6
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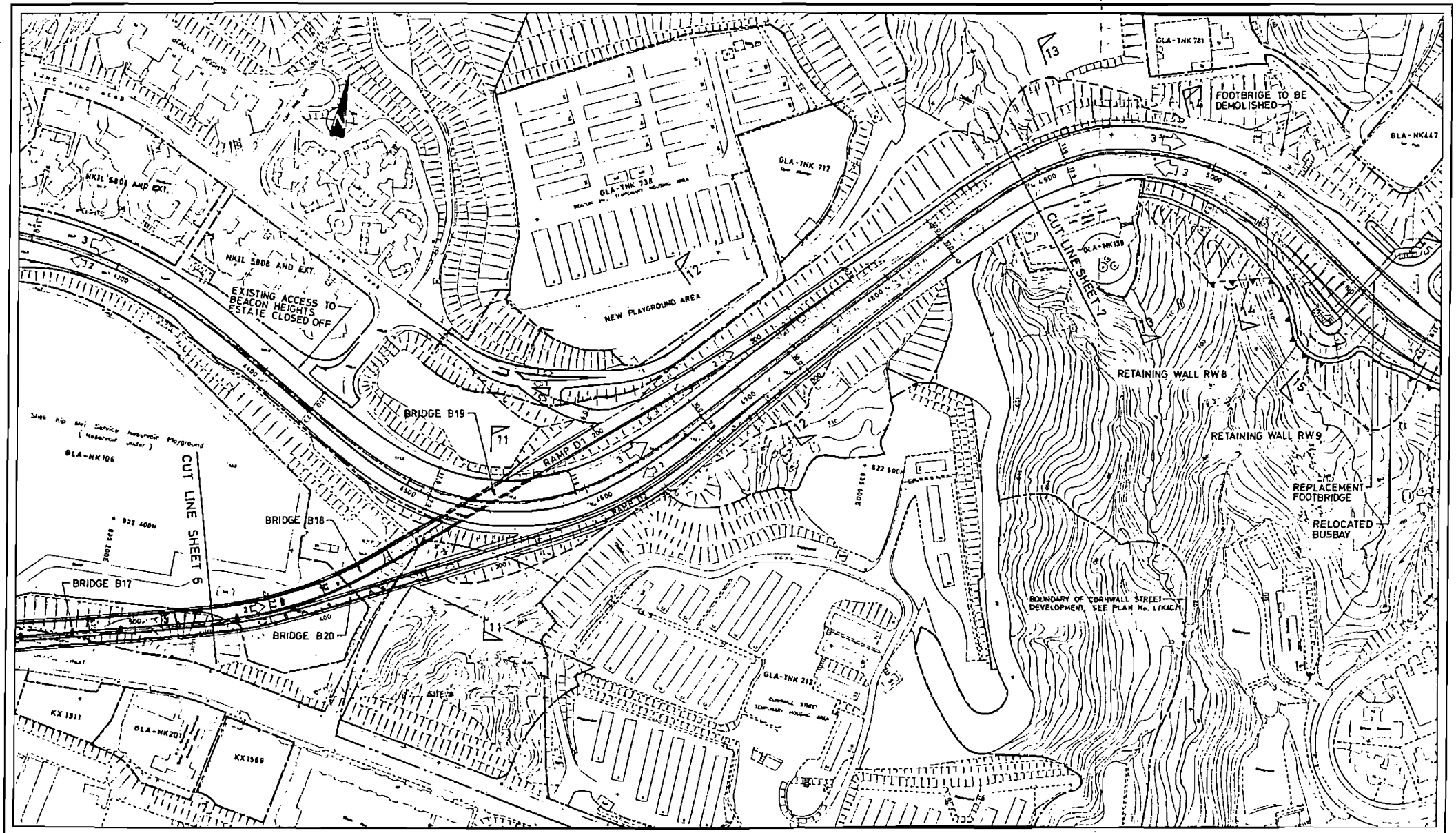
APPROVED	R. R.		
DATE	DECEMBER, 1991	SCALE AS SHOWN	



Note:-
See figure 3.4.22 to 3.4.26 for section details.

KEY:-

1. Proposed carriageway edge
2. Proposed structure edge
3. Proposed retaining wall
4. Existing made slope
5. Proposed made slope
6. Limit of proposed earthworks
7. 3 No. of traffic lanes
8. Lot boundary
9. Open structure

SCALE 20 0 20 40 METRES

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潘衍嶂－亨富利／奧雅納聯營工程顧問

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

LAYOUT PLAN
CH. 4300 TO CH. 5100
SHEET 6 OF 8

DESIGNED	M. W. C.	DRG. NO.	FIG.
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APPROVED	R. R.		
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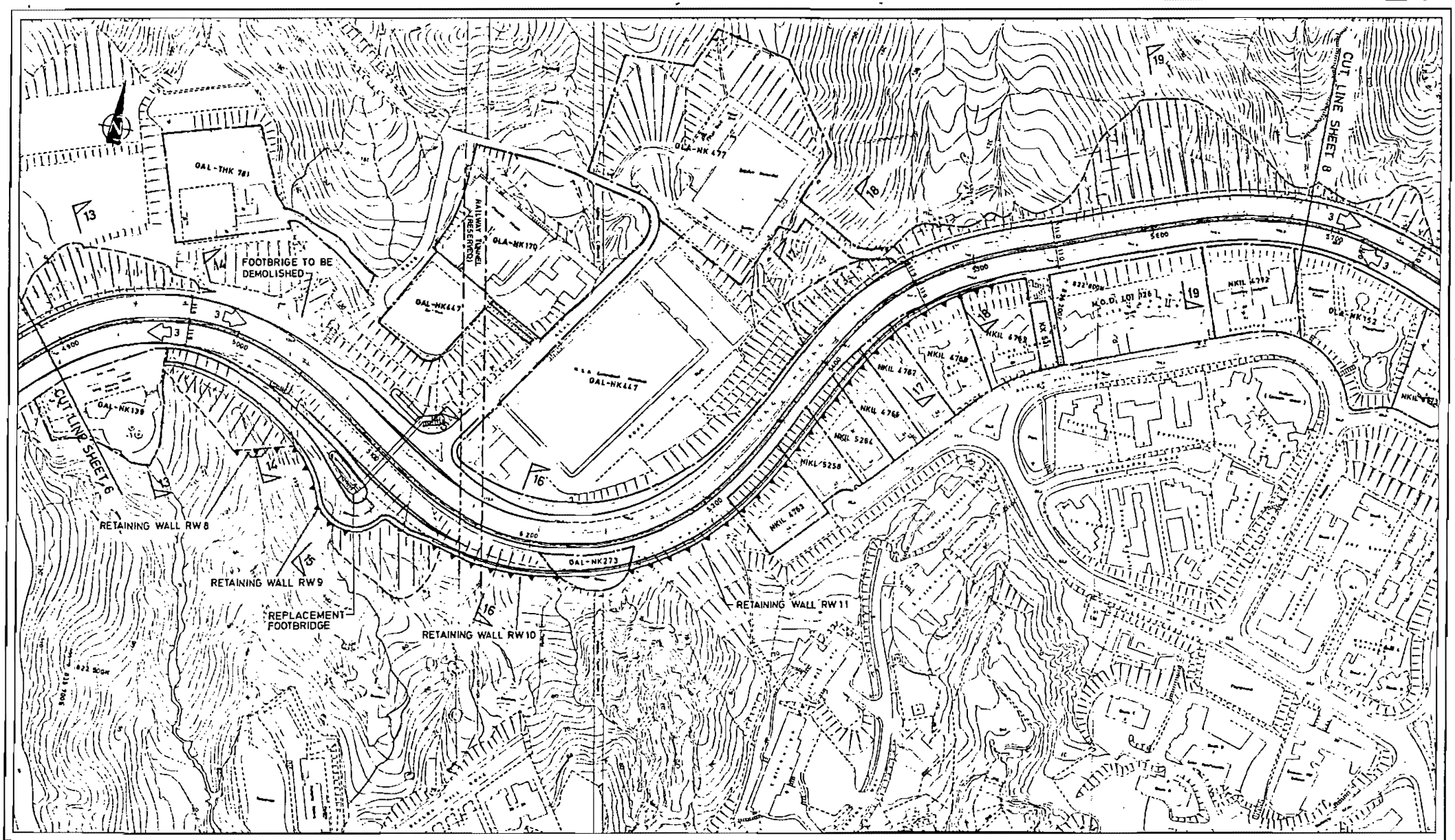

Note:-
See figure 3.4.22 to 3.4.26 for section details.

KEY:-

1. Proposed carriageway edge
2. Proposed structure edge
3. Proposed retaining wall
4. Existing made slope
5. Proposed made slope
6. Limit of proposed earthworks
7. 3 No. of traffic lanes
8. Lot boundary
9. Open structure

SCALE 20 0 20 40 METRES

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LAYOUT PLAN
CH. 4900 TO CH. 5700
SHEET 7 OF 8

DESIGNED	M. W. C.	DRG. NO.	FIG.
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APPROVED	R. R.		
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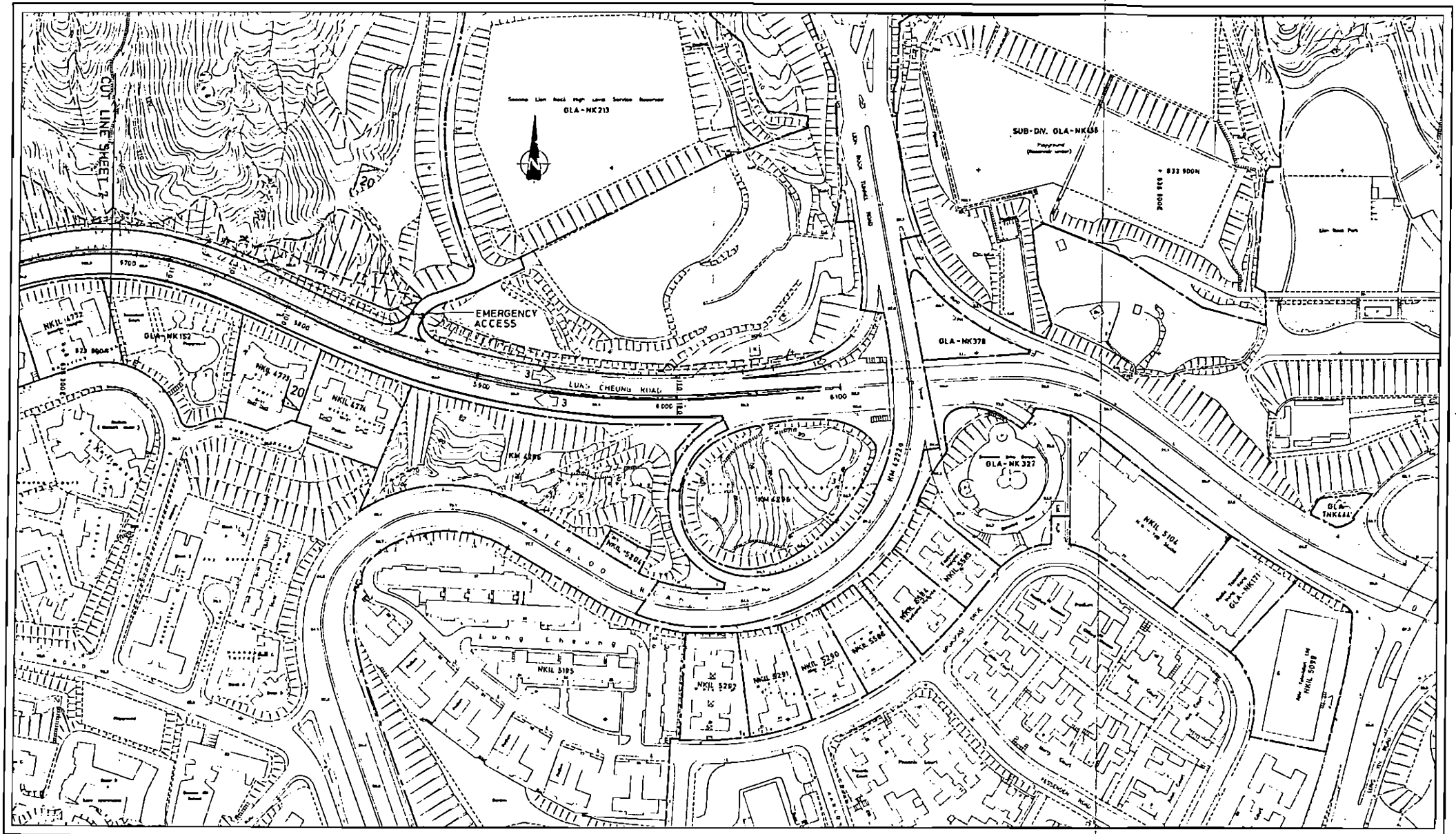

Note:-
See figure 3.4.22 to 3.4.26 for section details.

KEY:-

1. Proposed carriageway edge
2. Proposed structure edge
3. Proposed retaining wall
4. Existing made slope
5. Proposed made slope
6. Limit of proposed earthworks
7. 3 No. of traffic lanes
8. Lot boundary
9. Open structure

SCALE 20 0 20 40 METRES

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LAYOUT PLAN
CH. 5700 TO CH. 6100

SHEET 8 OF 8

DESIGNED	M. W. C	DRG. NO.	FIG.
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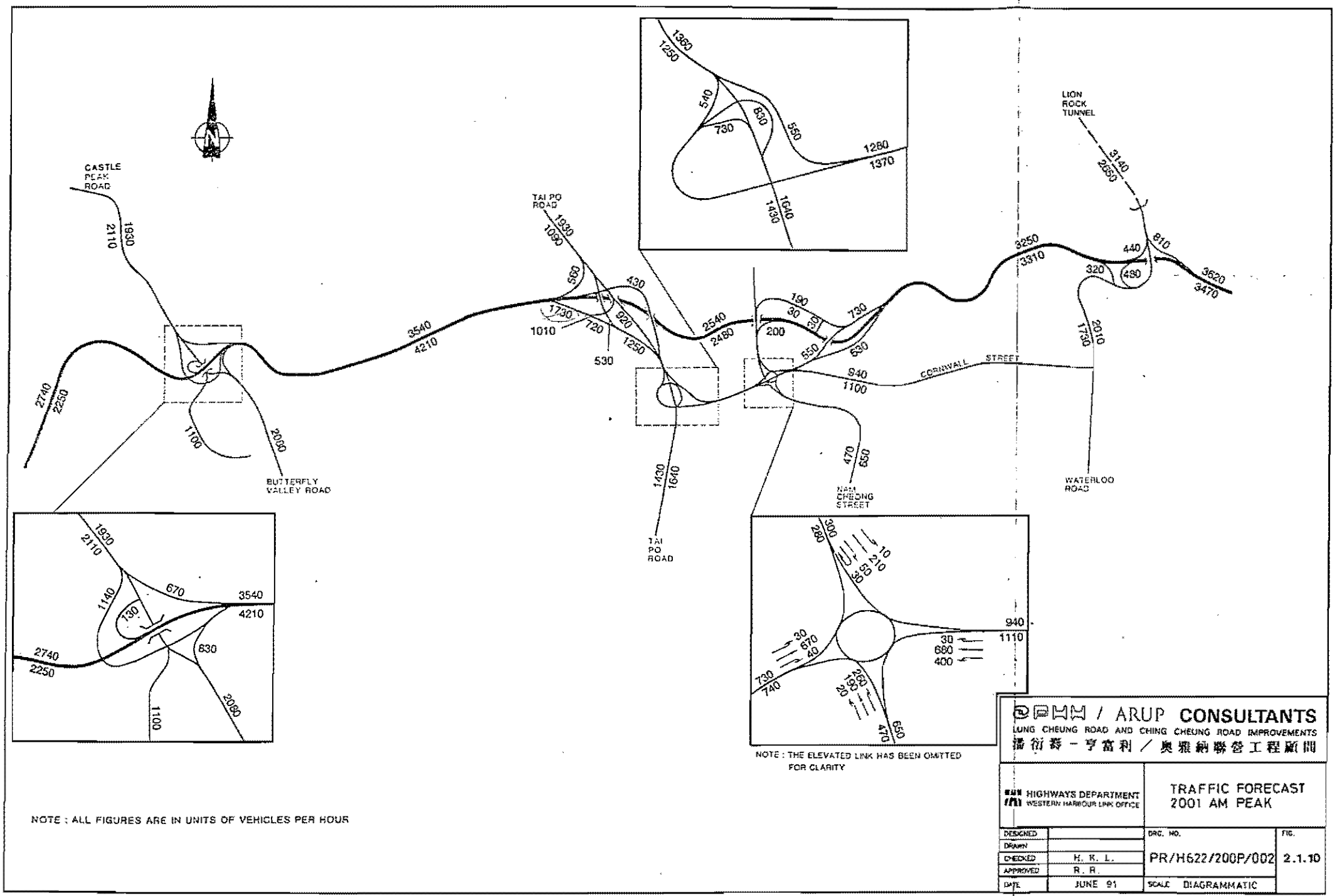
APPROVED	R. R		
DATE	DECEMBER, 1991.	SCALE AS SHOWN	



NOTE : ALL FIGURES ARE IN UNITS OF VEHICLES PER HOUR

DHM / ARUP CONSULTANTS

LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS

獅衍蔣－亨富利／奧雅納聯營工程顧問

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

TRAFFIC FORECAST
2001 AM PEAK

DESIGNED		DRG. NO.	FIG.
DRAWN		PR/H622/200P/002	2.1.10
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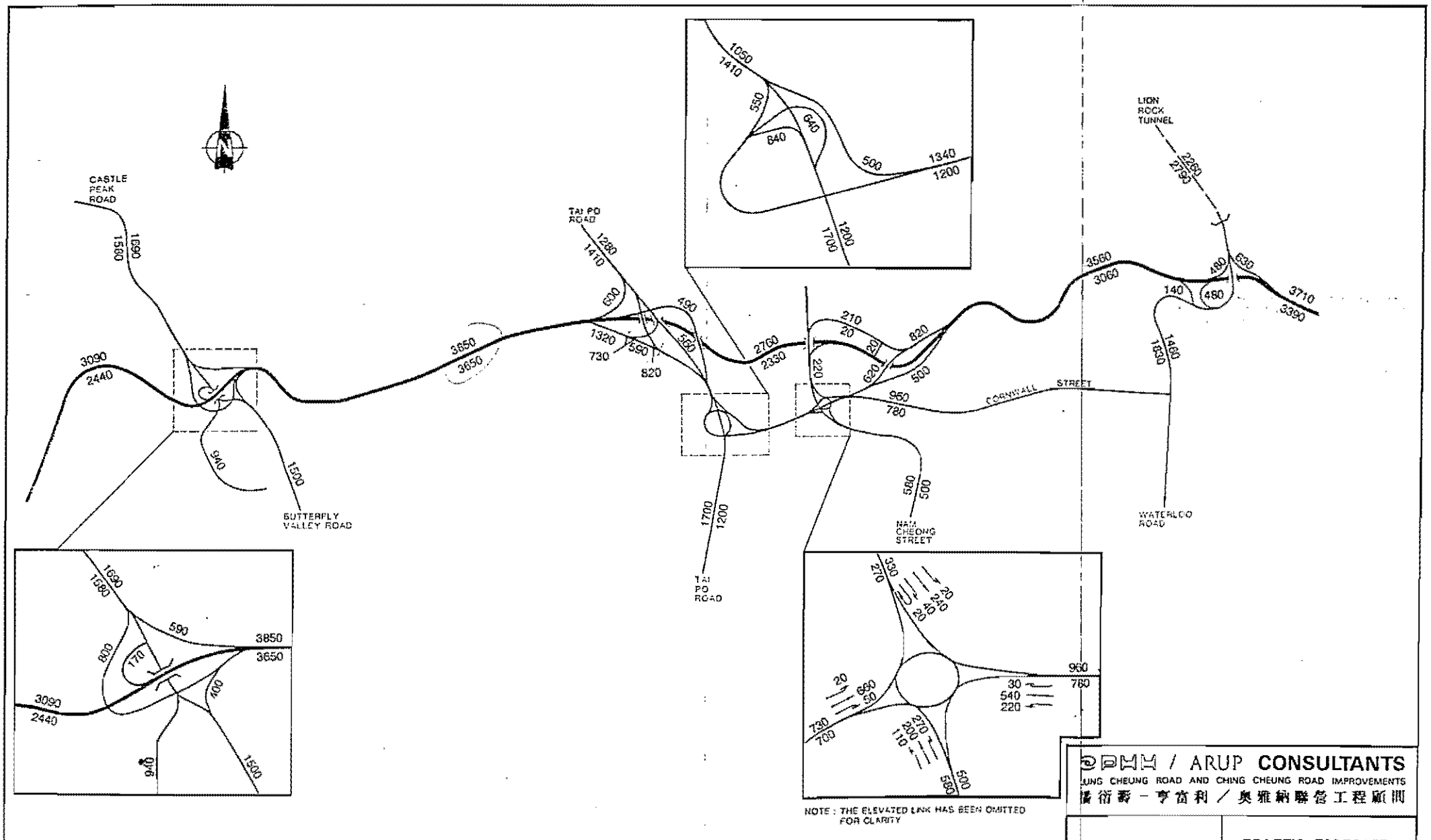
APPROVED	R. R.		
DATE	JUNE 91	SCALE DIAGRAMMATIC	



NOTE : ALL FIGURES ARE IN UNITS OF VEHICLES PER HOUR

NOTE : THE ELEVATED LINK HAS BEEN OMITTED FOR CLARITY

PHH / ARUP CONSULTANTS

UNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS

建衛署－亨富利／奧雅納聯營工程顧問

HIGHWAYS DEPARTMENT
WESTERN HARBOUR CRW OFFICE

TRAFFIC FORECAST
2001 PM PEAK

DESIGNED		DRG. NO.	FIG.
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APPROVED	R. R.		
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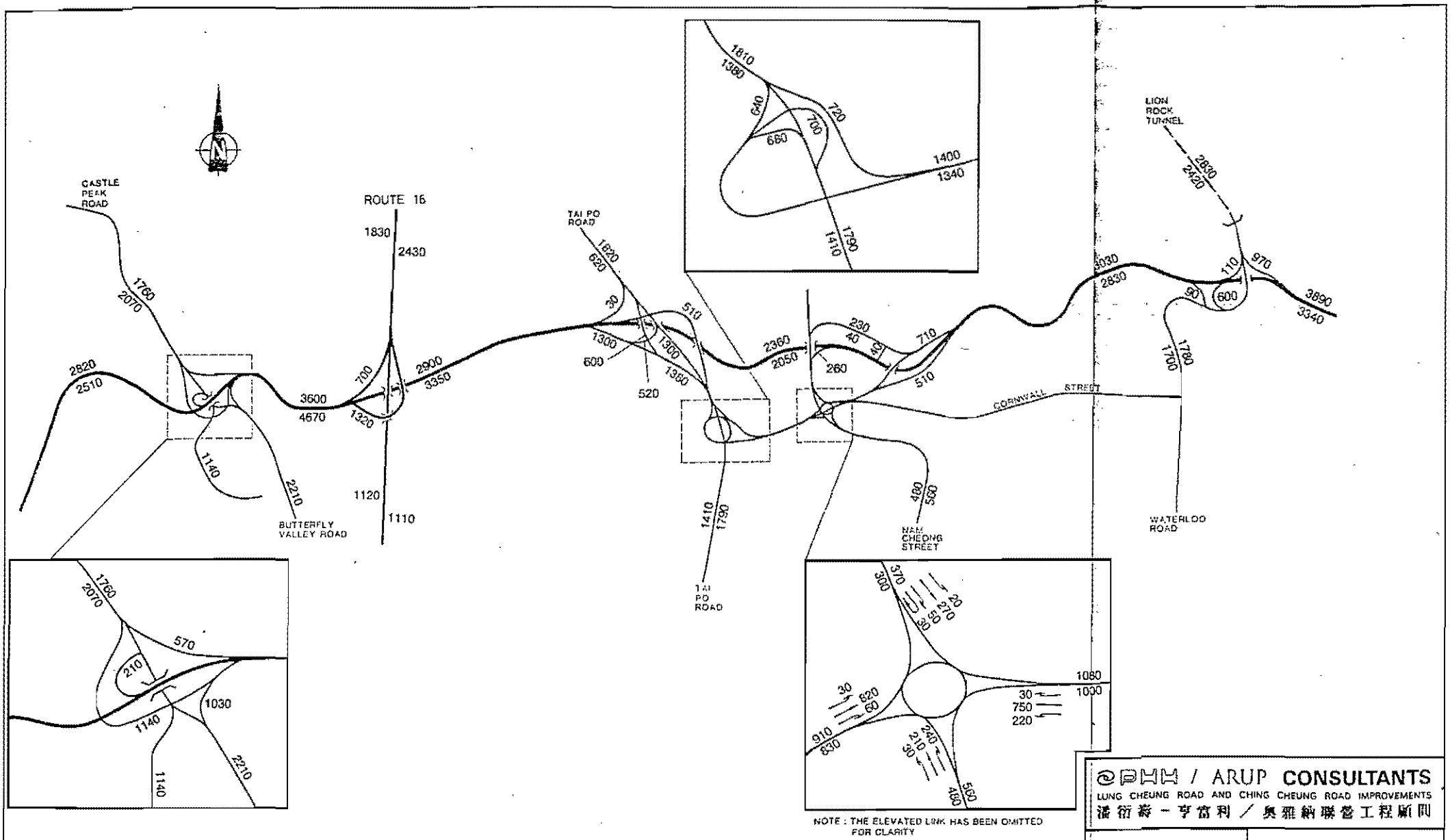


NOTE : ALL FIGURES ARE IN UNITS OF VEHICLES PER HOUR

NOTE : THE ELEVATED LINK HAS BEEN OMITTED FOR CLARITY

PHH / ARUP CONSULTANTS

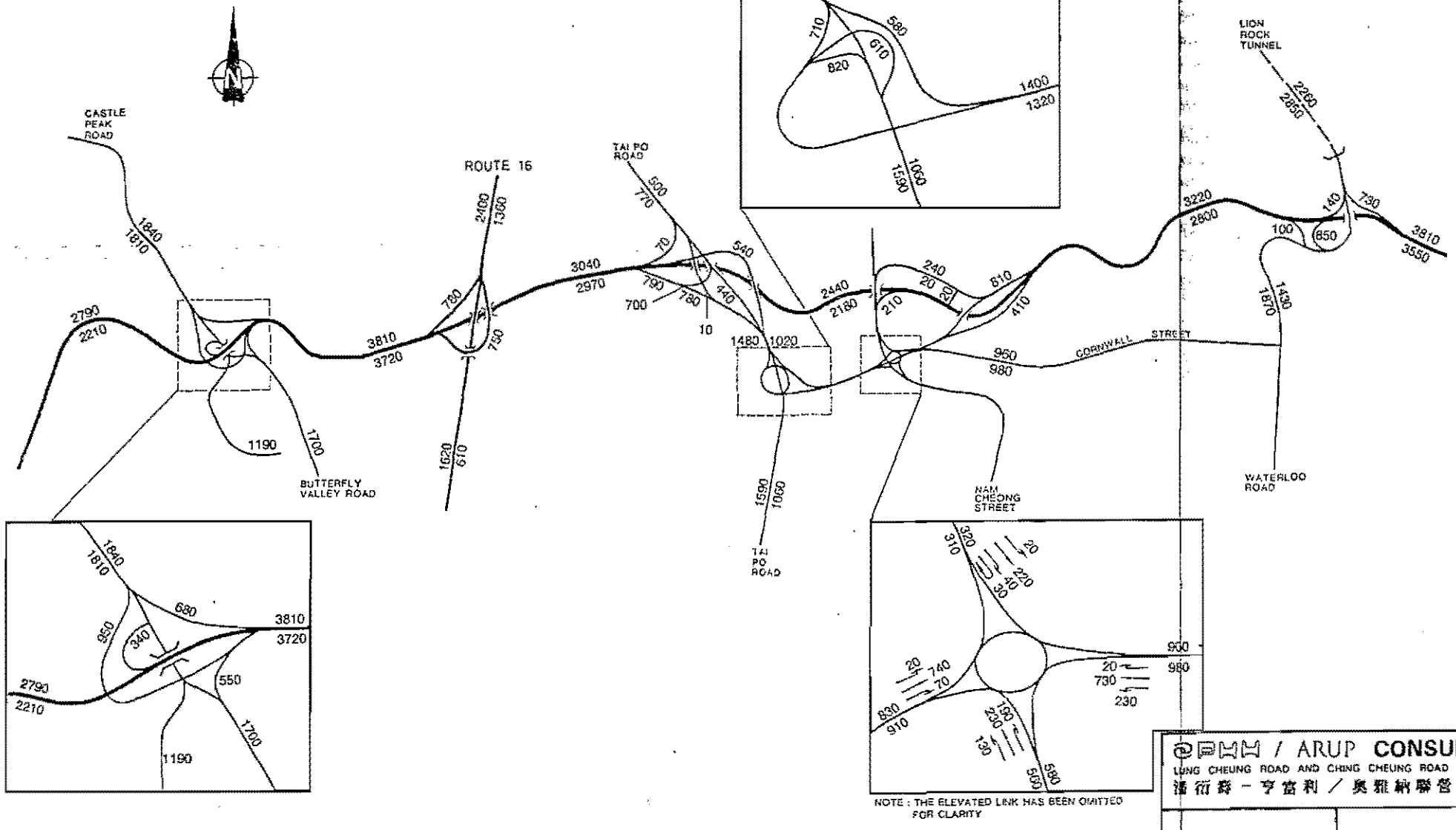
LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS

潘衍壽－亨富利／奧雅納聯營工程顧問

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

TRAFFIC FORECAST
2011 AM PEAK

DESIGNED		DRG. NO.	FIG
DRAWN		PR/H622/200P/004	2.1.12
CHECKED	H. K. L.		
APPROVED	R. R.		
DATE	JUNE 91	SCALE DIAGRAMMATIC	



NOTE : ALL FIGURES ARE IN UNITS OF VEHICLES PER HOUR

PPHH / ARUP CONSULTANTS

LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS

滙衍發－亨富利／奧雅納聯營工程顧問

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

TRAFFIC FORECAST 2011 PM PEAK

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CHECKED	H. K. L.		
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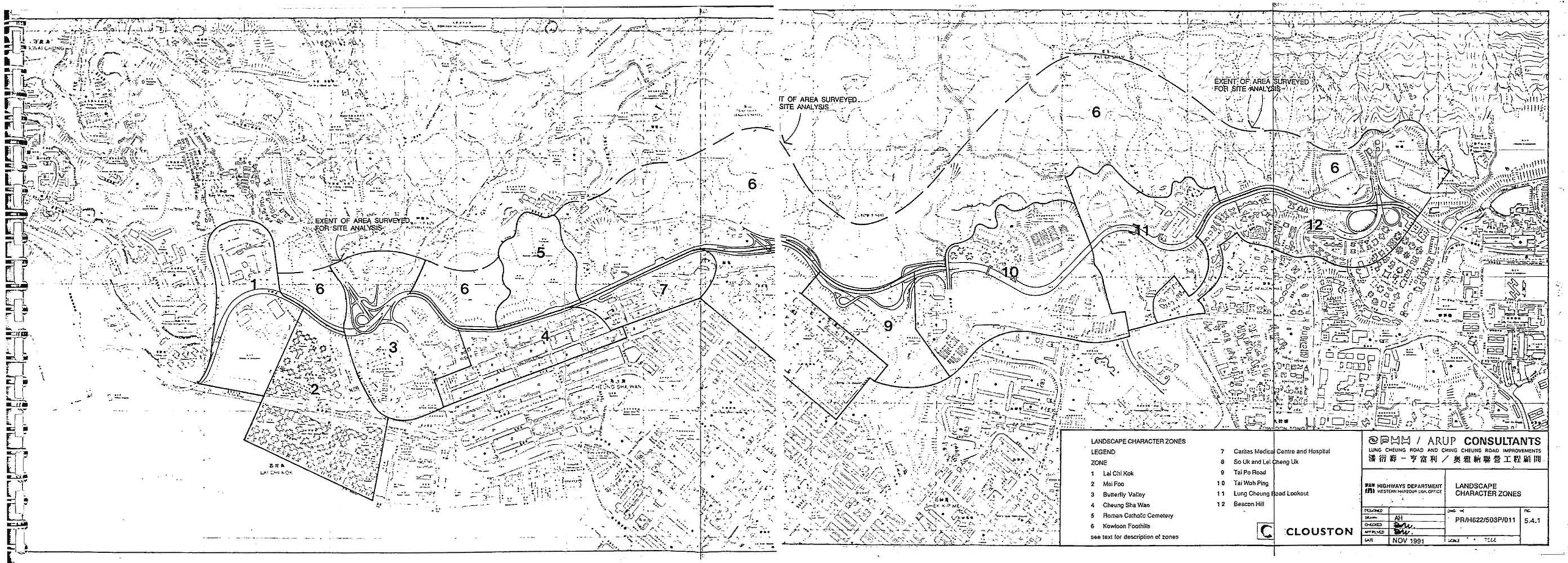
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EXENT OF AREA SURVEYED FOR SITE ANALYSIS
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LAI CHI KOK
CHEUNG SHA WAN
LANDSCAPE CHARACTER ZONES
LEGEND
ZONE
1 Lai Chi Kok
2 Mei Foo
3 Butterfly Valley
4 Cheung Sha Wan
5 Roman Catholic Cemetery
6 Kowloon Foothills
see text for description of zones
7 Caritas Medical Centre and Hospital
8 So Uk and Lei Cheng Uk
9 Tai Po Road
10 Tai Woh Ping
11 Lung Cheung Road Lookout
12 Beacon Hill
CLOUSTON
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LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS
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FIG. 5.4.1
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CHAPTER 3

3 NOISE

3.1 Introduction

3.1.1 This section describes the noise impact during the construction and operation of the proposed road improvement scheme. The noise sensitive receivers, (NSRs), are those classified and identified in section 2.4 and Annex 2.A. They are those identified in the Environmental Criteria Report and subsequently expanded as a result of further discussion with affected authorities.

3.2 Ambient Conditions

3.2.1 By nature, NSRs identified for the road improvement scheme are those predominately affected by traffic noise from the existing or future corridors. However, other influencing noise sources were also identified in certain areas. In general, residential areas to the south of the road scheme are subject to certain degree of noise disturbance from the overflying aircraft to or from Kai Tak Airport. Some individual NSRs in close proximity to construction sites are also influenced by noise from construction works.

Ambient Noise Measurements

3.2.2 A 24-hour noise monitoring programme was carried out in order to establish the prevailing noise levels. Representative sites for noise monitoring were selected after considering the location of the NSRs and potential noise sources. As a result of this process, seven sites as shown in Figure 2.4(a) along the proposed alignment were identified. At each site, 1-hour L_{10}, L_{90} and L_{eq} values were recorded at the facades over a 24-hour period. A summary of the noise measurements at each site is shown in Table 3.1(a) and detailed descriptions are presented in Annex 3.A.

Table 3.1(a) Summary of the Noise Levels, dB(A), at Seven Selected NSRs for 24-hour Noise Measurements

NSR	L_{10} (1-hr)		L_{90} (1-hr)		L_{eq} (1-hr)	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
Mei Foo Sun Chuen	73.7 (72.1-74.6)	67.8 (64.1-72.1)	68.2 (65.6-69.6)	58.7 (54.1-64.6)	71.5 (69.7-72.8)	64.7 (60.8-69.3)
Caritas Medical Centre	77.8 (74.6-79.1)	73.1 (70.1-75.6)	72.9 (69.6-75.1)	62.0 (56.6-69.1)	75.8 (72.7-77.2)	69.8 (66.2-73.0)
So Uk Estate	72.8 (71.1-74.1)	67.7 (64.6-71.6)	68.6 (66.1-70.1)	59.4 (54.6-64.6)	71.0 (69.0-72.5)	64.8 (61.4-69.0)
Chak On Estate	70.7 (68.1-73.1)	62.1 (58.6-67.1)	63.2 (60.1-65.1)	52.2 (48.6-58.1)	68.4 (65.0-70.9)	59.1 (55.8-63.8)
Beacon Heights	77.9 (75.6-79.1)	71.1 (67.6-75.1)	72.4 (68.6-74.1)	59.1 (52.1-67.1)	75.8 (73.0-76.9)	67.8 (64.3-72.1)
Elizabethan Court	78.1 (75.6-79.6)	71.6 (68.1-76.6)	72.4 (68.6-74.1)	56.2 (49.1-66.6)	75.8 (73.0-77.5)	68.0 (64.3-73.5)
Lung Cheung Court	77.9 (75.1-79.1)	71.2 (67.6-75.6)	72.1 (65.6-74.1)	59.5 (52.1-68.6)	75.7 (72.1-76.9)	67.9 (64.3-73.0)

3.2.3 Results of the noise monitoring indicated high noise levels in daytime and evening (0700 to 2300) which dropped sharply at nighttime (2300 to 0700). High L_{10} values were recorded for daytime peak traffic flow, in all cases exceeding the recommended level of maximum 70dB(A) for residential areas laid down in HKPSG in some instances by as much as 8dB(A). The high noise levels of L_{10} 74 to 80dB(A) recorded attribute to the high traffic volume (4,000-5,000 v/h) along the existing corridor and the particularly high percentage of heavy vehicles, which is about 35%.

3.3 Traffic Noise

Introduction

3.3.1 As road traffic noise already exceeds HKPSG levels along all of the route a number of noise reducing factors have been built into the design. Such measures include maximising free flow of traffic, maximising distance from NSRs where possible, minimising gradients and maximising soft ground where sound absorption could be expected to be significant. In addition, noise screens have been incorporated into the design in a number of areas where the noise levels already exceed HKPSG and their use would result in significant benefits.

3.3.2 Another means to control traffic noise is to reduce the tyre/road surface noise by laying noise reducing open textured surfacing on the road surface. Compared with a brushed concrete surface, the reduction attained when using open textured surfacing is in the range of 3-5dB(A). A conservative figure of 3.5dB(A) reduction was used in this assessment. The base calculations have not assumed the use of this material but the possibility of its adoption has been considered as a separate item.

3.3.3 The process however has not resulted in achieving HKPSG noise levels at all points. In many cases this would be totally impracticable and in others the improvements would not justify the expense.

3.3.4 In cases where an existing building is already subject to noise levels equal to, or in excess of, the recommended maximum, measures to avoid (as far as possible) deterioration of the situation are included in the design if such measures are likely to result in significant improvements.

Noise Standards

3.3.5 The base criteria laid down in HKPSG are reproduced in Table 3.3(a).

Table 3.3(a) Summary of Road Traffic Noise Standards

Noise Sensitive Uses	Noise Standards (Road Traffic Noise) L_{10} (1 hour) dB(A)
All domestic premises including temporary housing accommodation	70
Hotels and hostels	70
Offices	70
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	65
Places of public worship and courts of law	65
Hospitals, clinics, convalescent homes and homes for the aged	55

Notes:
1. The above standards apply to buildings which use windows as the main source of ventilation.
2. The above standards should be viewed as the maximum permissible noise levels at the external facade.

Methodology

3.3.6 Road traffic noise levels likely to be experienced by the identified NSRs were predicted using the procedure given in "Calculation of Road Traffic Noise", (CRTN) U.K. Department of Transport (1988). The noise levels presented in this section, unless stated otherwise, are in terms of dB(A) L_{10}(1-hr). 2001 morning peak hour traffic data was adopted for the assessment here as this presents the worst case scenario. Traffic speeds used in the modelling were 70kph for mainline and 45kph for slip roads. These speeds are unlikely to occur very often in practice because of the combination of gradients and HGV's, they are however possible and have therefore been adopted as they represent a "worst case" scenario. Concrete road surface was assumed throughout the scheme in this assessment.

3.3.7 Two height levels are assessed for each receiver. One is the top floor which would generally be least protected by roadside barriers and have greatest view angle, and the other is 10m above the carriageways which should be outside the protection of roadside parapets and would benefit least from distance attenuation.

3.3.8 The effectiveness of noise barriers, to protect the NSRs exposed to high traffic noise, was also modelled according to the CRTN procedure. The height of the barrier can vary and in Hong Kong, most of the existing noise barriers are no higher than 4m. In this study, barriers of 2m, 3m and 4m high have been considered. In some instances, roadside barriers may be effective in screening traffic on the nearside carriageway but would be ineffective for screening traffic on the offside carriageway. In this study, barriers at the roadside and median strip have been considered where they might be appropriate.

Noise Impact Assessment

3.3.9 In general, traffic noise levels along the main alignment will increase by 1-2dB(A) due to the projected traffic growth. The increase in the percentage of heavy vehicles from 35% to 45% will further increase the noise levels by about 1dB(A). In areas where the improved road scheme will be closer to the NSRs, further increase in the traffic noise levels will occur. The new off line link will add a new noise source to certain NSRs, although a few existing NSRs will benefit by such a re-routing. For the planned sensitive developments in close proximity to the proposed scheme, future traffic noise levels are predicted as far as possible based on the site layout and building plans.

3.3.10 Table 3.3(b) is a summary of the existing situation at the various NSRs juxtaposed with the expected noise levels in 2001. A number of points should be borne in mind when considering the table:-

a) Even though CRTN methodology was observed for both measurement of existing noise levels and calculation of future noise levels, the comparison cannot be entirely precise. The discrepancies are due to the fact that the complicated factors in field monitoring cannot always be taken into account by the numerical model. Moreover, in certain cases, field monitoring location could not be placed precisely at the assessment points because of the practical difficulties.

b) The noise level variations which can be expected to arise out of traffic increases only have been calculated for comparison purposes by calculating variations in base noise levels associated with 1991 and 2001 traffic flows. Other aspects, such as road geometry, are assumed to be constant for the purposes of this comparison.

c) The predicted noise levels in the table in all cases include for all appropriate noise mitigation measures incorporated into the design, such as barriers (see Figures 3.3.1 to 3.3.3). As stated in paragraph 3.3.1, the application of open textured wearing course can be expected to reduce noise levels at receptors by as much as 3-5dB(A). The Draft Preliminary Report concludes that the new road should consist of rigid paving throughout, mainly in the interests of economy. It is recognised that an open textured overlay will be of value environmentally but also that it would carry economic disadvantages both in capital cost and in maintenance commitment.

d) Differences of up to 2dB(A) are hardly discernible by the human ear. It has not been considered reasonable therefore to include for the cost of noise barriers in areas where noise level reductions would be of that order.

Consideration of Individual Noise Sensitive Receivers

3.3.11 Table 3.3(b) presents the assessment of the traffic noise impact at individual noise sensitive receivers. Consideration of planned uses is addressed below.

Table 3.3(b) Summary of Change in Noise Levels L_{10} for the Proposed Scheme

			1991 Calculation		2001 Calculation			
Mei Foo Sun Chuen Chainage 1220 - 1450	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	21/F; top	74	3300	76	5500	78	N.A.	+ 2
	13/F; mid	-		74		76		
	Remarks:- No new lane is proposed to add onto this section of the corridor and the predicted 2dB(A) increase is due to a corresponding growth in traffic flow. Barriers of 2m, 3m and 4m height between Chainage 1250 and 1420 were tested: one at the nearside of the westbound carriageway and one on the central separator. Up to 4 to 5dB(A) noise reduction could be obtained using barriers higher than 3m, although not for the upper floors. Open textured surfacing macadam would bring down the 2001 noise levels to less than existing levels even without the use of barriers. As the change is therefore not a result of the scheme proposals no mitigation proposals arising out of the current scheme are recommended. Such mitigation measures might however be justified under the terms of the brief requiring improvements to the existing situations in order to avoid deterioration in the situation.							
Lai Chi Kok Hospital Chainage 1470 - 1550	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	2/F; top	-	3300	67	5100	69	N.A.	+ 2
	Remarks:- The predicted 2001 noise levels for upper floor wards are around 69dB(A), exceeding the HKPSG level by 14dB(A) but are only 2dB(A) above current levels, entirely as a result of increased traffic flows. The 2-storey wards are designed in such that most openable windows are not facing the road alignment. Moreover, the second floor wards are currently air-conditioned whereas ground floors are completely screened by the knoll and the traffic noise from the proposed scheme should not have any impact on this area.							
Wai Man Tsuen - school - residential Chainage 1650 - 2050	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	1/F; top	-	5300	63	7800	65	N.A.	+ 2
	1/F; top	-		65		67		
	Remarks:- The predicted noise levels are within acceptable levels of 70dB(A) for residential areas and 65dB(A) for schools as laid down in the HKPSG. No mitigation measures are therefore necessary.							

Table 3.3(b) Summary of Change in Noise Levels L_{10} for the Proposed Scheme (Cont'd)

			1991 Calculation		2001 Calculation			
Nam Wah Middle School Chainage 2570 - 2620	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	6/F; top	-	5300	69	7800	69	2m barriers at nearside ($0.36 million)	+ 2 *
	3/F; mid	-		65		65		

Remarks:-
There are two teaching blocks on this school site. The block near the carriageway is separated from it by the elevated slip road to the Caritas Medical Centre and is level with the main alignment at roof top. Only the top floor of the far block is exposed to LCR traffic but is currently air-conditioned. The predicted 2001 noise level without the barriers is 73dB(A) for the top floor of the near block and 68dB(A) for lower floors as a result of screening by the slip road structure. With the barriers, the future noise levels will not therefore be significantly different to those experienced at present. Approximately twelve classrooms would benefit.

			1991 Calculation		2001 Calculation			
Jockey Club Wai Oi Block, Caritas Medical Centre Chainage 2650 - 2720	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	11/F; mid	79	5300	80	7800	82	N.A.	+ 2

Remarks:-
The new alignment is some 10m closer to the block (staff quarters) but the increase in noise levels is mainly due to traffic growth. As the block has about 17 storeys above ground, roadside noise barriers would not be effective. However, all the quarters are currently air-conditioned, which can reduce its sensitivity to the noise level change. Their priority to abate the traffic noise will be lower when compare to the fan-ventilated wards.

			1991 Calculation		2001 Calculation			
Caritas wards and nurse quarters Chainage 2800 - 3100	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	8/F; top	-	5300	74	7800	68	2m barriers at separator and 3m barriers at nearside ($0.51 million)	+ 2 *

Remarks:-
The nurses quarters and the wards are fan-ventilated, and in this regard, they should have a high priority for abating traffic noise. This should take the form of a barrier at the separator between Chainage 2800 and 2900 and two barriers between Chainage 2800 to 3150; as shown in Figure 3.3(b), one on the earth berm and one to adjoining east. The most effective combination is 2m high at the separator and 3m high at the near roadside, which would have a 8dB(A) reduction, but the resulting 68dB(A) is still unacceptable compared to the HKPSG level of 55dB(A). However this would reduce the future noise level to less than the existing level. The upper four floors of two wards buildings would benefit from such reduction.

* Noise level change if without barriers

Table 3.3(b) Summary of Change in Noise Levels L_{10} for the Proposed Scheme (Cont'd)

			1991 Calculation		2001 Calculation			
Proposed Caritas School Chainage 3050 - 3150	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	3/F; top	-	5300	68	7800	67	2m barriers at nearside ($0.44 million)	+ 2 *
	Remarks:- As neither the final layout nor the ventilation means of the school are known at this stage, it is impossible to recommend a cost-effective measure. Nevertheless, it is recommended that spatial and structural reservations should be provided at the nearside edge to allow for any possibility of installing a 2m high noise barrier in the future. Alternatively, classrooms with windows facing the road should be air-conditioned so as to reduce the noise impact.							
Park Mansion Chainage 3100 - 3220	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	3/F; top	-	5300	74	7800	76	N.A.	+ 2
	Remarks:- Park Mansion sits on a platform of 90m PD which projects out in such a manner that the lower floors are protected from traffic noise from the alignment. The new westbound link will not have any significant influence and the traffic noise would be mainly from the main alignment. The predicted noise increases arises out of traffic growth rather than the new scheme. As the residential units are air-conditioned, it is unlikely the change in noise levels are perceivable. Specific mitigation measures are not required.							
Pine Hill Chainage 3000 - 3100	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	4/F; top	-	5300	70	7800	72	N.A.	+ 2
	Remarks:- Similar to Park Mansion, Pine Hill is located on a platform of 95m PD. As the predicted noise level exceeding HKPSG by only 2dB(A) and the residential units are currently air-conditioned, no specific mitigation measures are recommended.							

* Noise level change if without barriers

Table 3.3(b) Summary of Change in Noise Levels L_{10} for the Proposed Scheme (Cont'd)

			1991 Calculation		2001 Calculation			
So Uk Estate Chainage 3050 - 3400	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	18/F; top 14/F; mid	74 -	5300	75 -	7800	77 75	N.A.	+ 2
	Remarks:- A westbound link for Tai Po Road northbound traffic connecting to Ching Cheung Road westbound is added to the south of the westbound carriageway. The abutments and earth berm under the elevated road structure will provide some noise screening for the upper floor and middle floor residents. The proposed link will carry some 700 vph at 70 kph, about 2m higher than the existing mainline and at some 15m closer to the residential lots than the original westbound lane. Barriers on top of the existing earth berm and along the new carriageway were tested for their effectiveness. 4dB(A) reduction can only be achieved for both upper and middle floors when barriers are 4m high, which is considered not cost-effective.							
Fu Chak House, Chak On Estate Ramp C5 - C6	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	8/F; top	73	N.A.	N.A.	2600	70	2m barriers at nearside ($0.53 million)	N.A.
	Remarks:- The field measurement point is at the eastern facade of Wah Chak House whereas the calculation point is at the southern facade. The southern facade of Fu Chak House currently has no direct view to Cornwall Street Roundabout and should experience low traffic noise level, likely to be below 70dB(A). Without any mitigation measures, the new off line link will lead to a significant increase in noise level, up to 72dB(A), at the southern facade. 2m high barriers at the nearside of the new off line link will reduce the noise to 70dB(A). The upper four floors (approx. 100 persons) are approximated to benefit by such a reduction.							
Wing Chak House, Chak On Estate Chainage 4000 - 4020	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	13/F; top 5/F; mid	- -	5000	73 70	5000	70 68	2m barriers at separator and 2m barriers at nearside ($0.96 million)	0 *
	Remarks:- With the 2m barriers, the future noise levels will be acceptable to HKPSG. The shape of Wing Chak House is such that long barriers along the carriageway are required to give effective shielding. The upper six floors (approx. 150 persons) are estimated to benefit from such a reduction.							

* Noise level change if without barriers

Table 3.3(b) Summary of Change in Noise Levels L_{10} for the Proposed Scheme (Cont'd)

			1991 Calculation		2001 Calculation			
Wah Chak House, Chak On Estate Chainage 4000 - 4150	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	13/F; top 9/F; mid	- -	5100	79 78	5000	73 70	3m barriers at separator and 3m barriers at nearside ($1.6 million)	0 *
	Remarks:- The new off line link will take away the Tai Woh Ping Road traffic and thereby reduce the traffic noise from the source to Wah Chak House, the northernmost block. The predicted noise levels will be similar to existing noise levels as the traffic flow on the mainline fronting the NSRs will remain approximately the same as a result of the planned diversion of the increased traffic to the new off line link. As the brief requires consideration of existing levels however, barriers have been included for this area (Figure 3.3.2). The highrise nature of the residential block, with 10-storeys above Lung Cheung Road, would reduce the effectiveness of roadside barriers. The number of persons exposed to high traffic noise would be reduced from 300 to 100. Upon the completion of the scheme, Nam Cheong Street traffic which currently consists of 50% heavy vehicles will be halved due to the traffic diversion to the new off line link. The eastern facade of Lai Chak House will benefit by about 3dB(A) noise reduction.							
Beacon Heights Chainage 4150 - 4420	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	13/F; top 9/F; mid	79 -	4400	80	5200	81 81	N.A.	+ 1
	Remarks:- No change in alignment. Any increase in traffic noise is due to the corresponding change in traffic volume and mix. Whilst the fence wall along the development can give some noise protection to the lower 2 floors, the top 9 floors will be affected by the increase. Barriers at the separator and at near roadside were evaluated. As all the 13 storeys of the residential lots are exposed to the mainline traffic noise, the roadside barriers are not effective. Only 2dB(A) reduction can be attained even with 4m high barriers. However, Beacon Heights are high standard residential development with all units fitted with air-conditioners and the 1dB(A) increase should not be noticeable with their current ventilation practice.							

* Noise level change if without barriers

Table 3.3(b) Summary of Change in Noise Levels L_{10} for the Proposed Scheme (Cont'd)

			1991 Calculation		2001 Calculation			
G/ICs on Kwong Lee Road Tai Po Road Interchange	**Floor**	**Measured Noise Level**	**Traffic Flow vph**	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	**Noise Level Change due to Increased flow**
	6/F; top	-	4200	62	6500	64	N.A.	+ 2
	Remarks:- The community facilities are all lowrise and 30m to 40m below the LCR and the new off line link. Traffic noise emanating from the off line link will not significantly affect the sensitive facilities. No mitigation measures are required.							
Lei Cheng UK Estate Tai Po Road Interchange	**Floor**	**Measured Noise Level**	**1991 Calculation**		**2001 Calculation**			**Noise Level Change due to Increased flow**
			Traffic Flow vph	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	
	25/F; top	-	N.A	N.A.	2600	68	N.A.	N.A.
	Remarks:- The estate is 200m away from the mainline and 100m from the off line link. The predicted noise level is below the HKPSG. No mitigation is required.							
Lung Ping Road THA Chainage 4600 - 4800	**Floor**	**Measured Noise Level**	**1991 Calculation**		**2001 Calculation**			**Noise Level Change due to Increased flow**
			Traffic Flow vph	**Predicted 1991 Noise Level**	**Traffic Flow vph**	**Predicted 2001 Noise Level**	**Mitigation Measures**	
	2/F; top	-	4400	69	6600	71	N.A.	+ 2
	Remarks:- The 2001 predicted noise level marginally exceeds the guideline and the difference in 1dB(A) should not be noticeable. In this regard, no mitigation measures on the road are recommended. If noise abatement measures have to be considered, a 2m high solid fence wall at the THA site would be more cost-effective and visually acceptable than any roadside barrier.							

Table 3.3(b) Summary of Change in Noise Levels L_{10} for the Proposed Scheme (Cont'd)

Beacon Hill Residential Chainage 5300 - 5900	Floor	Measured Noise Level	1991 Calculation		2001 Calculation			Noise Level Change due to Increased flow
			Traffic Flow vph	Predicted 1991 Noise Level	Traffic Flow vph	Predicted 2001 Noise Level	Mitigation Measures	
	13/F; top 10/F; mid	80 -	4400	81 81	6600	79 74	3m barriers at separator and 3m barriers at nearside ($5.5 million)	+ 2 *

Remarks:-

A lane to the southern edge of westbound carriageway between Chainage 5330 and 5500 will bring the noise source some 4m closer to the residential lots nos. 43-53. However, the lots of 3 to 4 storeys are at a slightly lower level than the existing and future corridor and no noise impact would result from the additional lane.

For the residential lots nos. 55-67, the northern facade of the top 8 to 9 floors will have an increase of about 2dB(A) due to the corresponding rise in traffic flow. Noise levels predicted at Elizabethan Court is very high, up to 83dB(A), due to the large volume of traffic flowing in close proximity to the block.

Barriers of various heights placed at nearside and separator were tested. It is estimated that about 230 flats and 700 persons would benefit from such a reduction. The predicted noise levels are lower than existing but still unacceptable to HKPSG.

* Noise level change if without barriers

Kau Wah Keng Development Area (Chainage 900 to 1100)

3.3.12 As the development study is still in a very preliminary stage and no site layout plan is available, detailed assessment cannot be carried out. However, based on the traffic forecast, 80dB(A) is predicted at the near edge of the site and most of the site is expected to be exposed to traffic noise higher than HKPSG noise level for residential development. Without noise abating measures in block layout and design, the first 100m from the carriageway would be deemed as unacceptable to residential buildings.

3.3.13 As the existing structure does not have an allowance for additional loading it is not feasible to install noise barriers on the flyover.

3.3.14 It is recommended that the site layout and the building design measures should be considered to reduce the noise impact from the road. These measures could include siting car parking facilities as a noise barrier or buffer and reducing the view angle by optimal facade orientation.

Carlton Hotel Redevelopment (Chainage 3000 to 3100)

3.3.15 Assuming the receivers are at 110m PD, 78dB(A) is predicted at the southern edge of the platform. The platform edge can offer certain protection should the sensitive block be located further away from Lung Cheung Road. 70dB(A) is predicted 30m from the edge. The buffer distance could be shortened by improved block design to reduce the view angle to Lung Cheung Road traffic. With an optimal building layout, traffic noise from Lung Cheung Road would not pose severe constraints on the development. Mitigation measures at the road would not therefore be required.

Tai Woh Ping Residential Development (Chainage 4000 to 4200)

3.3.16 The proposed development will sit on a 97m PD platform and have a direct view to Lung Cheung Road. For receivers at 114m PD, the predicted noise level at the southern boundary is about 76dB(A). To reduce the noise impact from Lung Cheung Road, a 40m setback from the edge of the platform is recommended. This could then act as an effective noise barrier. If a fence wall is built at the southern edge, improved barrier effects and noise reduction could be obtained.

3.3.17 Alternatively, when designing the site and block layouts, block orientation and the boundary wall requirement should be considered. It is concluded that with suitable design, the traffic noise should not pose a severe constraint to the development.

Proposed Private Hospital East of Beacon Heights (Chainage 4450 to 4600)

3.3.18 As there are no layout and block plans available, it is impossible to make a detailed assessment of the future noise impact. However, it is expected that the development will be exposed to high noise levels of about 80dB(A) due to Lung Cheung Road traffic.

3.3.19 The maximum number of storeys allowed for the hospital development on the site is only four. A fence wall of sufficient height may be required to maintain a quiet environment on the site and should be easier to install and be more cost-effective than a roadside barrier. Bearing in mind that the current practice for hospitals is to use air-conditioning rather than open window ventilation, the priority of incorporating mitigation measures over this segment of the present scheme would be low.

Proposed School Site at Tai Woh Ping THA (Ramp C6)

3.3.20 Assuming the school is 6-storey, i.e. 93m PD, 70dB(A) for top floors and 65dB(A) for lower floors are predicted at 40m from the new off line link. As no layout plan has been prepared, it is impossible to recommend any cost-effective mitigation measures at this stage. If the site is developed for educational purpose, non-sensitive uses such as playgrounds or staircases should face Lung Cheung Road and the provision of air-conditioning to the classrooms should be considered.

Open Textured Wearing Course

3.3.21 As stated above, the figures quoted assume the construction of a concrete carriageway with no additional surfacing. The result is that a comparison between existing and proposed roadworks is entirely valid as the existing pavement is rigid. It can be seen that the new scheme will not of itself result in lose increases in traffic noise to any sensitive receiver, the largest increases being of the order of 2dB(A), most of this being as a result of traffic growth. In a number of areas, a significant improvement is to be expected as a result of the mitigation measures built into the scheme.

3.3.22 There is scope for an overall improvement to all NSR's by the application of an open textured wearing course. This could be expected to reduce noise levels at receivers by up to 3.5dB(A) where the road thus treated constitutes the predominant noise source, i.e. noise levels would fall below those currently experienced. This approach is however costly. To treat the entire road would cost approximately $22 million. This and the fact that the scheme will not of itself significantly worsen the situation has led to the separation of this mitigation item. Those areas which would benefit from such a treatment and which fall within the proposed modifications to the existing road being proposed are:-

- Chainage 2650 to 3100

  At a capital cost of approximately $1.7 million the noise levels at the Jockey Club Wai On Block of the Caritas Medical Centre could be reduced from 82dB(A) to about 78.5dB(A), and the levels at the Caritas wards from 68dB(A) to 64.5dB(A). Both of these remain substantially above HKPSG levels.

- Chainage 3050 to 3220

  At a capital cost of approximately $0.75 million the noise levels at the proposed Caritas School would be reduced from 67dB(A) to about 63.5dB(A), still substantially above HKPSG levels. Noise levels at Park Mansion would be reduced from 75dB(A) to 72.5dB(A), at Pine Hill from 72dB(A) to 68.5dB(A) and at So Uk Estate from 77dB(A) to 73.5dB(A). In all cases HKPSG standards would not be met and the result would represent an improvement over the existing situation.

- Chainage 4000 to 4420

  At a capital cost of $1.1 million on already mush improved situation at Wah Chak House would be brought within HKPSG levels, and noise levels at Beacon Heights would reduce to about 77.5dB(A). Note that none of these areas will be adversely affected by the scheme proposals.

- o Chainage 5300 to 5900

  The higher levels of the residences to the south of this road are already expected to perceive a slight improvement over the existing situation as a result of the scheme. The addition of open textured wearing course, at a cost of $1.9 million would result in a further reductions, but HKPSG standards would still not be met.

3.3.23 To the above costs would have to be added the recurrent costs associated with the use of the material. It is a relatively recent innovation in Hong Kong and no specific costs can be attributed to it. It would however be considerably greater than that associated with untreated concrete, and the material would require refurbishment/replacement more frequently. Such costs on Lung Cheung Road would be greater than elsewhere in the Territory because of the high axle loadings and the high incidence of diesel spillage arising ut of the high HGV content of the traffic.

Compliance Monitoring and Auditing

3.3.24 In order to evaluate the effectiveness of the mitigation measures incorporated into the road scheme, it is recommended that noise measurements should be taken during traffic peak hours before and after improvement works. The noise level monitoring should be carried out at 1m from the external facade of the following locations:-

- o Nam Wah Middle School;
- o Caritas nurses quarters or wards;
- o Peony House, So Uk Estate;
- o Fu Chak House, Chak On Estate;
- o Wing Chak House, Chak On Estate;
- o Wah Chak House, Chak On Estate;
- o Beacon Heights; and
- o Elizabethan Court.

3.3.25 The parameter taken to measure the traffic noise should be L_{10} 1-hr. The noise environment at the above locations is dominated by traffic noise of the road which has a typical daily pattern. As the day to day variation of the noise pattern is small, monitoring on a typical weekday at each location should be sufficient.

Conclusion and Recommendations

3.3.26 Noise sensitive uses (NSRs) surrounding Lung Cheung Road/Ching Cheung Road are currently subject to high levels of traffic noise. The proposed layout in most areas should not in itself result in noise impact significantly greater than would the "do-nothing" option. In some areas, the noise environment should be improved to a degree as a result of the smoother flow of traffic. Except at the NSRs where new carriageway would be added in close proximity, the increase in traffic noise from the proposed layout would be due primarily to the projected increase in traffic flow and the proportion heavy vehicles.

3.3.27 Noise sensitive receivers along the existing Lung Cheung Road and Ching Cheung Road are mostly highrise developments which make roadside barriers in most cases ineffective. On the other hand, whilst the laying of open textured wearing course can significantly reduce the predicted noise levels to at least lower than existing, it has the disadvantage is that it carries capital and maintenance costs and periodic disruption of traffic during maintenance periods.

3.3.28 Noise abatement by various means have been investigated and built into the scheme proposals where considered appropriate. Noise barriers are proposed for those sensitive buildings which are either low rise or do not have many floors exposed to the traffic noise. The locations of proposed barriers are as indicated on Figures 3.3.1 to 3.3.3 and referred to in Table 3.3(b). The costs given in Table 3.3(b) have been included in the scheme estimate.

3.3.29 A rigid pavement has been recommended for this scheme because of the nature of the route and because of the nature of the expected traffic. To apply open textured wearing course would negate some, though not all, of the advantages of the rigid pavement.

3.3.30 It remains the Consultant's recommendation therefore that a rigid concrete pavement, similar to that currently in place, be used for the entire scheme.

3.3.31 Nonetheless it is recognised that the application of open textured wearing course would, at least in some areas, represent an improvement in the environmental conditions of the area. It is for this reason that the costs of such measures are included in this report.

3.3.32 Because the scheme proposals are not expected to make a significant difference to noise levels over the route as a whole, and because land uses (either existing or planned) already account for the presence of the road, it is not appropriate to include the cost of such a measure in the scheme costs. Should this measure be required therefore the costs will have to be added to the scheme estimate.

3.4 Construction Noise

3.4.1 Construction noise will be generated from road construction/improvement activities including excavation, earthworks, piling, concreting, paving and other earth moving activities. Major noise generating activities, together with the working hours, duration of works, types and numbers of powered mechanical equipment likely to be used are summarized in Annex 3.B.

3.4.2 From the outline of the construction programme described in Section 2.2, it is noted that several activities are likely to be carried out in parallel at any one time. However, as all the works are confined mainly along Lung Cheung Road and Ching Cheung Road, there is a limit to which parallel operations can be performed within short distances of each other. Most of the works will be carried out in sequence. Hence, the calculated maximum noise levels arising from a single activity should be able to define the worst case scenario at the identified noise sensitive receivers. Noise impacts from activities carried out at more than 300m from the NSRs should be insignificant. Depending on the relative location of the construction activities and the NSRs, addition of activity at multiple sites will be considered when applicable.

Statutory Criteria and Requirements

3.4.3 Legislation for the control of noise is provided under the Noise Control Ordinance (NCO) Cap. 400, 1988 and its Technical Memoranda. Noise Sensitive Receiver (NSRs) protected by the NCO are defined as any domestic premises, temporary housing accommodation, educational institutions and places of public worship. Industrial installations are not considered to be NSRs. The specific NSRs are listed in Annex 2.A. The impact from construction noise has been assessed by calculating the summation of the maximum noise level in terms of L_{eq} arising from an individual activity at the facade of the identified NSRs. The predicted noise levels at the facade of the NSRs due to construction activities have been compared with the appropriate standards in the Noise Control Ordinance for the applications of noise permits for nighttime construction. The applications will be assessed by the EPD in accordance with the two following Technical Memoranda.

Technical Memorandum on Noise from Construction Work other than Percussive Piling

3.4.4 There are no legislative restrictions on construction noise during daytime hours. For general construction work, no noise restriction is imposed during daytime hours of the normal working day (0700 - 1900 Monday - Saturday inclusive). However, for evening time (1900 - 2300), nighttime (2300 - 0700) and 0700 - 2300 on Sundays and Public Holidays, acceptable Noise Levels (ANLs) have been stipulated in the Technical Memorandum.

3.4.5 In general, the Area Sensitivity Rating for most of the designated NSRs should be "C" as they are located in the urban area and are directly or indirectly affected by heavy traffic on Lung Cheung Road and Ching Cheung Road. However, exceptions probably can be found at the lower floors of So Uk Estate and Caritas Medical Centre Wards where the traffic noise is not perceivable due to the screening by the high cut slope right in front of them. The Rating for these areas should be "B". The corresponding ANLs for general construction works are as shown in Table 3.4(a).

Table 3.4(a) Acceptable Noise Levels, L_{eq}, dB(A)

Time Period	Area Sensitivity Rating	
	B	C
All days during the evening (1900 to 2300 hrs), and general holidays (including Sundays) during the day-time and evening (0700 to 2300 hrs)	65	70
All days during the night-time (2300 to 0700 hrs)	50	55

Technical Memorandum on Noise from Percussive Piling

3.4.6 The ANL for piling noise is generally 85dB(A) for receivers with windows or other openings but without central air conditioning systems. However, 10dB(A) is subtracted from the ANL for NSRs which are hospitals, medical clinics and educational institutions.

3.4.7 In granting the noise permit for carrying out percussive piling, the EPD will compare the Corrected Noise Level (CNL) with the ANL, the permitted hours of piling operation will be imposed by the EPD in accordance with the difference between the CNL and ANL given in Table 3.4(b).

Table 3.4(b) Permitted Hours of Operation

Amount by which CNL exceeds ANL	Permitted hours of operation on any day not being a general holiday
More than 10dB(A)	0800-0900 and 1230-1300 and 1700-1800
Between 1dB(A) and 10dB(A)	0800-9300 and 1200-1400 and 1630-1800
No exceedence	0700-1900

Guidelines for Daytime Construction Noise

3.4.8 Currently there is no daytime construction noise standard under the NCO. General guidelines adopted are that noise levels at the nearest NSR facade should not exceed 75dB(A) when ambient L_{eq} is not greater than 70dB(A) or should not exceed 5dB(A) above when the ambient L_{eq} is greater than 70dB(A). The noise monitoring results were used to indicate the ambient noise levels at the NSRs of concern. Wherever ambient noise has not been measured, reference to the nearby noise measurement points was made.

Major Sources of Noise Impact

3.4.9 The principal activities associated with the road improvements likely to result in significant noise impacts are as follows:

- Earthworks/Excavation

  Earthworks and excavation will be involved in the construction of cut slopes and retaining walls. An excavator, a dumper and a lorry are likely to be used together for such activities at a specific site. The overall sound power level from these activities will be about 116dB(A).

- Piling

  Piling at foundation locations will be carried out for the elevated sections of the proposed alignment. It is assumed that large diameter bored piles will be used. The noisiest equipment is likely to be the piling rig with a sound power level of 115dB(A).

- Substructure/Caisson

  Substructures and caissons will be involved in providing the foundation of retaining walls and bridges. Most of the construction activities will be undertaken at more than 2m below ground level, and therefore the noise emitted will be lower than that from percussive piling and also less impulsive. A generator, an electric winch and a compressor are likely to be in operation on the surface emitting a total sound power level of 111dB(A).

- Main Structure of Retaining Wall

  Retaining walls will be used to avoid extensive removal of cut slopes and to stabilize the slopes. The walls will be built after the completion of the foundation and reinforced concrete will then be used to form the structural walls. A compressor, a pneumatic breaker and a concrete mixer lorry will be used which have a total sound power level of 118dB(A).

- Roadworks

  Roadworks will involve earthworks, drainage work and road surfacing along most of the chainages. A hydraulic breaker, an excavator, a poker, a compressor, a generator and a lorry are likely to be in simultaneous operation at close distances emitting a total sound power level of 124dB(A).

o Works Area

There are likely to be two works areas, one at the existing Tai Woh Ping THA and another in the West Kowloon Reclamation area which is yet to be identified. Main activities in the Tai Woh Ping works area will include:

- storage of precast concrete units; and
- movement of materials.

Main activities will involve in the West Kowloon Reclamation works area are:

- precasting concrete units;
- batching operations or concrete mixing lorries; and
- transport of materials.

Mobile cranes will be used to lift the precast units to form the bridge structure. The work within the West Kowloon Reclamation works area is expected to be carried out 24 hours a day. The noisiest equipment is likely to be the special truck for transporting the precast bridge units and a pneumatic breaker emitting a sound power level of 117dB(A).

Predicted Noise Levels

3.4.10 Based on the sound power level of the dominant equipment employed, the maximum noise levels at the facade of the NSRs for general construction works and piling have been predicted. Detailed noise calculations are presented in Annex 3.B whereas the results are summarized in Tables 3.4(c) and (d). The "duration" indicated in the tables is the period for the respective construction work along the road segment right in front of the sensitive buildings. The predicted noise level will affect a single NSR for a much shorter period.

3.4.11 As indicated in Table 3.4(c), predicted noise levels for general construction activities, especially the roadworks, will exceed the evening and nighttime criteria stipulated in the Technical Memorandum. The construction noise will also be perceivable in daytime even considering the high ambient noise levels. Based on the predicted noise levels, the Authority would not grant a restricted hours Construction Noise Permits to the contractor. An exception could be considered at Chainage 2000 to 2500 where industrial buildings are the only receivers which should not be noise sensitive in evening and night time.

3.4.12 As caissons would be widely used for the bridge foundations, noise impact from piling can be significantly reduced. Noise from percussive piling, except for the schools in Wai Man Tsuen, will not exceed the ANLs and thereby piling should be allowed between 0700 and 1900 of Monday to Sunday. The schools in Wai Man Tsuen are no longer in use and the impact from piling and general construction noise to normal teaching will not exist. In this regard, no stringent restriction should be imposed on the piling at Bridge B2.

3.4.13 Chak On Estate is the nearest NSR to the Tai Woh Ping works area which would be used for the storage of precast beams and units. The transport of materials to various construction sites of the road alignment via Nam Cheong Street would add certain traffic to the roads. However, the additional traffic would not result in a perceivable increase in traffic noise as the number of truck movements would be small, especially when compared to the large traffic flow on Nam Cheong Street and Lung Cheung Road/Ching Cheung Road.

Table 3.4(c) Predicted Noise Levels L_{eq} for General Construction Activities

NSRs	Construction Activities	Location	Predicted Noise Level dB(A)	Daytime Guidelines	Evening Time Criteria	Nighttime Criteria	Duration (Week)
Mei Foo Sun Chuen	Roadwork Earthwork Excavation	Chainage 1250-1400 Cut slope N1 RW 3	83 64 64	77	70	60	8 6 6
Lai Chi Kok Hospital	Roadwork	Chainage 1490-1550	76	75	70	60	3
Wai Man Tsuen	Roadwork Earthwork Excavation Caisson	Chainage 1700-2000 S13 RW8 B3 B4	83 81 77 75 80	75	70	60	10 6 4 8 8
Nam Wah Middle School	Roadwork Excavation Caisson	Chainage 2590-2600 RW12 B6 B7	82 77 65 79	75	N.A.	N.A.	1 4 10 10
Caritas Wai Oi Block	Roadwork Caisson	Chainage 2630-2730 B7	89 76	81	70	60	3 10
Caritas Wards	Roadwork Earthwork Caisson	Chainage 2800-3050 S31 + S33 B7	88 82 75	75	70 (upper floors) 65 (lower floors)	60 (upper floors) 50 (lower floors)	9 6 10
So Uk Estate	Roadwork Excavation Cassion	Chainage 3050-3400 RW16 B8	86 71 73	76	70 (upper floors) 65 (lower floors)	60 (upper floors) 50 (lower floors)	12 6 6
G/ICs along Kwong Lee Road	Roadwork Cassion	off line link B10 B11 + B12	86 73 73	75	70	60	3-4 8 8
Wah Chak House, Chak On Estate	Roadwork	Chainage 4050-4100	84	81	70	60	1
Southern facade of Fu Chak House, Chak On Estate	Roadwork Cassion	off line link B16	86 67	75	70	60	1-2 6
Eastern facade of Fu Chak House, Chak On Estate	Roadwork Cassion	off line link B17	86 73	75	70	60	1-2 6

Table 3.4(c) Predicted Noise Levels L_{eq} for General Construction Activities (Cont'd)

NSRs	Construction Activities	Location	Predicted Noise Level dB(A)	Daytime Guidelines	Evening Time Criteria	Nighttime Criteria	Duration (Week)
Beacon Heights	Roadwork Cassion	Chainage 4180-4420 B18 B20	88 64 63	81	70	60	6 6
Chak Yan Centre	Roadwork Cassion	off line link B18 B20	81 67 68	75	70	60	1-2 6 6
Cornwall Street THA	Roadwork Cassion	off line link B18 B20	80 65 64	75	70	60	1-2 6 6
Beacon Hill Road (No. 43-47)	Roadwork Excavation Earthwork	Chainage 5300-5700 RW34 N50 N51	93 94 79 76	81	70	60	10-11 12 8 10
Rhondda Road	Roadwork Earthwork	Chainage 5770-5860 N53 N54	97 76 77	81 81 81	70	60	2 10 8

Table 3.4(d) Predicted Noise Level L_{eq} for Percussive Piling

NSRs	Location	Predicted Noise level dB(A)	Criteria dB(A)	Duration (Week)
Mei Foo Sun Chuen	B1	63	85	6
Lai Chi Kok Hospital	B1	66	75	6
Wai Man Tsuen	B2	77	85 (residential) 75 (schools)	6
G/ICs along Kwong Lee Road	B13	68	75 (schools and clinic)	4
Beacon Heights	B19	68	85	6

Mitigation Measures

3.4.14 Although construction work should not normally be allowed in the evening and nighttime with respect to its noise impact, it is likely that occasional night work would be unavoidable for activities such as formwork erection and the placing of bridge beams over the carriageway. The predicted noise levels from general roadworks are based on a worst-case scenario where noisy activities such as road breaking and excavation would be carried out simultaneously. Whenever the construction work in the restricted hours is required, the contractor would have to submit the details of the powered plant to be used, the location of operation and distance to the NSRs to the Authority for the application of the Construction Noise Permit. The noise impact from the work would be assessed and considered on a case by case basis for each application.

3.4.15 Temporary barriers of 2m high, in the form of noise panels, are recommended at the following locations:-

- o on the knoll in front of Caritas Medical Centre Wards for screening noise from roadworks and excavation between Chainage 2900 and 3050;
- o on the knoll west of Nam Wah Middle School and as close to the noise source as possible for screening noise from roadworks, excavation and earthworks for the proposed Caritas Medical Centre realigned access and the retaining wall RW4; and
- o if possible, on the completed retaining wall RW11 to protect residential lots no.43-53 from roadworks noise.

3.4.16 Noise impact from the excavation work at RW11 to residential lots on Beacon Hill Road would be very significant due the close proximity. Noise barriers in this case however would not be effective as the work would spread on a large and nearly vertical plane. Nevertheless, a hoarding wall of sufficient high could lessen the noise impact as well as other nuisance to the activities at ground level. A light excavator with a sound power level of 10dB(A) less than that adopted in the calculation should be used at the site. Stringent site management measures and close surveillance would be required. No construction work, whether powered plant used or not, should be allowed in evening and nighttime at this area.

3.4.17 For other areas, noise impacts from construction work in either daytime or nighttime can be reduced significantly by proper site management and practice. This includes:-

a) using silenced equipment wherever possible;

b) reducing the numbers of operating items of powered mechanical equipment as far as practical;

c) siting of equipment as far as practical from noise sensitive receivers;

d) turning off machinery that is not in use for long periods; and

e) maintaining the plant and equipment in good condition in order to minimize noise during construction.

3.4.18 Where the sensitive buildings are residential and hospital wards, noisy operations such as road breaking and excavation should be scheduled for the daytime 0700 to 1900 hours if possible when the ambient noise levels are higher. Moreover, the construction activities should be scheduled in such a way that the noisy operations will be spread along the alignment to prevent aggravating the impact at a single NSR. As the details on the operation of the plant cannot be defined at this stage, it is impossible to give precise data on the noise reduction. The reduction is estimated to be in a range of 5dB(A) to 10dB(A).

3.4.19 The recommended mitigation measures and site management practices should be incorporated into the contracts to reduce the impacts.

3.4.20 Furthermore, the location of the works area at West Kowloon Reclamation should be chosen to be sufficiently far away from any NSRs in order to avoid noise impact.

Conclusion

3.4.21 It should be appreciated that the bridge foundations are expected to be supported on caissons rather than piles installed using percussive methods. The associated noise impacts should therefore be significantly reduced.

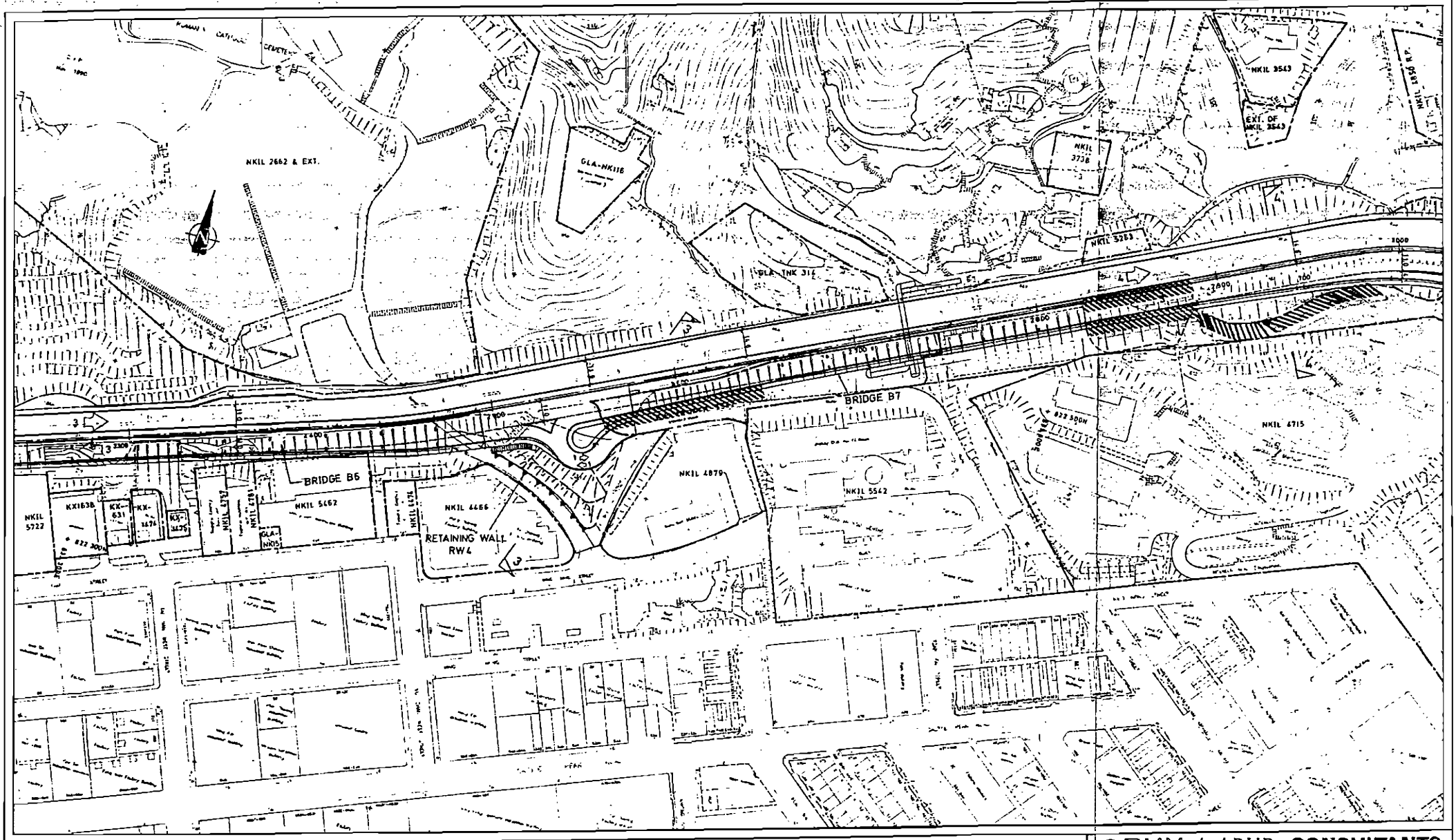
3.4.22 Although the NSRs are currently experiencing high ambient noise levels as a result of the large volume of traffic flow on the roads, construction noise in most cases will still be significant due to the close proximity of the sites. Construction noise in the restricted hours stipulated in the Technical Memorandum will be under the control of the permit system issued by the Authority. However, site management and mitigation measures as noted above and recommended for controlling the construction noise during the daytime hours of weekdays, should be enforced by contract conditions.

Compliance Monitoring and Auditing

3.4.23 The construction site should be surveyed regularly to ensure that recommended site management measures are being practised and that the noise reduced powered plant quoted by the contractor is used. Noise monitoring should be carried out to check for effectiveness of the noise control measures being enforced in the contract. Compliance monitoring for construction noise should be carried out to evaluate the impacts on the NSRs concerned.

3.4.24 Construction noise levels should be recorded as the average of three consecutive L_{eq} (5 min) measurements. The baseline noise monitoring should be carried out on a typical weekday in order to determine the daytime guideline for construction noise other than restricted hours.

3.4.25 The requirements of the noise monitoring should be included in the contract documents. A suggested basis for such clauses is given in Annex 4.A.



KEY :-

1. Proposed noise barriers

SCALE 20 0 20 40 METRES

PHH / ARUP CONSULTANTS

LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS

滙衍壽－亨富利／奧雅納聯營工程顧問

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

NOISE BARRIER LOCATIONS
CH.2300 TO CH.3000

SHEET 1 OF 3

DESIGNED	E R L	DRG. NO.	FIG.
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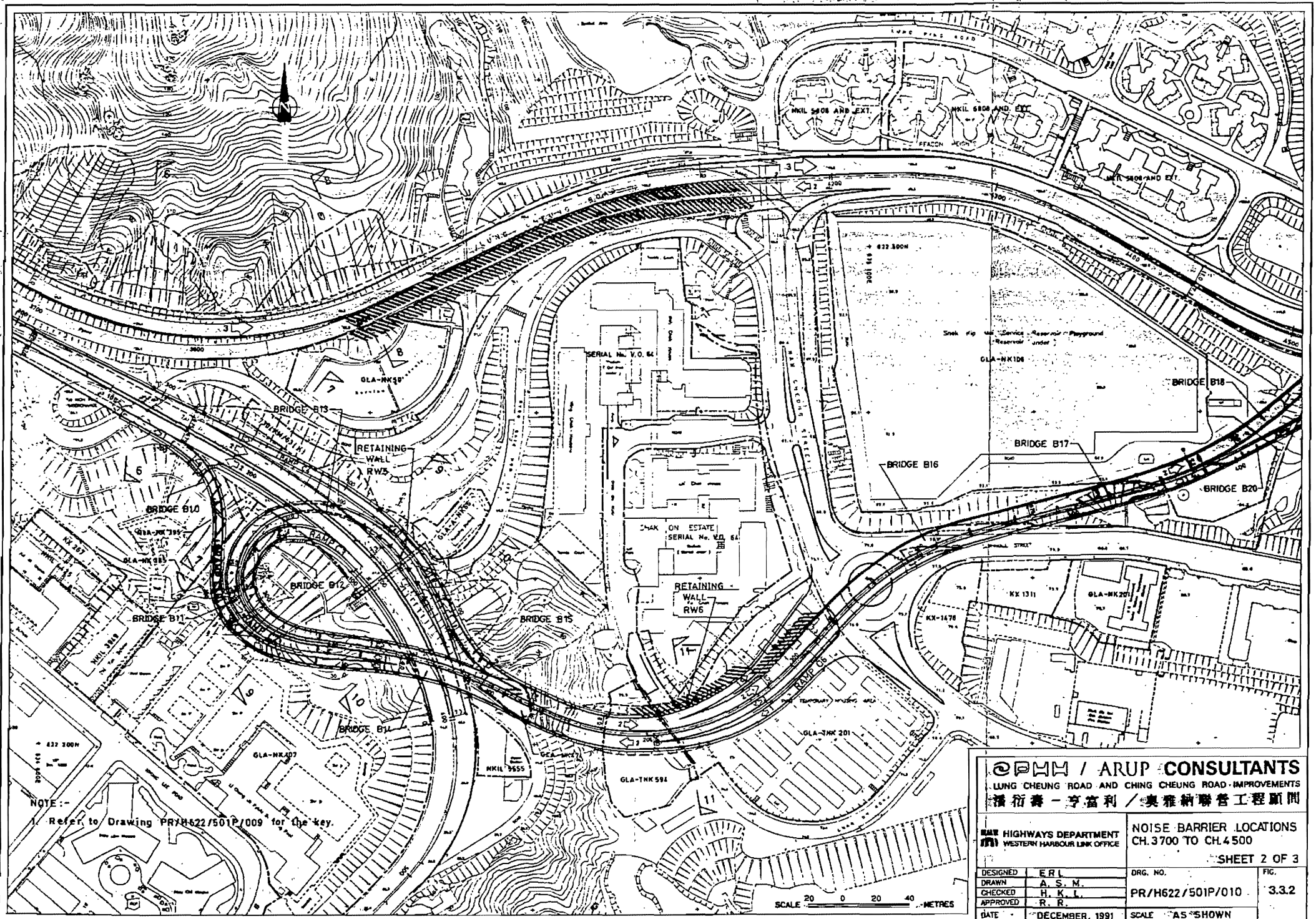
CHECKED	H. K. L.		
APPROVED	R. R.		
DATE	DECEMBER, 1991.	SCALE AS SHOWN	



CPHH / ARUP CONSULTANTS

LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS

福祈善－亨富利／奧雅納聯營工程顧問

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

NOISE BARRIER LOCATIONS
CH. 3700 TO CH. 4500

SHEET 2 OF 3

DESIGNED	E.R.L.	DRG. NO.	FIG.
DRAWN	A.S.M.	PR/H622/501P/010	3.3.2
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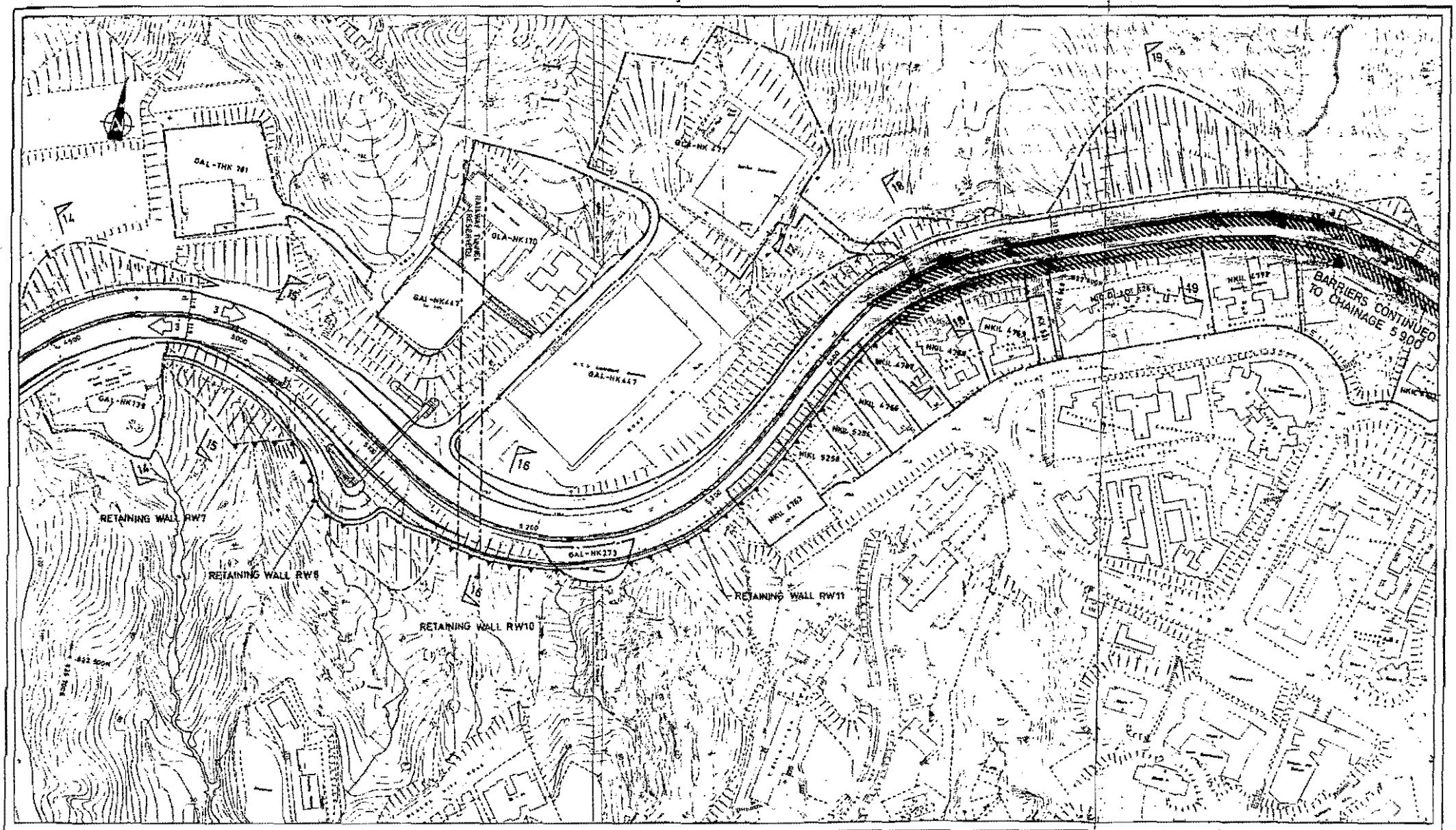
APPROVED	R.R.		
DATE	DECEMBER, 1991	SCALE AS SHOWN	



KEY :-

1. Proposed noise barriers

SCALE 20 0 20 40 METRES

PHH / ARUP CONSULTANTS

LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS

浦祈嘗－亨富利／奧雅納聯營工程顧問

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

NOISE BARRIER LOCATIONS
CH. 4900 TO CH. 5700
SHEET 3 OF 3

DESIGNED	E.R.L.	DRG. NO.	FIG.
DRAWN	A.S.N.	PR/H622/501P/011	3.3.3
CHECKED	H.K.L.		
APPROVED	R.R.		
DATE	DECEMBER, 1991.	SCALE	AS SHOWN

CHAPTER 4

4 AIR QUALITY

4.1 Introduction

4.1.1 The existing LCR/CCR passes through residential and industrial developments from the west to the east along the southern slope of the north Kowloon Hills. As the Air Sensitive Receptors (ASRs) close to LCR/CCR are at a higher elevation than most parts of Kowloon, they are less affected by the vehicle emissions from the other main urban areas. Apart from the vehicle emissions along LCR/CCR, the industrial emissions from Cheung Sha Wan also affect the existing air quality in this region. However most of the sensitive receptors are located in close proximity to the carriageway and thus the impacts from vehicle emissions are likely to be of more importance.

4.1.2 Air quality impacts during the construction and operational phases are discussed in this section. The air pollutants considered in the assessment of air quality impact are carbon monoxide (CO), nitrogen dioxide (NO_2) and particulates. Air sensitive receptors (ASRs) are described in Section 2 and listed in Annex 4.A.

4.2 Ambient Conditions

4.2.1 No air quality data is available for areas close to LCR/CCR, therefore measurements from elsewhere in Hong Kong have been considered in the assessment to assess the baseline air quality.

4.2.2 The nearest EPD air quality monitoring station to the alignment is at Yen Chow Street Police Station, Sham Shui Po. The annual average concentrations of the Nitrogen Dioxide (NO_2), and Sulphur Dioxide (SO_2), Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP) measured are :-

NO_2 : 60 $\mu g\ m^{-3}$
SO_2 : 15 $\mu g\ m^{-3}$
TSP : 100 $\mu g\ m^{-3}$
RSP : 60 $\mu g\ m^{-3}$

4.2.3 The level of NO_2 and SO_2 were within the Air Quality Objectives (AQOs) for an annual average of 80 $\mu g\ m^{-3}$. The annual average TSP and RSP levels exceed the AQOs of 80 $\mu g\ m^{-3}$ and 55 $\mu g\ m^{-3}$ respectively. The results indicate that NO_2 and TSP levels are high in areas where vehicle emissions are the main source of pollution. It should be noted that the air quality along LCR/CCR is in general likely to be better than the figures quoted above due to the higher elevation.

4.2.4 The future background air quality around LCR/CCR would be significantly different from the present air quality due to spatial and time difference. As the ASRs are mainly affected by vehicle emissions, the predicted results based on the traffic forecast should give a good representation of the overall air quality at the ASRs. Hence, the assessment of the future air quality impact has not taken any background concentration into account.

Local Meteorology

4.2.5 Since the potential for the dispersion of air pollutants is very much dependent on the prevailing wind directions and speeds, it is important to consider the local meteorological conditions.

4.2.6 The Royal Observatory weather station at Cheung Sha Wan is used to represent the prevailing wind conditions of the study area and the annual wind rose is shown in Figure 4.2.1. The winds are generally light, with more than 70% of the wind speeds lower than 3 m/s^{-1}. During winter, northeasterly and easterly winds are more frequent, whilst in summer the winds are southerly.

4.2.7 It should be noted that local topography, particularly highrise buildings and steep slopes along the alignment will have a significant effect on local wind conditions. As the roads stretches in an east-west direction with steep terrain to the north and highrise to the south, wind is likely to be deflected to trend parallel to the road.

Statutory Requirements

4.2.8 The air quality assessment has made reference to the Air Quality Objectives (AQOs) laid down under the Air Pollution Control Ordinance which applies to all parts of the territory. The short term criterion of 0.5 mg m^{-3} over one hour for dust (i.e. TSP) arising from construction activities will also be used. The AQOs are summarized in Table 4.2(a)

Table 4.2(a) Hong Kong Air Quality Objective

Pollutant	Concentration in microgrammes per cubic metre (i)				
	Averaging Time				
	1 Hour (ii)	8 Hours (iii)	24 Hours (iii)	3 Months (iv)	1 Year (iv)
Sulphur Dioxide	800		350		80
Total Suspended Particulates			260		80
Respirable Suspended Particulates (v)			180		55
Nitrogen Dioxide	300		150		80
Carbon Monoxide	30,000	10,000			
Photochemical Oxidants (as ozone (vi))	240				
Lead				1.5	

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

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

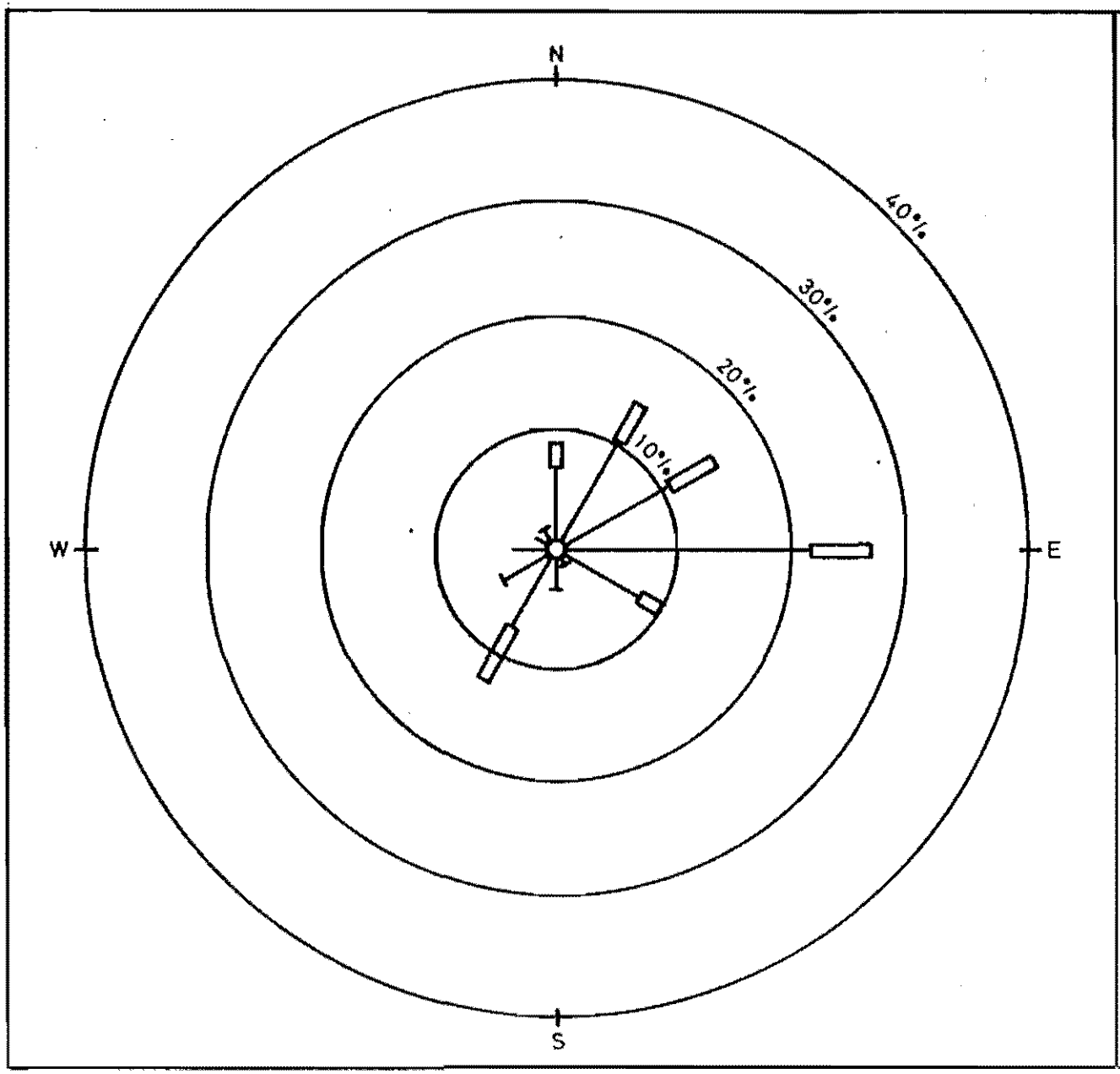
(iii) Not to be exceeded more than once per year.

(iv) Arithmetic means.

(v) Respirable Suspended Particulates : suspended particles in air with a nominal aerodynamic diameter of 10 micrometres and smaller.

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

WIND ROSE FOR CHEUNG SHA WAN AWS



JAN 1989 - DEC 1989

NO. OF OBSERVATIONS = 7890

NO. OF VARIABLE WINDS = 0 (0.0%)

NO. OF CALM WINDS = 3 (0.0%)

0 10 20 30

PERCENTAGE FREQUENCY

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

WIND SPEED

(Data : hourly mean wind)

FIGURE 4.2.1

4.3 Operational Phase

4.3.1 During the operational phase of the improved LCR/CCR, the main source of air pollution on the nearby ASRs would be vehicle emissions due to their close proximity. The principal pollutants of concern include carbon monoxide (CO), nitrogen oxides (NO_x) and particulates. Petrol-powered motor vehicles contribute more carbon monoxide, while diesel-powered heavy vehicles contribute more nitrogen oxides and particulates. The Air Quality Objectives as shown in Table 4.2(a) stipulate the acceptable concentrations of the concerned pollutants.

4.3.2 With the increase in the percentage of heavy goods vehicle from 37% in 1991 to 45% by 2001 together with the increase in peak hour traffic volume from 4,900 vph in 1991 to the predicted 7,200 vph for the year 2001, the pollutants emitted is expected to increase. However, the rate of increase in the total amount of pollutants emitted from vehicles is also dependent on the vehicle emission control strategy in Hong Kong, and the technological advance in vehicle emissions control which will be further discussed in this section.

Air Quality Model

4.3.3 The traffic-related air pollutants concentrations which would be experienced by the ASRs during the operational phase of the improved road have been predicted using a mobile source dispersion model, CALINE 4 which is a gaussian dispersion model for line source emission. The model has a NO_2 option which allows direct prediction of NO_2 using a NO_x emission factor. Background concentrations of NO, NO_2 and O_3 are the limiting factors to NO/NO_2 conversion and are required as input to the prediction model of NO_2 concentrations. However, as no representative O_3 data is available for 2001 and for the study area, the assessment has adopted a more conservative estimate of 20% NO to NO_2 conversion in the evaluation of NO_2 concentrations at the identified assessment points, assuming that initial tailpipe (exhaust) NO_x emissions are 92.5% NO and 7.5% NO_2, by mass.

4.3.4 The assessment points were identified and are presented in Annex 2.A. The assessment points were selected so as to demonstrate the worst case air quality levels which would be experienced by their representative sections.

Meteorological Conditions

4.3.5 Meteorological conditions play an important role in the dispersion of air pollutants. Typical worst case meteorological conditions as stated in the Brief have been assumed, and they are:

wind speed	: 2 m/s
wind direction	: worst case (i.e. towards the ASR)
stability class	: D
mixing height	: 500m
temperature	: 25°C

4.3.6 In urban areas, surface wind varies considerably in direction. At street level, the variability of wind directions is even greater because of the mechanical turbulence created by movements of vehicles. Hence, it has been assumed that 20 degree standard deviation used in the air quality modelling should represent a worst-case situation. The assumption of a wind speed of 2 m/s was adopted in the modelling, since winds blowing with speed lower than 2 m/s tend to be highly variable in direction.

Emission Factors

4.3.7 Impacts from vehicle emissions primarily depend on the emission rates of the pollutants, traffic volumes and the dispersion potential of the air and wind. It is likely that by the year 2001, most old petrol-driven vehicles will be replaced by new vehicles satisfying the new Air Pollution Control (Vehicle Design Standards)(Emission) Regulation 1991.

4.3.8 The new regulations came into force on 1st January 1992. New emission control technology, such as catalytic convertors, which will reduce CO, NOx and hydrocarbons emissions by 80% - 90%, would be installed in all new petrol driven vehicles registered on or after 1st January 1992, in order to achieve the required standards. Also cheaper unleaded petrol was introduced on 1st April 1991, to encourage users to switch to unleaded petrol. As a result, the rates of emission of certain pollutants, such as lead, CO, NO_x and hydrocarbon should be greatly reduced.

4.3.9 A set of emission factors as shown in Table 4.3(a) was calculated based on the new Air Pollution Control (Vehicle Design Standards)(Emission) Regulation 1991, for cars with gross vehicle weight less than 2.5 tonnes, and the Compilation of Air Pollutant Emission Factors, AP-42, Third Edition, 1980 data for heavy goods vehicles (i.e. more than 4 tonnes). The emission factors were calculated as a function of the design vehicle speed of 70kph, which were then applied to the LCR/CCR fleet mix as in Table 4.3(a).

4.3.10 The emission factors were calculated on the assumption that 30% of cars/taxis are diesel and 70% are petrol driven, and that 70% of Light Bus/Light Goods Vehicle are diesel driven and 30% are petrol driven. This set of emission factors has been agreed with the EPD. However, these emission factors were based on limits set under the current regulations and 1980 emission factors for goods vehicles. This is certainly a very conservative estimate for vehicle emissions in the year 2001. The adoption of these conservative figures in the modelling exercise will result in a worst-case scenario and the interpretation of the results should take note of future emissions control strategies which might yet be derived from those in other countries.

Table 4.3(a) Summary of the Calculation of Composite Emission Factors

Vehicle Category	Vehicles Included	Percentage of Fleet (%)	Emission Factor (g/mile)		
			CO	NO_x	Particulates
Cars/Taxi	Cars/Taxi	28.5	4.35	1.01	0.53
Light Buses/Light Goods Vehicles	Passenger Vans, Light Goods Vehicles, Public Light Buses and Maxicabs	26.4	9.79	1.69	0.92
Heavy Goods Vehicles	Heavy Goods Vehicles, Franchised Buses, Non-franchised Buses/Coaches	45.1	9.34	19.14	8.05
Composite Emission Factors			8.04	9.37	4.02

Air Quality Assessment

4.3.11 Table 4.3(b) summaries the predicted worst case air quality impacts at the selected assessment points along the whole length of the LCR/CCR from vehicle emissions. Daily concentrations of RSP are estimated using a 40 % conversion basing on the daily traffic flow pattern so that the results can be compared with the AQOs.

4.3.12 The CALINE 4 model iteratively selects the worst case wind direction and therefore gives the highest concentration for each receiver point, under one prevailing wind direction. Therefore, it should be noted that the worst case concentration of various pollutants for all sensitive receptors does not occur simultaneously.

4.3.13 The results show that the levels of carbon monoxide that would be experienced by all the ASRs within the vicinity of LCR/CCR remain safely below the air quality standard of 30 mg m^{-3}. However, high levels of NO_2 and RSP are predicted at a number of ASRs within 40m from the main carriageway. Due to the various gradients of the main carriageway of LCR/CCR, the highest concentrations of the concerned pollutants are predicted at the most affected receptors of most residential blocks along the carriageway.

4.3.14 The following future developments have no specific air quality assessments as the site layouts are not available. Reference is made to the nearby assessment points with the same locational characteristics.

a) Future developments in the Lai Chi Kok Area

A Comprehensive Development has been proposed in the Kau Wah Keng area within the existing Lai Chi Kok Amusement Park and Sung Dynasty Village. As the proposed site is more than 40m away from the alignment, the air pollutants emitted from vehicles should have adequately dispersed and no unacceptable impact will result.

b) Proposed Caritas School

A 3-storey school for the severely mentally handicapped is proposed to the north of So Uk Estate, 10m to the south of the main carriageway. As the proposed school is lower than the carriageway (i.e. some 10m lower than the carriageway), the vehicle emissions should not affect the future school even with the short horizontal distance. The air quality of the proposed site is considered to be acceptable.

c) G/ICs on Kwong Lee Road

As the G/IC facilities are positioned more than 30m below and 40m away from the proposed link, adequate dispersion of the vehicle emissions would have taken place before reaching the site. Therefore the air quality of this area will not be affected by the new link.

d) Future Developments at Cornwall Street THA

The comprehensive developments at the existing Cornwall Street THA site are expected to experience similar air quality impacts to the southern part of Chak On Estate, that are below the AQOs. The new off line link will not pose any constraint on these developments in terms of air quality.

Table 4.3(b) Air Quality Assessment Results at the following Sensitive Receptors

	Height (mPD)	Distance (m)	Wind Direction (degree)	Predicted Max Hourly Concentration ($\mu g/m^3$)			Estimated Daily Concentration ($\mu g/m^3$)
				CO	NO_2	Particulates	Particulates
Mei Foo Sun Chuen Chainage 1220 - 1450	28	63	84	809	245	405	162
	Remarks:- The predicted concentrations are below the AQOs level. Lower levels of CO, NO_2 and RSP are predicted for this area when compared to other ASRs. This is due to Mei Foo Sun Chuen being parallel with a sloping section of the mainline resulting in a lesser accumulating effect of the air pollutants. Also the nearest block to the carriageway is more than 60m away, which allows adequate dispersion of the air pollutants before reaching the residential blocks.						
Lai Chi Kok Hospital Chainage 1470 - 1550	45	118	358	194	59	97	39
	Remarks:- Lai Chi Kok Hospital is about 118m from the main carriageway and is located at an elevated level overlooking Castle Peak Road. Due to its distance from the main carriageway, adequate dispersion of the air pollutants would have taken place before reaching the hospital. Moreover, due to the particular orientation of the hospital and the physical characteristics of its locality, the air quality of this site is expected to be influenced by vehicle emissions from Castle Peak Road rather than the mainline. Therefore the improvement scheme on the mainline carriageway would not affect the air quality at this hospital.						
Caritas Medical Centre Chainage 2800 - 3100	40	35	264	992	301	497	199
	Remarks:- The predicted CO concentration is well within the AQOs of 30 mg m^{-3}. However, the 1 hour NO_2 concentration predicted under westerly winds exceed the AQOs. A high level of RSP concentration exceeding the AQOs is also predicted under the same worst case meteorological conditions. With westerly winds, vehicle emissions from the long stretch of mainline sloping uphill can accumulate at the Centre. Due to the close proximity, inadequate dispersion occurs and thereby results in high levels of NO_2 and RSP whenever there is a westerly wind. It should be noted that high levels of TSP and NO_2 are predicted under westerly winds, however this worst case wind direction will occur at a much lower frequency than the more prevalent easterly for this area.						

Table 4.3(b) Air Quality Assessment Results at the following Sensitive Receptors (Cont'd)

	Height (mPD)	Distance (m)	Wind Direction (degree)	Predicted Max Hourly Concentration ($\mu g/m^3$)			Estimated Daily Concentration ($\mu g/m^3$)
				CO	NO_2	Particulates	Particulates
So Uk Estate Chainage 3050 - 3400	75	45	47	627	190	314	126
	Remarks:- The predicted 1 hour CO and NO_2 levels and 24 hours RSP levels are within the AQOs under easterly winds. This is due to the Estate being at a location where a lesser accumulating effect of vehicle emissions is allowed from a relatively short section of the carriageway. Although it is proposed to move Chainage 3100 to 3600 southwards closer to the estate, the predicted air quality result shows no significant impacts.						
Wah Chak House, Chak On Estate Chainage 4000 - 4100	85	43	285	513	156	257	103
	Remarks:- Wah Chak House is 43m from the mainline. The air quality is predicted to be within the AQO, therefore the overall air quality of this area would be acceptable after the completion of the road improvements.						
Fu Chak House, Chak On Estate (Eastern & Southern Pt) Ramp C5 - C6	80	55	185	194	59	97	39
	100	43	73	205	62	103	41
	Remarks:- Southern and eastern faces of Fu Chak House are at least 43m from the proposed off line link to the south. This part of Chak On Estate would also be affected by vehicle emissions from Cornwall Street and Nam Cheong Street. After the completion of the proposed elevated off line link, the air quality of the southern part of Chak On Estate is predicted to remain acceptable as the traffic volume on this new link is relatively small.						

Table 4.3(b) Air Quality Assessment Results at the following Sensitive Receptors (Cont'd)

Beacon Heights Chainage 4200 - 4400	**Height (mPD)**	**Distance (m)**	**Wind Direction (degree)**	**Predicted Max Hourly Concentration ($\mu g/m^3$)**			**Estimated Daily Concentration ($\mu g/m^3$)**
				CO	**NO_2**	**Particulates**	**Particulates**
	95	15	250	1790	543	896	358
	Remarks:- Beacon Heights is a residential area 15m to the north of mainline. Due to the close proximity of the carriageway to the residential blocks, high levels of NO_2 and RSP are predicted under a westerly wind and these would exceed the AQOs. With a westerly wind, air pollutants from vehicle emissions along LCR (i.e. from Chainage 3800 to 4300) would accumulate to the east, and therefore high levels of pollutants would be experienced by this residential area. However, building blocks further away from the main carriageway would experience lesser impacts. Nevertheless, westerly winds are less frequent in Hong Kong and thus the chances of being exposed to high pollutant levels would be reduced.						
Residential Lots on Beacon Hill Road and Rhondda Road	**Height (mPD)**	**Distance (m)**	**Wind Direction (degree)**	**Predicted Max Hourly Concentration ($\mu g/m^3$)**			**Estimated Daily Concentration ($\mu g/m^3$)**
				CO	**NO_2**	**Particulates**	**Particulates**
	110	20	38	1619	491	810	324
	Remarks:- The residential lots are 20m to the south of the carriageway. Due to the close proximity of the carriageway to the residential blocks on Beacon Hill Road, high levels of NO_2 and RSP are predicted under easterly winds to exceed the AQOs. With a easterly wind, vehicle emissions from the long stretch of carriageway to the east of the residential sites and from the Lion Rock Tunnel (i.e. Chainage 5600 to 6300) accumulate to the west, therefore residential blocks above the carriageway to the west of this stretch of LCR carriageway would experience similar pollution levels.						

e) Tai Woh Ping Residential Development

Tai Woh Ping Residential Development is proposed to the west of Beacon Heights and a Private Hospital Development is proposed at the existing Lung Ping Road THA to the east of Beacon Heights. These two planned developments would experience similar high concentrations of air pollutants from vehicle emissions on LCR under westerly winds. It should be noted that the residential developments will be located on raised platforms thus the potential impacts would be reduced. However, it is still recommended that the proposed private hospital should be placed at least 40m away from the mainline in order to safeguard the air quality.

Evaluation of Mitigation Measures

4.3.15 Traffic-related air pollution can only be tackled effectively at source. Alignment geometry could have some effect on the roadside pollutant concentrations. It can be seen from the prediction results that high levels of NO_2 and RSP will be experienced by the sensitive receptors within 40m of the alignment. The only effective amelioration measure against high levels of NO_2 and RSP is to control the pollution at source. This may involve some changes such as the introduction of reformulated diesel fuels and compressed natural gas, encouraging the use of technologies to improve combustion and the use of exhaust treatments such as particle traps.

4.3.16 It is expected that it will take some years before the old existing petrol-driven cars are replaced by new vehicles with better emission standards as required by the Air Pollution Control (Vehicle Design Standard) (Emission) Regulation 1991. The emission factors adopted in the prediction have taken this into account but petrol vehicles are only responsible for a small portion of the overall emissions from mobile sources. At present diesel vehicles, accounting for about 65% of the total travel distance of vehicle in Hong Kong, contribute a significant portion of fine particles and nitrogen dioxide to overall emissions. If reliance on diesel vehicles can be reduced or light duty goods vehicles are encouraged to switch to petrol, the emissions of NO_2 and particulate can be further reduced.

4.3.17 Although more should be done on the control of emissions from diesel powered vehicles, with the recent strengthening of the Vehicle Smoke Control Programme, the level of particulates emission is expected to reduce in the future, especially from diesel driven goods vehicles. If more stringent inspection and maintenance programmes can be enforced, it can significantly increase the effectiveness of the overall vehicle emission control strategy.

Conclusion and Recommendations

4.3.18 In general, the predicted levels of carbon monoxide remain safely below the air quality standard of 30 mg m^{-3}. However, 1-hour NO_2 and the 24-hours RSP levels are likely to exceed the air quality standard of 300 μg m^{-3} and 180 μg m^{-3} respectively, within 40m of the carriageway. Dependent on the background of NO_2 and RSP levels taken and the geometry of the alignment, ASRs between 40m and 70m of the carriageway may also experience pollution exceeding the air quality standard.

4.3.19 The high levels of NO_2 and RSP predicted are mainly attributable to the high average vehicle speed and the high percentage of heavy goods vehicle of 45% when compared to 30% of HGVs on most trunk roads in Hong Kong. This is not entirely a consequence of the proposed scheme as the vehicle mix is not significantly affected by it.

4.3.20 With further emission control technologies and strategy (especially with regard to HGVs), the overall air quality impacts at the ASRs could be better than the predicted levels as the results were based on a very conservative approach. It is therefore possible to have a substantial reduction in vehicle emissions in the years to come. However the long term commitment by the Government to progressively reduce vehicle emissions is strongly supported. When the emission control technology for heavy goods vehicle is made available, it is suggested that the Government should consider a more stringent emission limit for those vehicles that are not under the current control (i.e. vehicle weight more than 4 tonnes).

4.3.21 For any future developments along the main carriageway, they are recommended to be at least 40m away in order to safeguard their air quality. However, due to the dominating effect of traffic noise, air quality will not be a major constraint on land use along LCR/CCR.

4.3.22 In order to assess the extent of air quality impacts during the operational phase, air quality monitoring should be carried out at the Caritas Medical Centre and Beacon Heights. Measurements of CO, NO_x and RSP should be taken at the monitoring sites. The monitoring results will provide an information base to evaluate the effectiveness of the strategy and policy to control vehicle emission and planning of the territory road network.

4.4 Construction Phase

Introduction

4.4.1 During the construction phase of the road improvements, extensive earth-moving activities across the Kowloon foothills could cause dust nuisance to the air sensitive receivers along the existing carriageway and the proposed off line link if uncontrolled. The extent of the dust generation depends on the moisture content composition and the degree of mechanical disturbance of the soil. Meteorological conditions also play an important role in creating wind blown dust. Worst-case situations usually occur on dry and windy days, especially during the winter.

4.4.2 Exhaust emissions from diesel trucks for the haulage of materials and construction plants will contain high percentage of NO_x, smoke particulates and unburnt hydrocarbons in comparison with petrol driven vehicles. As the anticipated traffic flow rate and the number of items of construction plant that will result from the construction works are unlikely to be high, no significant impacts on the existing air quality are envisaged.

Identification of Potential Dust Sources

4.4.3 Particulate emissions could arise from the following activities during the road improvement works.

Excavation and Earthworks

4.4.4 Dust emissions are mainly associated with the earthworks and excavation for the at-grade sections, cut slopes and retaining walls. Backfilling will also be involved in the construction of retaining walls.

4.4.5 Movement of vehicles carrying dusty loads and the inevitable deposition on roads and equipment constitute significant sources of dust.

Handling of Fill Material

4.4.6 It has been estimated that the total quantity of fill required for backfilling will be about 100,000m^3. The spoil resulting from excavation may be used as backfill. During the loading and unloading of the material dust emissions will result.

Stockpiling

4.4.7 Stockpiling will involve adding aggregate material to a storage pile or removing it using front end loaders in a batch drop operation. Although, there are no definite plans for stockpiling the cut material for backfill, it is still possible that the contractor will have stockpiles of fill material within the works areas or at the construction sites. The major associated sources of dust are likely to be:

- o dust generation during material input and loading, namely by front end loader;
- o wind blow-off from the stockpile in dry and windy conditions;
- o vehicle movement on roads around the stockpiling areas.

4.4.8 The extent of dust emissions from a stockpile is dependent on the mechanical activity on the pile and the emission factor for the particular stock material. The loading and the movement of vehicles on the site is a potential dust source. However, the sizes of the stockpiles are likely to be small and therefore this is not considered likely to create any significant air quality impacts.

Vehicle movement over unpaved surfaces

4.4.9 Dust generated from the movement of vehicles on unpaved surfaces within works areas could be a major concern.

4.4.10 The emission factor for dust emissions from vehicle movements is highly variable, but determining factors include vehicle speed and weight, surface silt loading, moisture content, etc.

Potential Impacts and Possible Mitigation Measures

4.4.11 Most of the sensitive receives are to the south of the proposed road improvement areas, and the worst-case situations will occur whenever the wind is blowing from the north. However, northerlies are somewhat restricted due to the Kowloon Peak to the north and easterlies are more frequent as a result of the funnelling effect.

4.4.12 It is unlikely that any of the dust sources in isolation would result in unacceptable impacts if dust suppression measures are employed. In general, dust should be controlled at source through proper site construction management discussed as follows.

Excavation and Earthworks

4.4.13 Excavation of slopes will create a significant amount of dust as will the handling of spoil material and movement of vehicles around the site.

4.4.14 The receptors which may experience some impacts from dust generated by excavation and earthworks are:-

- a) Wai Man Tsuen
- b) Nam Wah Middle School
- c) Caritas Medical Centre
- d) So Uk Estate
- e) Residential Lots on Beacon Hill Road
- f) Residential Lots on Rhondda Road

4.4.15 Caritas Medical Centre and Nam Wah Middle School are considered to be the most sensitive receptors. Caritas Medical Centre and residential lots on Beacon Hill Road may experience significant dust impacts from the earthworks and excavation to be carried out in close proximity.

4.4.16 Other receptors may be better protected from the dust nuisance due to their further distance away from the excavation or earthworks. Dust nuisance is unlikely to be significant, provided good site management and dust suppression practices are carried out at the construction sites.

4.4.17 Regular wetting of the exposed soil is the most effective way of suppressing dust emissions during excavation and earthworks. For excavation sites which are close to sensitive receptors, dust screens or a fence or wall with a height of more than 2 metres should be placed at the construction site boundaries in order to reduce the dust and noise nuisance as well as for safety purposes, especially for sites close to the Caritas Medical Centre and residential lots on Beacon Hill Road.

Stockpiling and Fill Handling

4.4.18 The locations for the storage of the cut spoil for backfilling are yet to be identified. Assuming stockpiles will either be placed at sites where backfilling is required or in the works areas, the receptors likely to be affected by dust from the aggregate stockpiles and the handling of fill material are as follows:-

a) Wai Man Tsuen
b) Nam Wah Middle School
c) So Uk Estate
d) Chak On Estate
e) Lung Ping Road THA
f) Residential lots on Beacon Hill Road

4.4.19 The amount of spoil likely to be stored at construction sites where backfilling is required ranges from 3,000 m^3 to 38,500 m^3. The extent of the dust impacts from the stockpiles is dependent on the size and the settling rate of the particles and the wind velocity. Larger particles tend to settle within a few metres of the sources under typical wind conditions due to their greater settling velocity. Conversely, smaller particles with slower settling rates tend to be more affected by wind turbulence and can be carried away from construction sites.

4.4.20 The most effective way to suppress dust emissions is to enforce good site management. Dust emissions arising from loading and spreading of the fill material can be effectively reduced by water spraying. Drop heights of the material during unloading should be kept to the minimum to avoid unnecessary dust disturbance. Stockpiles of soil, spoil or construction material should be covered in order to reduce the dust impacts due to erosion and sediment release.

4.4.21 An active stockpile should be located well away from any sensitive receivers. In particular no stockpile should be placed close to sensitive receivers such as the residential lots on Beacon Hill Road. If all the fill material is to be stored at the works area at Tai Woh Ping THA or on the West Kowloon Reclamation area then the number of sensitive receivers which are likely to be affected by the dust emissions will be limited to Chak On Estate or the sensitive receivers close to the West Kowloon works area. Suitable wind screens will also reduce the construction material being blown away from then.

Vehicle Dust Control

4.4.22 Wheel-washing facilities should be provided at site exits of the works area. Vehicles should be restricted to a maximum speed of 8km per hour and be confined to designated roadways when inside the works areas.

4.4.23 Materials that have the potential to create dust should not be loaded to a level higher than the side and tail boards of the truck and should be dampened and covered. Regular compaction and water spraying are recommended for unpaved road surfaces that are frequently used.

Conclusion

4.4.24 The main air quality impacts during the construction phase are from dust emissions created by material handling and vehicle movements. With good site management as recommended and good site supervision, construction dust impacts will be restricted and reduced.

4.4.25 Hoardings of heights more than 2 m should be placed at the site boundaries facing Caritas Medical Centre and the residential lots of Beacon Hill Road in order to reduce the dust nuisance. No stockpiling should be placed close to sensitive receptors especially the residential lots on Beacon Hill Road.

Monitoring and Auditing

4.4.26 In order to assess the effectiveness of the mitigation measures adopted and the extent of the air quality impacts during the construction period, routine monitoring of air quality will be required. Hourly or daily dust measurements for TSP should be carried out at residential blocks on Beacon Hill Road and the Caritas Medical Centre. The results should be assessed according to the standards stated in the AQOs.

4.4.27 To ensure that proper site management is being practised by the contractor, it is recommended that regular site inspection should be carried out to ensure that the recommended mitigation measures are being put into practice. 24 hour samples should be taken at each location at least once a month and one hour samples should be collected if required.

4.4.28 The contractor should prior to the commencement of the construction works carry out baseline monitoring to determine and agree ambient dust (TSP) levels. The baseline monitoring should be carried out for a period of at least two weeks, with measurements to be taken every day at each location. From the baseline measurements an agreed ambient dust (TSP) level shall be calculated.

4.4.29 The requirements of the dust monitoring should be included in the contract documents, typical clauses for which are given in Annex 4.A.

CHAPTER 5

5 VISUAL IMPACT

5.1 Introduction

5.1.1 The Inception Report stressed the need to provide environmental betterment as part of the road improvements. Whilst this is in part met by the improvements to traffic flow, it was also noted that the minimising of any adverse impacts is a fundamental prerequisite to the design of the road. Visual impact was cited in the Inception Report as one of the environmental criteria to be assessed.

5.1.2 The starting point for any visual impact assessment is the existing conditions, which serve as a baseline from which the degree of modification and change can be assessed. In looking at the visual impact of the improvement works at Lung Cheung Road/Ching Cheung Road the baseline needs to embody the existing road, its immediate surroundings and the adjacent land uses. It is acknowledged that the present road and its associated structures and slopes have a major impact on the area. It is also acknowledged that the opportunity for improving the visual resources in the area by removal or remedy of some of the existing eyesores, exists through the road improvement works, and that this is a requirement of the Brief.

5.1.3 In many areas visual upgrading is likely to be achieved as an adjunct to the slope stabilisation process. Some of the more obtrusive visual elements at present are the existing chunam slopes along the northern side of Lung Cheung Road. Where slope rehabilitation is required for geotechnical reasons, bioengineering solutions which are likely to enable the slopes to support vegetative growth will be proposed for their ultimate treatment. This would assist in blending man-made slopes with the adjacent natural hillsides.

5.1.4 Likewise the shielding of some of the existing structures would also involve their visual improvement. Quality of design, attention to detailing and material selection to reduce staining would all be given priority in the design of new structures associated with the road improvements.

5.1.5 An integrated design approach to all aspects of the engineering involving the Landscape and Environmental consultants has been adopted. The visual aspects (as one of the environmental elements) are therefore being considered as part of the ongoing design work. In many cases landscape design solutions put forward in the Landscape Strategy are effectively neutralising effects in areas which would otherwise create negative visual impact.

5.1.6 The visual impact assessment appraises the situation during both construction phase and the operational phase. It is evident that the visual impact during the construction phase is likely to be much more severe than during the operation phase because during the construction phase the landscape works would not, or would only be beginning to, achieve their mitigation value.

5.1.7 For this reason it is essential that landscape works form an integral part of the engineering implementation and are programmed to commence as early as possible. The achievement of the desired effect of landscape planting works means that an intermediary stage elapses before the full design goals are achieved. The visual assessment of the operational phase is therefore carried out in terms of the effect which would be ultimately achieved by the mature landscape.

5.1.8 In assessing the visual impact the existing character of the area provides the important site specific background. Other factors which are taken into account include the visibility of the sections of the site, the type and source of impact, the sensitivity of receivers and their proximity to impacts.

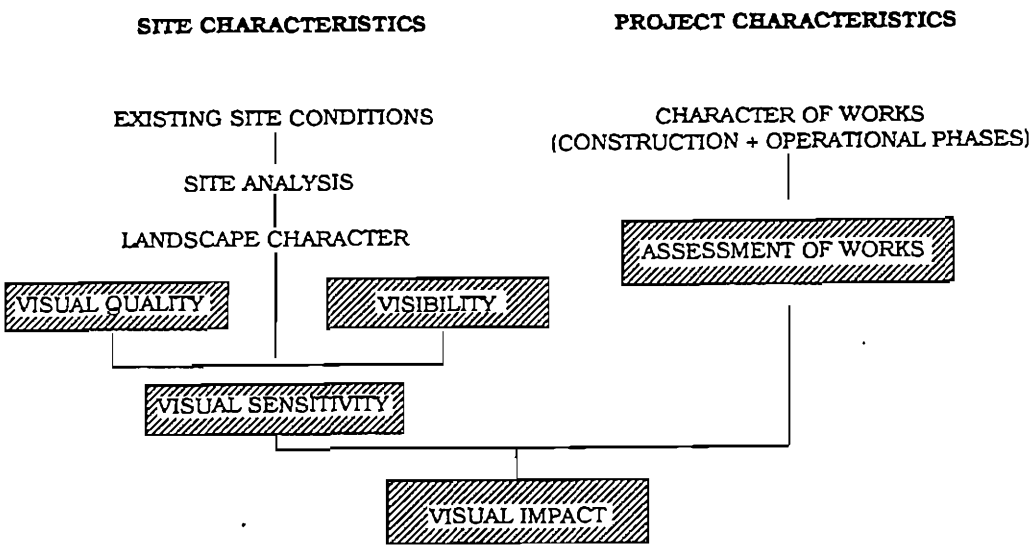
5.1.9 Having assessed the visual impact of the proposed scheme, there are some areas of visual intrusion which still exist. Further recommendations for mitigation of sections of the road which have not included aspects of amelioration to visual impact are then made as part of this report.

5.2 Objectives and Methodology

5.2.1 The objectives of the visual impact assessment are:-

- o to identify the changes which would occur to the visual resources in the area where the road widening and realignment would take place
- o to assess those activities and land uses at construction stage which may affect the visual resources in the vicinity of the road and any adjacent areas
- o to assess the visual impact of the completed road improvement works
- o to identify areas where further visual improvement or mitigation may be appropriate

5.2.2 The methodology which was adopted to assess the visual impact of the proposed road improvements for Lung Cheung Road and Ching Cheung Road is outlined below on the flow diagram. The evaluation of both site characteristics and project characteristics was carried out in parallel and the combined results of each were assessed to establish the degree of visual impact.



5.2.3 Definitions are given below of the various stages shown on the flow diagram.

- o Existing Site Conditions

  The existing conditions relevant to visual impact are those which contribute to the character of the area. They would include land use, building types, vegetation and views and aspect.

- o Site Analysis

  Site analysis is a review of the existing site conditions on a land use basis which provides a basis from which landscape character zones can be determined.

- o Landscape Character

  Landscape character is a term which describes elements of the landscape and built environment which contribute significantly to the character of an area.

- Landscape Character Zones

  Landscape character zones are defined areas, edged with physical boundaries which are established based on the predominant landscape character elements of each area, as identified in the site analysis.

- Visual Quality

  The visual quality is an assessment of the landscape character zones based upon the degree of modification and extent to which the natural character of the landscape remains.

- Visual Quality Areas

  Visual Quality Areas result from the grading system which is adopted to assess the landscape character zones. The assumption made is that natural areas of landscape will be more sensitive to visual impact and intrusion, and more sensitive to change, than areas which have already been modified.

- Visibility

  Visibility of the site is an assessment of the views seen by whom from where. It takes into account the nature of a sensitive receiver, position and distance from a site of a sensitive receiver and the extent of the view. Visibility is graded high, intermediate and low according to the number of people who can see a particular area where road improvements works would take place.

- Visual Sensitivity

  The Visual Sensitivity of an area is its susceptibility to change. It is based on an amalgam of the visual quality and the visibility.

- Character of the Works

  The character of the works is concerned with the nature and extent of the works which would be undertaken both during construction and operation phases. This includes the engineering and the landscape works.

- Assessment of Works

  The assessment of the works comprises a grading system which takes into account the extent of modification to the existing landform, the nature of that modification and the character of the works.

- Visual Impact

  Visual Impact is an assessment of the effect the works would have on a given area.

  The Visual Impact Assessment is a synthesis of the visual sensitivity of a given area with the assessment of the works.

  The Visual Impact is assessed for construction phase and operational phase activities.

5.2.4 More detailed descriptions of how the various stages of the study were carried out are included in the following sections, which describe the process and the results step by step.

5.3 Site Analysis

5.3.1 A photographic and site survey of the existing conditions was undertaken for the study area stretching west to east from Lai Chi Kok to Lion Rock Tunnel along the existing alignment of Ching Cheung Road and Lung Cheung Road.

5.3.2 The site analysis established a basis from which to determine the landscape character of the area.

5.3.3 The site area through which the existing road runs and where road improvement works would take place is bounded by the Kowloon Foothills to the north and the urban development of Lai Chi Kok, Cheung Sha Wan, Tai Woh Ping and Beacon Hill to the south.

5.3.4 The primary land uses of the area have been classified into the following categories which are illustrated on the Landscape Analysis Plan (Figure 5.3.1):-

- o vegetated areas
- o residential/commercial
- o industrial
- o educational/hospitals and clinics
- o places of worship
- o recreational

Vegetated Areas

5.3.5 The vast majority of existing vegetation is located to the north of the road and forms part of the Kowloon Foothills. Small pockets of vegetation are found to the south of the road, primarily between residential developments but the only significant areas of vegetation below the road are located south of the Lung Cheung Road Lookout, below the Tai Woh Ping Reservoir and surrounding Lai Chi Kok Hospital. The vegetation is described more fully in the tree survey report.

5.3.6 In the western sector of the study area many established street trees line the road edge, these trees comprise predominantly Bombax malabaricum and form a significant landscape character element.

Residential/Commercial

5.3.7 Residential development intermixed with some commercial development bounds much of Ching Cheung Road and Lung Cheung Road to the south. The development varies in its form from dense public housing to low rise private homes.

5.3.8 At Lai Chi Kok the housing development of Mei Foo Sun Chuen is dense and uniform forming a large block of high rise buildings. Further to the east the estates of So Uk and Lei Cheng Uk are also dense and high rise but slightly more varied in their form.

5.3.9 The private development of Beacon Heights at Tai Woh Ping is relatively dense comprising blocks 8-10 storeys high, but the mature areas of amenity planting between the residential blocks provide visual relief, breaking the hard urban form of the buildings. Other areas of housing clustered around Tai Woh Ping include Chak On public housing estate and the temporary housing areas of Lung Ping Road and Tai Woh Ping. The temporary housing areas are low rise but dense and surrounded by unsightly chunam on concrete covered cut slopes.

5.3.10 At Beacon Hill to the south east of the study area private residential developments predominate. The built form and height varies but the developments lack significant areas of planting with the exception of Beacon Hill Road (west) which is surrounded by vegetation.

Industrial

5.3.11 The industrial zone of the study area is located at Cheung Sha Wan south of Ching Cheung Road. The built form is hard and dense with no visual relief in the form of intermittent pockets of planting or remnants of existing vegetation.

Educational/Hospitals and Clinics

5.3.12 The majority of hospitals and schools are located south of Ching Cheung Road on either side of So Uk Estate with the exception of Lai Chi Kok Hospital which is located below the Butterfly Valley Interchange. The hospitals and schools vary in height but are generally less dense than the surrounding residential developments and include some boundary planting treatment.

Places of Worship

5.3.13 A large Roman Catholic Cemetery is located north of Ching Cheung Road above Cheung Sha Wan. The cemetery is a significant feature set against the surrounding foothills but the hard form of the numerous terraces, retaining walls and gravestones is broken by mature groups of amenity planting. To the east of the cemetery a series of small temples steps up the hill; the temples are surrounded by dense vegetation and for the most part provide visual interest rather than visual intrusion. Several churches are also located south of the road on either side of So Uk Estate.

Recreational

5.3.14 At Lai Chi Kok and Cheung Sha Wan existing recreational facilities include the Lai Chi Kok Amusement Park and Swimming Pool, but apart from these areas there is a severe shortfall of open space. A small playground is located south of the Butterfly Valley Interchange but the remaining areas of planting can only be classed as amenity and not usable areas of open space.

5.3.15 Recreational areas to the east include a swimming pool complex adjacent to Lei Cheng UK Estate, several small sports fields attached to Chak On Estate, a large playing field and small playground above the Tai Woh Ping Reservoir, a playground on Beacon Hill Road, Lung Cheung Road Park between Waterloo Road and Lung Cheung Road, a small garden below a flyover adjacent to Broadcast Drive and a playing field above a reservoir at Lion Rock Tunnel.

5.4 Landscape Character Zones

5.4.1 The first step in the visual impact assessment involves an analysis of the existing landscape character. This exercise includes a general overview of the existing site conditions and an identifiable analysis of elements which contribute significantly to the character of zone. Such elements include:-

- topography/landform
- type and scale of built structures
- land use
- vegetation cover

5.4.2 Landform is an important element of the landscape which often dominates an area where there is very little development. The type and scale of built structures are heavily influenced by their function, therefore, the land use of a developed area will often be the dominant element in determining landscape character. Synthesising the information gathered, zones of similar visual character in terms of enclosure, exposure and features have been identified. Each zone is a separate visual unit and coincides with valleys extended from ridgelines. The zones identified for this study are shown in Figure 5.4.1 and are named as follows:-

A Lai Chi Kok
B Mei Foo Sun Chuen
C Butterfly Valley
D Cheung Sha Wan
E Cemetery
F Kowloon Foothills
G Caritas Hospital
H So Uk & Lei Cheng Uk Estates
I Tai Po Road
J Tai Woh Ping
K Lung Cheung Road Lookout
L Beacon Hill

Lai Chi Kok - Character Zone A

5.4.3 Lai Chi Kok is situated in the floor of a valley in front of and below Kwai Chung. The area comprises predominantly recreational land uses; Lai Chi Kok Amusement Park, Sung Dynasty Village and Lai Chi Kok Swimming Pool and Park. The built form is low and varied and subsequently open in character. Very little natural vegetation remains, however amenity planting occurs within each recreational unit. Ching Cheung Road forms a strong visual barrier between the northern and the southern areas.

Mei Foo - Character Zone B

5.4.4 Mei Foo Sun Chuen is built on flat reclaimed land; it is a private residential housing development. The built form comprises predominantly dense, tall tower blocks which are uniform in design, the podia between the residential blocks have been used to provide sitting-out spaces with amenity planting. The density and uniformity of the buildings, combined with the lack of major planting areas creates a character which is closed and hard.

Butterfly Valley - Character Zone C

5.4.5 Land use in the Butterfly Valley area is low-profile, comprising predominantly low storied buildings, surrounded by vegetation. Lai Chi Kok Hospital, a group of low buildings, is well hidden on the small hill overlooking Ching Cheung Road. Wai Man Tsuen, a group of cottages, is located at the bottom of Butterfly Valley below the road. A small rest garden is situated south of Ching Cheung Road, off Castle Peak Road. The most significant built features of the area are an electric substation and the Castle Peak Road Interchange. The valley form gives the area a dramatic appearance and because of an absence of any major group of buildings and an abundance of vegetation, this zone has a natural and open feeling, except where major cut slope work is in evidence.

Cheung Sha Wan - Character Zone D

5.4.6 To the south of Ching Cheung Road is the industrial district of Cheung Sha Wan. This zone has a strong and identifiable character due to the sudden level change between the road and the factories, which are located several metres below the level of the road. The factories are not uniform in design but are quite tall and dense. Most factories are 12 to 14 storeys high and occupy almost an entire city block, with very little intervening open space. The appearance of these buildings and significant lack of vegetation gives an industrial character to the area.

Cemetery - Character Zone E

5.4.7 To the north of Ching Cheung Road opposite the industrial area of Cheung Sha Wan is the Roman Catholic Cemetery. The Cemetery covers almost all of the slope up to Caldecott Road with terraces of stone graves and retaining walls. The area has an open but hard character. The absence of major buildings and any planting groups contribute to this. None of the indigenous vegetation remains but the landform of the slope evokes some of the original landscape character of the area, and the hard appearance of the area is occasionally softened by intermittent pockets of planting.

Kowloon Foothills - Character Zone F

5.4.8 This area consists of the slopes to the north of Lung Cheung Road and Ching Cheung Road and is the largest zone in the study area. The slopes are predominantly vegetated and inaccessible. Many large chunam slopes intrude into the natural landform adjacent to the road and are by contrast hard in character with a stark appearance. The slopes form a distinctive boundary and backdrop to the urban area due to their scale and height. Small structures in the area include a temple, petrol station, the Tai Po Road interchange and the Waterloo Road interchange. Other than these structures, there is a distinct lack of built form in this zone. The scale of Lung Cheung Road and Ching Cheung Road and the highway interchanges intrude upon an area which is otherwise rural in character.

Caritas Hospital - Character Zone G

5.4.9 This area consists of the Caritas Medical Centre and Hospital. The landform slopes away from Ching Cheung Road and the landscape character is heavily influenced by the dense planting groups in the hospital grounds and on the slopes below the road. The distinctively institutional buildings are quite massive but not dense. The buildings are generally 6 to 8 storeys high but a more recent block situated close to the road is 20 storeys high. Construction of a proposed mentally handicapped children's school east of the hospital and adjacent to the road will have begun before the start of the road improvement works. The proposal includes a large retaining wall and slope planting above the school buildings to screen the wall.

So Uk and Lei Cheng Uk Estates - Character Zone H

5.4.10 This area comprises a large housing estate located below the slopes south of Lung Cheung Road. The character is largely determined by the land use, namely public housing. There are two types of tower blocks; a trident form and the other long and linear. Their overall appearance is uniform and dense. The residential blocks are 17 storeys high. The spaces between the buildings consists predominantly of hard surface playgrounds broken by intermittent pockets of planting. The housing blocks are separated from the road by slopes, which are chunamed in parts and vegetated in parts.

Tai Po Road - Character Zone I

5.4.11 This area consists of the slope in front of and below Chak On Estate and behind and above Kwong Li Road (near Lei Cheng Uk Housing Estate). A large portion of this area is heavily wooded, especially along the slopes on both sides of Tai Po Road. There are very few structures in the area; a petrol station, a sitting out area and a footbridge. The slope overlooks the Sham Shui Po district from a higher level and forms a spur which extends from Beacon Hill, a green finger and a buffer between Lei Cheng Uk and the Tai Woh Ping district.

Tai Woh Ping - Character Zone J

5.4.12 Tai Woh Ping is dominated by residential land use; Beacon Heights and Chak On Estate. The former is a private housing development consisting of buildings which are lower and less dense than the latter which is a public housing development. There is an obvious difference in the appearance of the two residential areas, in terms of the choice of finishes and the architectural detailing. The Shek Kip Mei Reservoir Playground is located to the south of the road several metres below grade. Dense woodland occurs along the edge of the playground, and many individual trees have been planted in the south east corner and in the children's playground. The playground gives an open feeling to an otherwise dense and built up area.

Lung Cheung Road Lookout - Character Zone K

5.4.13 Surrounding the Lung Cheung Road Lookout is an area which has retained much of the original landscape character. It is a steep valley, heavily vegetated, with no predominant land use except for the Lookout point. The Lookout is a paved platform with several shade structures and a small carpark. Views from this point are extensive, overlooking the urban area of Kowloon and the harbour and Hong Kong Island beyond. Phoenix House of the Correctional Services and a Water Services Department Building are also located in this area north of the road; however the area retains a distinct rural character despite the visual intrusion of the WSD Building.

Beacon Hill - Character Zone L

5.4.14 To the south of the Lung Cheung Road is a residential area of sloping topography, characterised by varied residential buildings on Beacon Hill Road, Broadcast Drive and the Waterloo Road area. Some buildings are tall and compact, but less dense than public estate housing. Most buildings are in the range of 10 to 12 storeys high. No major planting groups occur in the area with the exception of a small park on Beacon Hill Road which is visible from Lung Cheung Road. The slope between the residential tower blocks and the road is chunamed.

Summary

5.4.15 In conclusion the overall landscape character of the study area is predominantly dense and urban to the south of the road and to the north the dominant feature is the green vegetated ridgelines and valleys of the Kowloon foothills, which form a distinctive predominantly green backdrop to the main urban areas.

5.5 Visual Quality

5.5.1 Areas of visual quality are determined by evaluating existing conditions and data contained in the landscape character zone analysis.

5.5.2 The purpose of establishing visual quality is to determine the sensitivity of an area to change or modification. An area of existing high visual quality is likely to be particularly sensitive to changes resulting from roadworks, whereas an area of low visual quality will be less sensitive. Changes resulting from new roadworks may not always be adverse, where reinstatement takes place the visual quality of an area may be upgraded.

5.5.3 Visual quality is graded into three categories - high, medium and low. Each character zone is assessed to determine to what extent the natural landscape character has been retained and the degree to which the existing site has undergone modification or change. Both an objective interpretation of the degree of modification and a subjective visual assessment of the site are required.

5.5.4 Figure 5.5.1 indicates the distribution of the three categories identified.

High Visual Quality

5.5.5 Areas of high visual quality will include areas of natural landscape which have undergone very little modification and which have retained their natural character. Cut slopes which have been revegetated and areas of open space with stands of mature trees will also be included in this category as both provide important visual relief from their surroundings.

5.5.6 The specific areas along Lung Cheung Road and Ching Cheung Road which have been included in this category are listed and described below:-

Area C1	Lai Chi Kok Hospital
Area F1	Butterfly Valley - Kowloon Foothills
Area F2	The "Temple" Area
Area F3	Crows Nest - Kowloon Foothills
Area F4	Lion Rock - Kowloon Foothills
Area 11	Tai Po Road
Area K1	Lung Cheung Road Lookout

5.5.7 Area C1 has been modified slightly by the presence of the hospital buildings however the buildings are low and unobtrusive, and the dense mature vegetation is the dominant visual element of the area.

5.5.8 Area F1 consists predominantly of dense woodland planting to the north of Ching Cheung Road. Visual intrusions in the area include cut slopes adjacent to the road, an electric substation and the Butterfly Valley Interchange, but the vast majority of the area is of high landscape and visual quality.

5.5.9 Area F2 also consists predominantly of dense woodland to the north of Ching Cheung Road but the area includes small temple buildings which are dotted throughout the site. The buildings are unobtrusive and the overall visual quality of the area is high.

5.5.10 Area F3 comprises the vegetated slopes of "Crows Nest" to the north of Lung Cheung Road. Chunamed cut slopes adjacent to the road have degraded the original landform but the remaining area is of high landscape and visual quality.

5.5.11 Area F4 consists of a small section of the Kowloon Foothills which straddles the entrance to the Lion Rock Tunnel and is located north of Lung Cheung Road. Despite the visual intrusion of cut slopes adjacent to the road the overall landscape and visual quality is high.

5.5.12 Area I1 consists of the slopes surrounding Tai Po Road and Tai Woh Ping Road to the north of Lung Cheung Road. The area has been degraded with the presence of roads, associated cut slopes, a petrol station and a small reservoir, however the steep slopes which are heavily vegetated form the dominant visual element of the area.

5.5.13 Area K1 comprises vegetated slopes to the north and south of Lung Cheung Road and includes a lookout and sitting out area. Visual intrusions in the area include cut slopes adjacent to the road and a WSD workshop. Despite these intrusions the dominant visual element of the area is the mature woodland slopes, which form the most significant area of predominantly indigenous vegetation south of the road.

Medium Visual Quality

5.5.14 Areas of medium visual quality include some form of development, predominantly residential, but retain in part some of the original landscape character. Areas which have been developed but include established areas of tree planting have also been included in this category.

5.5.15 The specific areas adjacent to Ching Cheung Road and Lung Cheung Road which have been included in this category are:-

Area C2	Wai Man Tsuen
Area E1	Roman Catholic Cemetery
Area G1	Caritas Hospital and Medical Centre
Area J1	Tai Woh Ping
Area L1	Beacon Hill

5.5.16 Area C2 - Wai Man Tsuen is a small village located in a valley to the south of Ching Cheung Road at Butterfly Valley. Chunamed slopes lead down from the road to the cluster of village houses but mature vegetation has established on much of these slopes. Little of the original vegetation remains but the natural landscape character has been reinstated in part by the dense planting surrounding the village. This area has been designated for industrial development in Outline Development Plans for the Kowloon Area.

5.5.17 Area E1 - the Roman Catholic Cemetery covers much of the slopes between Caldecott Road and Ching Cheung Road above Cheung Sha Wan. The original landscape character has been modified by the stone graves, retaining walls and terraces which occupy most of the site but the sloping landform and presence of mature amenity planting in the cemetery evokes some of the original landscape character, and the area has been graded as medium in terms of visual quality.

5.5.18 Area G1 comprises the buildings and grounds of Caritas Hospital and Medical Centre. The area has been graded medium in terms of visual quality as the site has been almost completely modified but the buildings although tall are not dense and mature stands of vegetation remain between some of the buildings.

5.5.19 Area J1 comprises Chak On Estate, Shek Kip Mei Reservoir Playground and Cornwall Street Temporary Housing to the south of Lung Cheung Road. Beacon Heights residential development and Lung Ping Road Temporary Housing Area are located to the north of the road. Much of the area has been modified by building and road development but mature vegetation has been planted or still remains around some of the buildings. The open space and surrounding vegetation of the reservoir playground dominates views within the area.

5.5.20 Area L1 comprises predominantly private residential buildings south of Lung Cheung Road. The buildings are varied in form and height and vegetation has been planted or still remains in the small parks adjacent to the road. The area has been graded as medium visual quality due to the presence of some areas of vegetation and the visual interest provided by the varied forms of the residential buildings.

Low Visual Quality

5.5.21 Areas of low visual quality comprise mainly areas which have been developed for industrial use and those areas along the road which create an adverse visual impact such as chunamed cut slopes. Some residential and mixed land use areas also fall into this category where they do not retain any of the original landscape character.

5.5.22 Specific areas adjacent to Ching Cheung Road and Lung Cheung Road which are included in this category are:-

Area A1	Lai Chi Kok
Area A2	Mei Foo Sun Chuen
Area D1	Cheung Sha Wan
Area H1	So Uk and Lei Cheng Uk housing estates

5.5.23 Area A1 comprises the Lai Chi Kok Amusement Centre and Park. The area is characterised by urban forms and hard open spaces.

5.5.24 Area A2 retains none of the original landscape character and is dominated by the dense and uniform mass of the high rise buildings.

5.5.25 Area D1 comprises the dense and low quality industrial buildings of Cheung Sha Wan. Little of the original landscape character has been retained and consequently the visual quality of the area has been graded as low.

5.5.26 Area H1 comprises predominantly So Uk and Lei Cheng Uk housing estates. Areas of vegetation are interspersed along the slopes below Lung Cheung Road to the north of the estates, but the dense high rise buildings dominate the site and contribute significantly to the low visual quality of the area.

5.6 Visibility

5.6.1 In order to assess future visual impact of the proposed road improvements, it is necessary to first determine the extent of visibility, to establish from where the road can be seen and what can be seen. Visibility is assessed by site survey and mapping techniques and involves identifying the following:-

- the distribution and proximity of sensitive receivers
- the predominant land use of sensitive receivers
- the view from sensitive receivers

Both long and short distance views have been identified, however distant views from Hong Kong Island may be reduced in years to come as a result of abolishing height restrictions related to the closure of Kai Tak Airport.

5.6.2 An assessment of visibility involves determining not only from where the road can be seen but also what can be seen. Before assessing future visual impact it is necessary to define the context or existing setting of future road improvement works and the nature of what can already been seen, i.e. the visibility.

5.6.3 An existing view which is rural in character will be far more affected by future road works than a view which is predominantly urban in character even though the existing road may occur in both of these views. An identified view may already be significantly affected by the intrusion of some of the existing features. For example a view comprising many elevated structures may not be degraded any further by the addition of a new elevated structure. Also some of the existing slopes which are chunam covered create unsightly views which will be improved where replacement with a more natural appearance forms part of the road design.

5.6.4 The sensitive receivers for short distance views are plotted on Figure 5.6.1. Together with identified long distance views they will determine the distribution of viewers. Sensitive receivers are those land uses which would be affected by the road improvement works. In many cases identified sensitive receivers will already be affected by the existing road. The most sensitive land uses will include residential areas, public open space, schools and hospitals. Least sensitive land uses will include industrial and manufacturing areas and transport corridors. Sensitive receivers for short distant views have been specifically pinpointed. Long distance views have been described in general terms.

5.6.5 Section 5.9.24 lists identified visual receivers and the distinguishing elements of each view. The majority of sensitive receivers are located to the south of the road and look north across the road to the Kowloon Foothills. Where sensitive receivers are located to the north of the road existing views to Hong Kong Island and the harbour become important, particularly in the event that they may be obstructed by future road works.

5.6.6 The cut slopes associated with Ching Cheung Road and Lung Cheung Road are visually prominent for long distance views. Several factors contribute to such visual prominence:-

- o the level of Ching Cheung Road and Lung Cheung Road which is generally higher than most other developments in the Kowloon area.
- o the large cut slopes associated with the road are predominantly chunamed and very visible when seen against the green backdrop of the Kowloon Foothills.
- o the height restrictions for flight paths associated with Kai Tak airport have prevented the construction of buildings which are tall enough to block the view of large cut slopes associated with the road.

5.6.7 Long distance viewers (albeit intermittently) include; residents on Hong Kong Island, ferry passengers crossing the harbour and airline passengers on planes arriving and departing from Kai Tak Airport, this latter group of viewers is unlikely to exist once the road is opened, but will however continue to view the site during most of the construction phase.

5.6.8 Visibility has been graded high, medium or low for each Visual Quality Area, dependent on the following criteria:-

- o the number of sensitive receivers
- o the proximity of sensitive receivers
- o the type of sensitive receivers
- o the view which can be seen by the sensitive receivers
- o long distance views

The visibility grades for each area are plotted on Figure 5.6.1.

5.7 Visual Sensitivity

5.7.1 Visual sensitivity is an evaluation of an area in terms of both visibility and visual quality. The visual sensitivity of an area is derived from an amalgamation of the visibility and visual quality which have been assigned to an area. An area of high visual sensitivity will be of high visual quality and high visibility and subsequently most sensitive to the changes or modifications resulting from the proposed road improvement works.

5.7.2 Gradings of high, medium and low have been given to separate landscape character areas based upon an assessment of their visibility and visual quality. These areas and their given values of visual sensitivity are listed in Table 5.2.

High Visual Sensitivity

5.7.3 Areas of high visual sensitivity include those areas which have:-

- o high visibility and high visual quality
- o high visibility and medium visual quality
- o medium visibility and high visual quality

5.7.4 Landscape character zones which fall into this category comprise the following:-

- o Butterfly Valley/Kowloon Foothills
- o The Temple Area (Kowloon Foothills east of the R.C. Cemetery)
- o Crows Nest/Kowloon Foothills
- o Tai Po Road (slopes south of Lung Cheung Road)
- o Tai Woh Ping
- o The Lung Cheung Road Lookout area
- o Lion Rock/Kowloon Foothills

Medium Visual Sensitivity

5.7.5 Areas of medium visual sensitivity include those areas which have:-

- o high visibility and low visual quality
- o low visibility and high visual quality
- o medium visibility and medium visual quality

5.7.6 Landscape character zones which fall into this category comprise the following:-

- Lai Chi Kok Hospital
- Wai Man Tsuen
- The Roman Catholic Cemetery
- Caritas Hospital and Medical Centre
- So Uk and Lei Cheng Uk Housing Estates
- Beacon Hill

Low Visual Sensitivity

5.7.7 Area of low sensitivity include those areas which have:-

- medium visibility and low visual quality
- low visibility and medium visual quality
- low visibility and low visual quality

5.7.8 Landscape character zones which fall into this category comprise the following:-

- Mei Foo Sun Chuen
- Cheung Sha Wan

5.7.9 In conclusion Figure 5.7.1 clearly shows that the majority of the site to the north of Lung Cheung Road - the Kowloon Foothills, is highly sensitive to any changes or modifications resulting from the road improvement works.

5.7.10 The three central areas to the south of Lung Cheung Road which also fall into this category - Tai Po Road, Tai Woh Ping and the Lookout area do so because they contain pockets of dense vegetation and undisturbed areas of high quality landscape, or they are highly visible for a significant number of sensitive receivers.

5.7.11 Of these areas the Lung Cheung Road Area is particularly important. It is the one area where the landform and vegetation of the Kowloon Foothills appears to straddle the road and extend down through the surrounding urban development. Care should be taken not to sever the area with further development adjacent to the road.

5.7.12 Areas of moderate and low visual sensitivity are mainly located to the south west of the study area where there is the highest concentration of dense urban development.

5.8 Assessment of Project Characteristics

5.8.1 This section is organised as a series of data sheets which describe the project characteristics for each of the Character Zones, and Visual Quality Areas (Table 5.2). The type of works proposed in each area is indicated and an assessment is made of the degree of modification to the area. The degree of modification is assessed as high, medium low or improved dependent upon the disturbance to the existing landform and conditions which would be incurred by the road improvements. The elements of the work and degree of modification are assessed separately for construction stage and operational state. The project characteristics are illustrated on Figure 5.8.1. The effect of the roadworks is summarised on Table 5.1 and Figure 5.8.2.

Table 5.1 SUMMARY OF ASSESSMENT OF PROJECT CHARACTERISTICS

LANDSCAPE CHARACTER ZONE	A	B	C	C	D	E	F	F	F	F	G	H	I	J	K	L	
VISUAL QUALITY AREA	A1	B1	C1	C2	D1	E1	F1	F2	F3	F4	G1	H1	I1	J1	K1	L1	
Chainage																	
from	1000	1250	1450	1600	1950	2150	1100	2500	3250	5500	2500	3100	3600	4040	4850	5300	
to	1250	1450	1600	1950	2500	2500	2150	3250	4200	6140	3100	3600	4040	4850	5500	6140	
Project Characteristics																	Project Characteristics
OPERATIONAL PHASE																	**OPERATIONAL PHASE**
Major Interchange													●				Major Interchange
Road Widening at Grade	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Road Widening at Grade
Bridge/Viaduct				●	●		●		●		●	●	●	●			Bridge/Viaduct
Cut slope									●	●			●	●	●	●	Cut slope
Soiled Nailed Slope													●	●	●		Soil Nailed Slope
Fill Slope					●						●		●	●	●		Fill Slope
Retaining Wall				●	●		●				●	●	●	●	●	●	Retaining Wall
Noise Barrier											●			●	●	●	Noise Barrier
Loss of Vegetation					●	●			●	●	●	●	●	●		●	Loss of Vegetation
Roadside Planting				●	●			●	●	●	●	●	●	●	●	●	RoadsidePlanting
Slope Planting (Cut)									●	●			●			●	Slope Planting (Cut)
Slope Planting (Fill)					●						●		●		●		Slope Planting (Fill)
MODIFICATION	L	L	L'	M	M	L	L	L	H	H	M	M	H	H	H	L	MODIFICATION
ASSESSMENT OF WORKS	**L**	**L**	**L**	**M**	**L**	**L**	**L**	**L**	**I**	**I**	**M**	**M**	**H**	**H**	**M/I**	**M**	**ASSESSMENT OF WORKS**
CONSTRUCTION PHASE																	**CONSTRUCTION PHASE**
Works Area														●			Works Area
Road at Grade/Road Construction				●	●		●		●	●	●	●	●	●	●	●	Road at Grade/Road Construction
Road Resurfacing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Road Resurfacing
Bridge & Flyover Construction				●	●		●	●	●		●	●	●	●			Bridge & Flyover Construction
Cut Slope (New)										●	●		●	●			Cut Slope
Extension of Existing Cut Slope									●	●			●	●	●		Extension of Existing Cut Slope
Fill Slope					●						●		●	●	●		Fill Slope
Retaining Wall Construction				●	●		●				●	●	●	●	●	●	Retaining Wall Construction
Noise Barrier Construction											●	●		●		●	Noise Barrier Construction
Vegetation Removal				●	●				●	●	●	●	●	●	●		Vegetation Removal
Planting Operations			●	●	●		●	●	●	●	●	●	●	●	●	●	Planting Operations
MODIFICATION	L	L	L	L	M	L	L	L	H	H	M	M	H	H	H	M	MODIFICATION
ASSESSMENT OF WORKS	**L**	**L**	**L**	**M**	**M**	**L**	**L**	**L**	**H**	**H**	**M**	**H**	**H**	**H**	**H**	**M**	**ASSESSMENT OF WORKS**

I - IMPROVED
L - LOW
M - MEDIUM
H - HIGH

● Please see Table 5.2 for a description of the Project Characteristics specific to each Character Zone

5.8.2 An assessment of the effect of the works is graded into four categories:-

- o high
- o medium
- o low
- o improved

These are derived by synthesising the project characteristics data for an individual area with the degree of modification to come up with an overall assessment for construction stage and one for operation stage. The assessments of the works are based on the following:-

High

5.8.3 Roadworks which would result in extensive modifications to the existing landform and are likely to have a high impact on the surrounding landform are classified in this category. Areas where large scale roadworks would take place would be significantly affected by these works and the resulting effect would be high. Large scale roadworks would include the construction of interchanges and viaducts and the formation of cut slopes.

Medium

5.8.4 Roadworks which would result in a significant but not extensive amount of modification to the existing landform would be assessed as medium.

Low

5.8.5 Roadworks which would cause very little disturbance to the surrounding landform such as construction of road sections at grade and minor earthworks would have a low impact. Other areas where the impact would be low would include areas where roadworks may be extensive but they would incorporate significant visual improvements such as reinstatement planting on existing cut slopes.

Improved

5.8.6 For certain sections of the alignment the roadworks may be extensive but they would have a positive rather than negative impact on the surrounding landform particularly in areas where existing chunam slopes would be extended; the chunam would be removed, the slope hydroseeded and planted and the edges blended to match existing contours.

5.8.7 Table 5.2 includes a description of the project characteristics for each of the visual quality areas and grades their overall effect on the surrounding landform for both the construction and operational phases. Landscape proposals for each of the areas are included as a project characteristic. Their mitigating effects are taken into account when assessing the overall effects of the roadworks.

5.9 Visual Impact

5.9.1 Establishing the degree of visual impact associated with the roadworks is the final step in the assessment of both site conditions and project characteristics. For each landscape character zone, the synthesis of visual sensitivity and the assessment of the works described in section 5.8 will determine the degree of visual impact. (Figure 5.9.1)

5.9.2 In an area which is extremely sensitive to change due to the high landscape quality and with proximity to where roadworks would take place, and where extensive modifications would be implemented, the resulting visual impact is likely to be high. However the view may be improved if visual upgrading could be achieved as an adjunct to the road works, particularly where chunam on existing slopes would be removed and the slope replanted.

5.9.3 Landscape characters zones for which the visual impact would be medium comprise sections of road where both the visual sensitivity of the surrounding landscape and the extent of the works would be moderate and also areas where visual sensitivity is high and the extent of works low or the visual sensitivity low and the extent of works high.

5.9.4 In areas where there would be very little or no impact, the road improvement works would be minimal or take place within the existing alignment of the road.

5.9.5 Other sections of the road where the visual impact has been graded as low would include areas where the visual sensitivity is high but where the effect of the road works has been assessed as "improved" rather than low for the operational phase as a result of visual upgrading.

5.9.6 The overall impact for each area is illustrated on Table 5.2 and Figure 5.9.1.

5.9.7 Figure 5.9.1 indicates that the highest level of impact would be concentrated in the central region of the study area, Tai Po Road and Tai Woh Ping, where many proposed structures and cut slopes associated with the off line link would be constructed.

5.9.8 The impact of the roadworks affecting the following areas, Crows Nest/Kowloon Foothills, Lion Rock/Kowloon Foothills, So Uk and Lei Cheung Uk and the Lookout area would have been equally high but for the expected improvement associated with proposed reinstatement planting incorporated into slope improvement works in these areas.

5.9.9 For many of the areas particularly those listed above the landscape works associated with the roadworks would result in positive rather than negative visual impact. Should the landscape works not be implemented this situation would be reversed.

5.9.10 To the west of Caritas Medical Centre the visual impact of the roadworks would be predominantly low. The road improvement works between Chainage 1000 and 1600 would usually take place at grade and often within the existing alignment, resulting is very few changes or modifications.

5.9.11 At Wai Man Tsuen the extent of works and resulting impact would be moderate with road widening to the south supported by retaining wall or structure. At present a small village in located below the road but the area has been designated as industrial in the Kowloon ODP and once redeveloped would be less sensitive to visual intrusion.

5.9.12 At Cheung Sha Wan where road widening takes place to the south away from the Roman Catholic Cemetery the impact would be low due to the less sensitive nature of the industrial area adjacent to the road.

5.9.13 Between Chainage 2500 and 3100 the road would be widened to the south, the impact on the "Temple Area" to the north would be minimal but the impact on the area to the south of "Caritas" would be moderate due to the construction of a proposed elevated structure and a proposed 2m noise barrier.

5.9.14 Beyond Caritas to the southeast at So Uk and Lei Cheung Uk a section of the road would continue on structure for a distance of over 300m. The resulting impact would be high but for the presence of existing chunam slopes which have already degraded the view and the expected improvement associated with proposed screen planting along the top section of the slope adjacent to the elevated road. Taking into account the existing conditions and planting proposals the impact has been graded as moderate.

5.9.15 Above So Uk to the north of the road below Crows Nest, large chunamed slopes would be extended to allow for road widening but the existing chunam would be removed and the slopes hydroseeded and planted. As a result the existing extent of visual intrusion which is high would be upgraded to low.

5.9.16 Further east the visual impact for the off line link beyond Chainage 3600 has been graded as high. As previously discussed the visual impact upon the surrounding areas Tai Po Road and Tai Woh Ping would be high due to the introduction of extensive new structures some of which would be over 20 metres above the existing ground level.

5.9.17 There would however be an upgrading of the existing visual resources north of the mainline between Chainage 3600 and 3990 where three existing cut slopes would be extended to accommodate at grade widening. The existing chunam would be removed and the slopes hydroseeded and planted.

5.9.18 East of the off line link the effect of the roadworks on the area surrounding Lung Cheung Road Lookout would be moderate. Two fill slopes and retaining walls would be constructed to accommodate road widening to the south. These works would intrude into a particularly sensitive area in visual and environmental terms, however the slopes would be replanted with predominantly indigenous species and screen planting would be incorporated into landscape proposals for the area in front of the retaining walls. Both these measures would considerably reduce the impact of the works in this area.

5.9.19 To the north of the road opposite the Lookout an existing chunam slope would be extended and the slope replanted, as a result the existing extent of visual intrusion would be reduced.

5.9.20 Beyond the Lookout area between Chainage 5300 and 6140 the road would be widened to the south above Beacon Hill Road and to the north east of the WSD building. The impact of the roadworks which include a large retaining wall to the south and extended cut slopes to the north have been graded as moderate. Although the roadworks would be fairly extensive the assessment has taken into consideration the presence of existing chunam slopes the appearance of which would be significantly improved as a result of slope improvement works which would include reinstatement planting and slope blending.

5.9.21 The large retaining wall and proposed noise barrier behind residential buildings on Beacon Hill Road would have a significant impact upon the view from these buildings however the assessment takes into account the presence of existing chunam slopes which have already degraded the view. Careful consideration would need to be given to the finish chosen for the retaining wall to achieve a positive rather than negative visual impact.

5.9.22 The distribution of sensitive receivers contributes to determining the extent of visual impact but the visual impact for identified receivers needs to take into account the impact of the roadworks on specific views.

5.9.23 In some instances the visual impact for a sensitive receiver may differ from the overall impact for the area which can be seen. The view from a sensitive receiver may be narrow and focus directly on roadworks which are minimal for the area or the view may miss roadworks which are otherwise extensive for the area. The following text describes the specific effect of the roadworks on individual sensitive receivers.

5.9.24 The Visual Impact on Views from Sensitive Receivers

- Views from Lai Chi Kok Bay Garden

  The views from Lai Chi Kok Bay Garden Residential buildings would not be affected by the road improvements. For areas of the road visible from the buildings road improvement works would take place within the existing alignment.

- Lai Chi Kok Park and Swimming Pool

  The road improvement works would not increase the impact on views from the park, road improvement works for this area would take place within the existing alignment.

- Views from Mei Foo Sun Chuen

  The views to the south east (Butterfly Valley) are affected by the existing road and structures. The road improvement works would not increase the visual impact for this section of the road except for a minor amount of visual intrusion during the construction phase where road resurfacing would take place. Only high level floors would have a view of the area.

  The views to the north would not be affected as there would be no change in the existing road alignment. The view from the adjacent Lai Chi Kok Amusement Centre and Public Swimming Pool would also not be affected.

  The visual impact of the existing road is moderate.

- Views from Castle Peak Road Garden

  Views from the Garden would not be significantly affected by the roadworks as most construction would take place to the north away from the garden. A minor amount of visual intrusion might occur during the construction phase.

- Views from Lai Chi Kok Hospital

  The visual impact for the new roadworks in the area has been graded as moderate but the views from Lai Chi Kok Hospital to the north would only be slightly affected by the new roadworks. The buildings are not high and for the most part views to the north are blocked by existing vegetation.

o Views from Wai Man Tsuen

The visual impact resulting from road widening to the south would be significant where the road would be constructed on elevated structure and where existing vegetation would be removed. However, some views would be blocked by existing vegetation, the view has already been degraded in part by the presence of existing chunam slopes and the area has been designated as industrial in the Kowloon ODP.

Taking into account existing site conditions and future land uses the impact has been graded as moderate.

o Views from The Industrial Buildings along King Lam Street

Only very short distance views from the buildings would be affected where the road is widened to the south on elevated structure. A minor amount of visual intrusion is expected but the resulting impact would be low, particularly as the industrial buildings in the area have been categorised as less sensitive to impact. The visual impact would be higher where vegetation is removed.

o View from The Temples North of Ching Cheung Road

The temples are located east of the Roman Catholic Cemetery and north of the road. The road widening adjacent to this area would be to the south and little of the road is visible from the buildings which are surrounded by dense vegetation, as a result the impact on views from the temple buildings is expected to be minimal.

o Views from Nam Wah Middle School

The views to the north would be affected by the realigned access road to Caritas Medical Centre and associated fill slope. The fill slope would be planted to screen views to the road and as a result the impact would be moderate rather than high.

o Views from Caritas Medical Centre and Hospital

Buildings in the Medical Centre and hospital grounds with views to Lung Cheung Road would be affected by the new elevated structure associated with widening of Lung Cheung Road to the south and proposed 2m noise barrier between Chainage 2550 and 2700. The existing slopes over which the elevated road would be built are covered in chunam but vegetation has established in parts.

The loss of mature street trees to the east of the footbridge at Chainage 2800 would increase the impact of the roadworks.

The visual intrusion would be higher where existing vegetation would be removed but moderate where the road is constructed over existing chunam slopes. The overall visual impact would be moderate.

The Caritas proposed school for the severely mentally handicapped to be constructed adjacent to the road immediately east of the hospital would not be affected by the roadworks as such, however a large retaining wall would be constructed to the south of the road to allow for the development. Views of the wall from the school would be screened by proposed slope planting to be implemented as part of the proposal.

o Views from So Uk Estate

The views from So Uk Estate would be affected by the increase in cut slopes to the east and the new retaining walls and elevated structure and proposed noise barrier directly in front of the estate buildings to the south of Lung Cheung Road.

The degree of visual intrusion and overall visual impact would be moderate as the landscape has already been extensively modified by the existing road and chunamed slopes. There may be an opportunity to improve the appearance of some of the downhill slopes particularly where construction for the proposed roadworks would break up some of the existing chunamed slope surface, giving rise to opportunities for planting.

The landscape proposals for this area would include screen planting on the slope in front of the long stretch of elevated road Bridge B8. This would help reduce the impact of the elevated road proposed between Chainage 3100 and 3200, above Orchid and Marigold House.

The view from Orchid House to Lung Cheung Road would eventually be blocked by the proposed Caritas School.

o Views from Churches and Schools along Kwong Lee Road

Views would be affected by the increase in existing cut slopes to the north of Lung Cheung Road, the new retaining walls to the south and the large elevated structures associated with the off line link. The resulting visual intrusion and impact would be moderate due to the presence of existing cut slopes, but high for the buildings to the east (Kei Oi Church and School and Chi Yun School) due to the close proximity of the tall elevated roads associated with the off line link.

The appearance of the existing chunam cut slopes to the north would be improved with the implementation of slope works incorporating reinstatement planting. The existing view of this area would be significantly upgraded.

o Views from Lei Cheng Uk Housing Estate

The view from residential buildings on Kwong Lee Road would be significantly affected by the very high proposed elevated slip roads associated with the off line link and the increase in existing cut slopes to the north. The existing view has been degraded by the presence of chunam slopes, but due to the particularly sensitive nature of residential buildings and their proximity to proposed elevated roads the overall visual impact would be high.

The impact on view to the south and south west would be high due to the proximity of the off line link but views to the north west would be improved where reinstatement planting on existing cut slopes would be implemented as part of the road works.

o Views from Lei Cheng Uk Public Swimming Pool

Views would be affected by the very high proposed elevated slips roads passing a couple of metres from the pool boundary to the north. The visual intrusion and obstruction would be high but the overall visual impact would be moderate due to the presence of cut slopes faced with chunam which degrade the existing view.

- Views from Chak On Estate

The views from Chak On Estate would be affected to the east, south west and in some instances to the north.

The views from Fu Chak House would be affected by the proposed elevated structures associated with the off line link. Part of the elevated road would pass very close to the south of Fu Chak House obstructing the view from lower floors.

The views from Wing Chak House would be affected by the proposed elevated roads to the south and west, however, the views to the north would improve where existing chunam would be removed from cut slopes and the slope extended and replanted.

- Views from Tai Woh Ping Temporary Housing Area

The Temporary Housing Area should be closed before construction begins, but a proposed secondary school would be built on the site. The impact on views from the school are likely to be high as a section of elevated road associated with the off line link would cross through the site. Adequate screen planting should be implemented as part of the school development.

- Views from Shek Kip Mei Reservoir Playground

The reservoir playground would be affected by the proposed elevated structures associated with the off line link, which would be constructed along the southern boundary and cross directly above the children's playground.

The visual intrusion and subsequent visual impact would be high, consequently it would be desirable to reprovision the playground.

- Views from Beacon Heights

The views from Beacon Heights may be affected by the proposed elevated structures associated with the off line link but it is unlikely that the structures would obstruct views to the harbour. The visual impact would range from moderate to low.

Views to the south west are blocked by Chak On Estate.

- Views from Lung Ping Road Temporary Housing Area

Views to the south and south west would not be significantly affected by the road works as slopes immediately to the south block part of the view. The buildings are not high enough for residents to see over the slope except for long distance views to the harbour. Some of the proposed elevated structure may still be visible for short sections but the resulting visual impact would be low.

The site has been proposed for a hospital development in the Kowloon ODP and should the redevelopment include taller buildings which is likely, the visual impact may increase from low to moderate.

- Views from The Proposed Immigration Services Training School

The proposed school would be located opposite the Lung Cheung Road Lookout north of the road. The site is well above the level of the road and it is unlikely that future views would be affected by the road works in the area which comprise predominantly cut and fill slopes.

- Views from Cornwall Street Temporary Housing Area

The impact on views from the area has been graded as high due to the proximity of the off line link but views from the Temporary Housing area would not be severely affected by the roadworks due to the presence of existing cut slopes to the north and west which block extended views to Lung Cheung Road. The buildings are also low (only two storeys) and with the exception of a few locations residents cannot see above the slope.

The site has been designated for future residential, educational and institutional redevelopment in the Kowloon ODP. Elevated roads associated with the off line link would be visible from taller buildings developed on the site and the future impact may range from low to moderate.

- Views from Beacon Hill Road East

Views would be affected by the increase in cut slopes to the north of Lung Cheung Road immediately opposite the Lookout and the fill slopes to the east of the lookout. The view from residential buildings on Beacon Hill Road West would not however be severely affected as they are over 200 metres away from the road and both the fill and cut slopes would be replanted.

- Views from Residential Blocks on Beacon Hill Road West

Blocks 43-56 would be affected by a proposed retaining wall and noise barrier to the south of Lung Cheung Road, the retaining wall would be constructed adjacent to the residential buildings and would cover a length of 125 metres at a height of 18-20m. The impact has been graded as moderate due to the presence of existing chunam slopes.

The proposed 3m high noise barrier would extend between Chainage 5400 and 5800 affecting the view for several floors for all residential buildings along the road. However for higher floors the view would be improved where existing cut slopes to the north would be extended but the chunam removed and the slope replanted.

- Beacon Hill Road Playground

The view from the playground which is several metres below the level of the road would be affected by the increase in cut slopes to the north during the construction phase but would be improved once reinstatement planting on the slopes has established.

- Views from Residential Blocks on Rhondda Road

The view from apartments on the north side would be improved with the replanting of existing cut slopes to the north of Lung Cheung Road,

- Residential Blocks On Broadcast Drive

  Views from residential blocks between and including Welcome Gardens and Eastlead Heights would be affected by the increase in cut slopes to the north of Lung Cheung Road where the egress slip road from Lung Cheung Road to Lion Rock Tunnel would be realigned. The impact would be low as the affected slopes would be replanted and their appearance improved.

- Views from Lung Cheung Road Park

  The views from the park are unlikely to be affected by the road improvements as the works in this area are not extensive and views from within the park are partially screened by trees.

- Views from Broadcast Drive Garden

  The views from Broadcast Drive Garden are unlikely to be affected by the roadworks which would stop at Waterloo Road. The garden is well below the level of the road and surrounded by an existing flyover. The existing visual impact which is high would not be decreased or increased by the roadworks.

5.10 Recommendations

5.10.1 The Visual Impact Assessment recognises that the integrated design approach which has been adopted in the development of engineering and landscape design solutions for the road improvement works has resulted in varying degrees of visual impact. There are some areas where visual improvement is the end result because the works associated with the road improvement would necessitate the removal or upgrading of elements in the existing landscape which are identified as visually intrusive.

5.10.2 In many areas the road improvement works would be occurring in areas which already have a visual clutter of road associated elements. The introduction of additional bridges, abutments, walls etc would not therefore have a significant visual impact on the overall area. In some areas the visual impact of elements of the highway improvements would be significant, and would remain so even after maturing of the vegetation.

5.10.3 It is the aim of this section to take an overall review of the scheme as it would look when the landscape works, particularly the planting, have matured and to identify works which could improve the visual resources further. These are generally associated with areas where high visual impact was identified, areas where screening by off-site planting would be an added benefit to certain sensitive receivers and areas which would not be subject to visual improvement as part of the overall road improvement scheme.

5.10.4 The visual impact of the road improvements as described in Section 5.9 of this report would be dependent on the maturing of the landscape works in many areas to ensure that the works would ultimately blend satisfactorily into the local environs.

5.10.5 Areas where further mitigation against visual impact could be undertaken are as follows:-

o Remaining chunam slopes;
removal of chunam and replacement with slope stabilisation methods which support vegetation would improve the visual quality.

- existing chunam slopes north of the road between Chainage 1950 and 2400
- existing chunam slopes above Caritas Medical Centre
- existing chunam slopes north of the road between Chainage 2900 and 3200
- remaining chunam slopes above So Uk Estate
- existing chunam slopes at the Tai Po Road Interchange
- extensive areas of chunam on slopes south of the road between Chainage 3400 and 3900 above Kwong Lee Road
- existing chunam slopes above the reservoir playground
- existing chunam slopes above the Cornwall Street Temporary Housing Area
- existing chunam slopes surrounding Lung Ping Road Temporary Housing Area
- existing chunam slopes above residential buildings on Beacon Hill Road
- existing chunam slopes above the mainline between Chainage 4000 and 4180 west of Beacon Heights

o Existing structure;
some of the existing structures are badly stained. An applied finish to the structures would improve their visual amenity.

o Screen Planting;
planting in front of existing structures and retaining walls.

- additional planting in the Roman Catholic Cemetery
- screen planting near buildings in Chak On Estate with views to the off line link
- additional planting in the grounds of the Tai Woh Ping Reservoir Playground to screen views of the off line link
- planting of trailing plants above the large retaining wall directly south of the WSD buildings

Table 5.2 Visual Impact Assessment Table

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONES A & B (OPERATION PHASE)

CHARACTER ZONE	A Lai Chi Kok	B Mei Foo Sun Chuen
VISUAL QUALITY ZONE	A1 Lai Chi Kok	B1 Mei Foo Sun Chuen
Chainage	1000 - 1250	1250 - 1450
VISUAL QUALITY	Low	Low
VISIBILITY	Medium	Medium
VISUAL SENSITIVITY	Low	Low
PROJECT CHARACTERISTICS		
Major Interchange		
Road Widening at Grade	Road widening within existing alignment.	Road widening within existing alignment.
Bridge/Viaduct		
Cut Slope		
Soiled Nailed Slope		
Fill Slope		
Retaining Wall		
Noise Barrier		
Loss of Vegetation		
Roadside Planting		
Slope Planting (Cut)		
Slope Planting (Fill)		
Modification	Low	Low
ASSESSMENT OF WORKS	Low	Low
VISUAL IMPACT	LOW	LOW

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONES A & B (CONSTRUCTION PHASE)

CHARACTER ZONE	A Lai Chi Kok	B Mei Foo Sun Chuen
VISUAL QUALITY ZONE	A1 Lai Chi Kok	B1 Mei Foo Sun Chuen
Chainage	1000 - 1250	1250 - 1450
PROJECT CHARACTERISTICS		
Works Area		
Road at Grade/Road Construction		
Road Resurfacing	Yes	Yes
Foundation Works/Bridge & Flyover Construction		
Cut Slope (New)		
Extension of Existing Cut Slope		
Fill Slope		
Retaining Wall Construction		
Noise Barrier Construction		
Vegetation Removal		
Planting Operations		
Modification	Low	Low
ASSESSMENT OF WORKS	Low	Low
VISUAL IMPACT	LOW	LOW

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONE C (OPERATION PHASE)

CHARACTER ZONE	C Butterfly Valley	
VISUAL QUALITY ZONE	C1 Lai Chi Kok Hospital	C2 Wai Man Tsuen
Chainage	1450 - 1600	1600 - 1950
VISUAL QUALITY	High	Medium
VISIBILITY	Low	Medium
VISUAL SENSITIVITY	Medium	Medium
PROJECT CHARACTERISTICS		
Major Interchange		
Road Widening at Grade	Road widening to the north but within existing alignment to the south	To the south at Chainage 1650
Bridge/Viaduct		Two sections of elevated road to the south, projected out over slopes above village
Cut Slope		
Soiled Nailed Slope		
Fill Slope		
Retaining Wall		One large retaining wall adjacent to Bridge B3, finish to walls to be ribbed and bush hammered
Noise Barrier		
Loss of Vegetation		Vegetation removed from slopes above Wai Man Tsuen where road is widened to the south on structure and retaining walls
Roadside Planting		Screen planting in front of retaining wall and proposed elevated structures to the south
Slope Planting (Cut)		
Slope Planting (Fill)		
Modification	Low	Medium
ASSESSMENT OF WORKS	Low	Medium
VISUAL IMPACT	LOW	MEDIUM

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONE C (CONSTRUCTION PHASE)

CHARACTER ZONE	C Butterfly Valley	
VISUAL QUALITY ZONE	C1 Lai Chi Kok Hospital	C2 Wai Man Tsuen
Chainage	1450 - 1600	1600 - 1950
PROJECT CHARACTERISTICS		
Works Area		Sections of grade road constructed above Wai Man Tsuen and supported by retaining wall.
Road at Grade/Road Construction		
Road Resurfacing	Yes	Yes
Foundation Works/Bridge & Flyover Construction		Two sections of elevated road above slopes of Wai Man Tsuen
Cut Slope (New)		
Extension of Existing Cut Slope		
Fill Slope		
Retaining Wall Construction		One retaining wall adjacent to Bridge B3 (RW2)
Noise Barrier Construction		
Vegetation Removal		Vegetation removed from slopes above Wai Main Tsuen to accommodate road widening to the south
Planting Operations	Roadside planting	Screening planting on slopes above Wai Man Tsuen
Modification	Low	Low
ASSESSMENT OF WORKS	Low	Medium
VISUAL IMPACT	LOW	MEDIUM

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONES D & E (OPERATION PHASE)

CHARACTER ZONE	D Cheung Sha Wan	E Cemetary
VISUAL QUALITY ZONE	D1 Cheung Sha Wan	E1 Cemetary
Chainage	1950 - 2500	2150 - 2500
VISUAL QUALITY	Low	Medium
VISIBILITY	Medium	Medium
VISUAL SENSITIVITY	Low	Medium
PROJECT CHARACTERISTICS		
Major Interchange		
Road Widening at Grade	Road widening to the south at grade for three small sections of road.	Road widening to the south but within existing alignment to the north.
Bridge/Viaduct	Bridge B5 and B6 constructed over slopes to the south.	
Cut Slope		
Soiled Nailed Slope		
Fill Slope	Fill slope above retaining wall RW8 existing chunam to be removed and fill slope planted.	
Retaining Wall	Small retaining wall below fill slope at Chainage 2000 (RW3).	
Noise Barrier		
Loss of Vegetation	Vegetation removed from slopes above godowns between Chainage 1950 and 2050 where the road will be widened to the south, also from a small area below Bridge B5.	
Roadside Planting	Amenity planting, standard street trees to be planted adjacent to road.	
Slope Planting (Cut)		
Slope Planting (Fill)	Above retaining wall RW8.	
Modification	Medium	Low
ASSESSMENT OF WORKS	Low	Low
VISUAL IMPACT	LOW	LOW

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONES D & E (CONSTRUCTION PHASE)

CHARACTER ZONE	D Cheung Sha Wan	E Cemetary
VISUAL QUALITY ZONE	D1 Cheung Sha Wan	E1 Cemetary
Chainage	1950 - 2500	2150 - 2500
PROJECT CHARACTERISTICS		
Works Area		
Road at Grade/Road Construction	Between Bridge B4 & B5 and Bridge B5 & B6.	
Road Resurfacing	Yes	Yes
Foundation Works/Bridge & Flyover Construction	Bridge B5 and Bridge B6.	
Cut Slope (New)		
Extension of Existing Cut Slope		
Fill Slope	Above retaining wall RW3.	
Retaining Wall Construction	Retaining wall RW3.	
Noise Barrier Construction		
Vegetation Removal	Adjacent to existing alignment where road will be widened to the south.	
Planting Operations	Roadside and fill slope planting.	
Modification	Medium	Low
ASSESSMENT OF WORKS	Medium	Low
VISUAL IMPACT	LOW	LOW

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONE F (OPERATION PHASE)

CHARACTER ZONE	F Kowloon Foothills	
VISUAL QUALITY ZONE	F1 Butterfly Valley/Kowloon Foothills	F2 Temple
Chainage	1100 - 2150	2500 - 3250
VISUAL QUALITY	High	High
VISIBILITY	Medium	High
VISUAL SENSITIVITY	High	High
PROJECT CHARACTERISTICS		
Major Interchange		
Road Widening at Grade	Realignment of slip roads at Castle Peak Road Interchange.	Road widening to the south, new alignment remains within the existing road boundary to the north.
Bridge/Viaduct	Proposed bridge structure B1 built adjacent to existing structure at Castle Peak Road, finish to be applied to existing columns and structure to match proposed bridge structure.	
Cut Slope		
Soiled Nailed Slope		
Fill Slope		
Retaining Wall	Retaining wall RW1, north of Ramp A1.	
Noise Barrier		
Loss of Vegetation		
Roadside Planting		Roadside planting predominantly in pits cut back into the base of existing slopes adjacent to the road.
Slope Planting (Cut)		
Slope Planting (Fill)		
Modification	Low	Low
ASSESSMENT OF WORKS	Low	Low
VISUAL IMPACT	MEDIUM	MEDIUM

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONE F (CONSTRUCTION PHASE)

CHARACTER ZONE	F Kowloon Foothills	
VISUAL QUALITY ZONE	F1 Butterfly Valley/Kowloon Foothills	F2 Temple
Chainage	1100 - 2150	2500 - 3250
PROJECT CHARACTERISTICS		
Works Area		
Road at Grade/Road Construction	Realignment of slip roads at Castle Peak Road Interchange.	
Road Resurfacing	Yes	Yes
Foundation Works/Bridge & Flyover Construction	Bridge B1	Bridge B1.
Cut Slope (New)		
Extension of Existing Cut Slope		
Fill Slope		
Retaining Wall Construction	Retaining wall RW1 north of Ramp A1.	
Noise Barrier Construction		
Vegetation Removal		
Planting Operations	Roadside planting.	Roadside planting of standard street trees.
Modification	Low	Low
ASSESSMENT OF WORKS	Low	Low
VISUAL IMPACT	MEDIUM	MEDIUM

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONE F (OPERATION PHASE)

CHARACTER ZONE	F Kowloon Foothills	
VISUAL QUALITY ZONE	F3 Kowloon Foothills/Crows Nest	F4 Lion Rock/Kowloon Foothills
Chainage	3250 - 4200	5500 - 6140
VISUAL QUALITY	High	High
VISIBILITY	High	High
VISUAL SENSITIVITY	High	High
PROJECT CHARACTERISTICS		
Major Interchange		
Road Widening at Grade	Road widening to the north between Chainage 3300 and 4200.	Road widening to the north between Chainage 5500 and 6100.
Bridge/Viaduct	New bridge structure over short section of tunneled road at Chainage 3600, Bridge B9.	
Cut Slope	Three existing cut slopes extended between Chainage 3600 and 4000, existing chunam removed and slopes hydroseeded and planted.	Proposed cut slopes and an extension of existing cut slopes to the north, slopes to be hydroseed and planted. Chunam will be removed from existing slopes which will be extended.
Soiled Nailed Slope		
Fill Slope		
Retaining Wall		
Noise Barrier		
Loss of Vegetation	Vegetation removed from road edge (north) and above existing cut slopes where they will be extended.	Vegetation removed from road edge (north), proposed cut slopes and above existing cut slopes that will be extended.
Roadside Planting	At roadside edge (north).	Street trees in pits at base of cut slopes.
Slope Planting (Cut)	Hydroseeding and planting of existing chunamed slopes which will be extended.	Hydroseeding and woodland mixing planting.
Slope Planting (Fill)		
Modification	High	High
ASSESSMENT OF WORKS	Improved	Improved
VISUAL IMPACT	LOW	LOW

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONE F (CONSTRUCTION PHASE)

CHARACTER ZONE	F Kowloon Foothills	
VISUAL QUALITY ZONE	F3 Kowloon Foothills/Crows Nest	F4 Lion Rock/Kowloon Foothills
Chainage	3250 - 4200	5500 - 6140
PROJECT CHARACTERISTICS		
Works Area		
Road at Grade/Road Construction	Road widening to the north.	Road widening to the north.
Road Resurfacing	Yes	Yes
Foundation Works/Bridge & Flyover Construction	Bridge B9 at Chainage 3600.	
Cut Slope (New)		Proposed cut slopes between Chainage 5500 - 5580.
Extension of Existing Cut Slope	Three slopes between Chainage 3600 and 4000, existing slopes will double in their extent.	Three existing cut slopes will be extended, two of these slopes will be very large.
Fill Slope		
Retaining Wall Construction		
Noise Barrier Construction		
Vegetation Removal	Vegetation removed from road edge (north) and where existing slopes will be extended.	Vegetation removed from road edge (north) and cut slopes.
Planting Operations	Street tree planting at road edge and slope hydroseeding and planting.	Street tree planting at base of slopes and slope planting (hydroseeding and woodland mix planting).
Modification	High	High
ASSESSMENT OF WORKS	High	High
VISUAL IMPACT	HIGH	HIGH

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONES G & H (OPERATION PHASE)

CHARACTER ZONE	G Caritas Hospital	H So Uk & Lei Cheng Uk
VISUAL QUALITY ZONE	G1 Caritas	H1 So Uk & Lei Cheng Uk
Chainage	2500 - 3100	3100 - 3600
VISUAL QUALITY	Medium	Low
VISIBILITY	Medium	High
VISUAL SENSITIVITY	Medium	Medium
PROJECT CHARACTERISTICS		
Major Interchange		
Road Widening at Grade	Road widening to the south on fill or retaining wall.	Short section widened at grade to the south at Chainage 3500.
Bridge/Viaduct	Bridge B7 between Chainage 2560 and 2890 to accommodate road widening to the south.	Long structure spanning over slope from Chainage 3100 to 3450, Bridge B8.
Cut Slope	Small cut slope at Chainage 2900.	
Soiled Nailed Slope		
Fill Slope	Fill slope between Bridge B7 and B8, slope to be planted.	
Retaining Wall	Retaining walls at bridge abutments, finish to be ribbed and bush hammered.	Walls at bridge abutments, finish to be ribbed and bush hammered.
Noise Barrier	Noise barrier 2m high between Chainage 2550-2650 and 2820-2980.	
Loss of Vegetation	Vegetation removed between Chainage 2900 and 3030 where road will be widened to the south.	Small amount of vegetation removed at road edge above Carnation House, So Uk Estate.
Roadside Planting	Amenity planting adjacent to road between Chainage 2800 and 3000.	Screen planting in front of Bridge B8 on slopes above So Uk Estate.
Slope Planting (Cut)	Woodland planting on small cut slope at Chainage 2900.	
Slope Planting (Fill)	Woodland planting on fill slope between Bridge B7 and B8.	
Modification	Medium	Medium
ASSESSMENT OF WORKS	Medium	Medium
VISUAL IMPACT	MEDIUM	MEDIUM

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONES G & H (CONSTRUCTION PHASE)

CHARACTER ZONE	G Caritas Hospital	H So Uk & Lei Cheng Uk
VISUAL QUALITY ZONE	G1 Caritas	H1 So Uk & Lei Cheng Uk
Chainage	2500 - 3100	3100 - 3600
PROJECT CHARACTERISTICS		
Works Area		
Road at Grade/Road Construction	Road widening on fill slope and retaining wall.	At Chainage 3500.
Road Resurfacing	Yes	Yes
Foundation Works/Bridge & Flyover Construction	Bridge B7.	Elevated structure over slopes above So Uk Estate to accommodate road widening to the south.
Cut Slope (New)	Small cut slope at Chainage 2900.	
Extension of Existing Cut Slope		
Fill Slope	Small slope between Bridge B7 and B8.	
Retaining Wall Construction	At bridge abutments.	At bridge abutments.
Noise Barrier Construction	Barrier on structure and at edge of road on fill between Chainage 2550-2650 and 2820-2980.	2m high noise barrier.
Vegetation Removal	Vegetation removed from fill slope area, slope will be planted.	Vegetation removed from road edge (south) between Chainage 3300 and 3400.
Planting Operations	Slope planting and roadside planting between Chainage 2800 and 3000.	Screen planting on slope in front of Bridge B8, chunam to be removed from planted area.
Modification	Medium	Medium
ASSESSMENT OF WORKS	Medium	High
VISUAL IMPACT	MEDIUM	HIGH

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONES I & J (OPERATION PHASE)

CHARACTER ZONE	I Tai Po Road	J Tai Woh Ping
VISUAL QUALITY ZONE	I1 Tai Po Road	J1 Tai Woh Ping
Chainage	3600 - 4040	4040 - 4850
VISUAL QUALITY	High	Medium
VISIBILITY	High	High
VISUAL SENSITIVITY	High	High
PROJECT CHARACTERISTICS		
Major Interchange	Off line link elevated slip roads directly north of the Li Cheng Uk Public Swimming Pool.	
Road Widening at Grade	At grade road widening north of the mainline and along the existing Tai Po Road for the off line link.	At the Nam Cheong Street Interchange and new slip roads for the off line link which cut through the Tai Woh Ping Temporary Housing Area.
Bridge/Viaduct	Off line link elevated slip roads between Chainage 3800 and 4040.	Long elevated section of road for the off line link between Chainage 4180 - 4620.
Cut Slope	To accommodate at grade widening for off line link and widening of the mainline to the north.	Small cut slopes to accommodate slip road from Lung Ping Road to Lung Cheung Road.
Soiled Nailed Slope	Small nailed slope at off line link interchange.	North of mainline between Chainage 4700 and 4800.
Fill Slope	Fill slope beneath section of road at off line link interchange.	Small fill slope to the south of the widened mainline.
Retaining Wall	At bridge abutments and south of the mainline and off line link between Chainage 3600 and 3750 (RW5 and RW6).	At bridge abutments.
Noise Barrier		3m noise barrier on mainline north of Chak On Estate and 2m barrier on off line link south of Chak On Estate.
Loss of Vegetation	Vegetation removed from above existing slopes that will be further cut back and from some areas where roads will be widened at grade.	Vegetation removed for at grade slip road from Lung Ping Road.
Roadside Planting	At base of cut slopes and beside at grade roads.	Adjacent to at grade roads and where existing access to Lung Ping Road will be closed.
Slope Planting (Cut)	Chunam will be removed from existing slopes that will be extended, slopes will be planted. Proposed cut slopes will also be planted.	
Slope Planting (Fill)	At road edge where fill slope is beneath section of road for the off line link.	
Modification	High	High
ASSESSMENT OF WORKS	High	High
VISUAL IMPACT	HIGH	HIGH

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONES I & J (CONSTRUCTION PHASE)

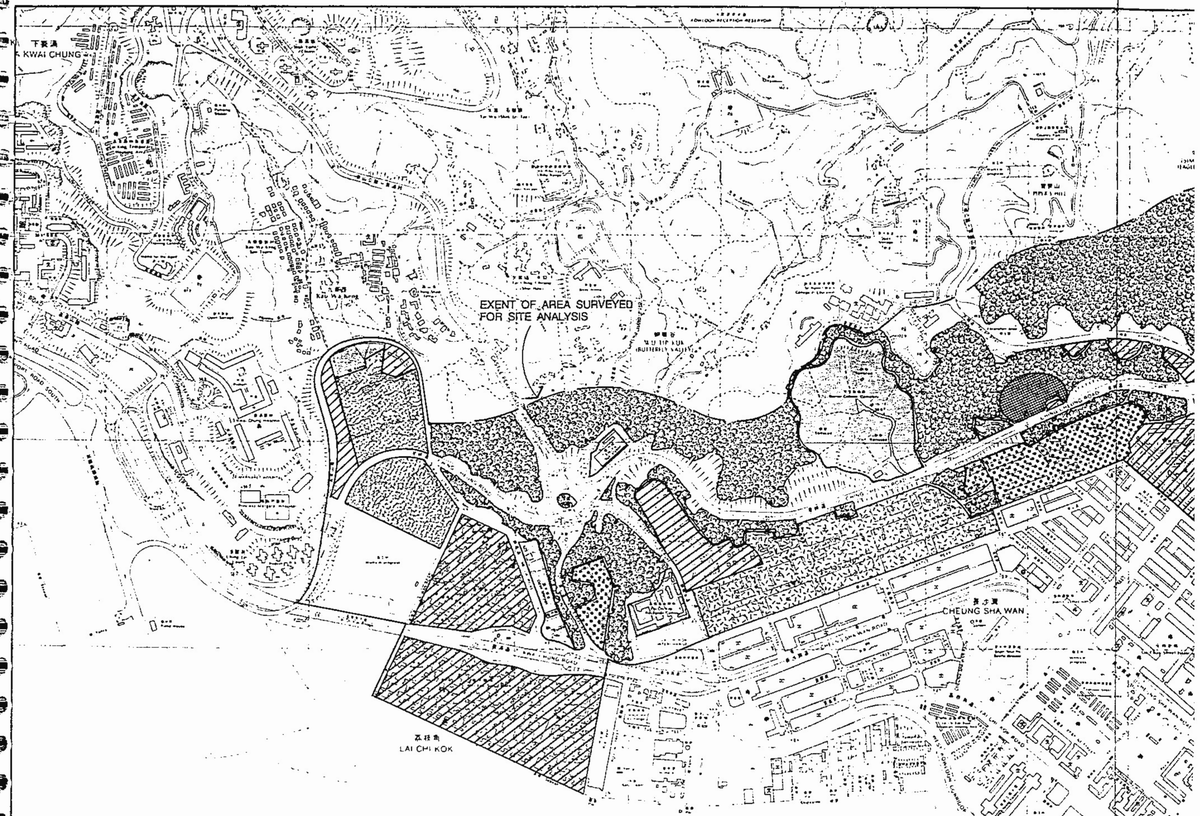
CHARACTER ZONE	I Tai Po Road	J Tai Woh Ping
VISUAL QUALITY ZONE	I1 Tai Po Road	J1 Tai Woh Ping
Chainage	3600 - 4040	4040 - 4850
PROJECT CHARACTERISTICS		
Works Area		Tai Woh Ping Temporary Housing Area for Section B.
Road at Grade/Road Construction	Road widening at grade north of the mainline and along Tai Po Road for the off line link.	Small sections for the mainline and off line link.
Road Resurfacing	Yes	Yes
Foundation Works/Bridge & Flyover Construction	Large elevated slip roads for the off line link.	Long elevated section of off line link between Chainage 4180 and 4620.
Cut Slope (New)	Cut slopes to accommodate proposed slip road for the off line link at Chainage 4000.	Small slopes at junction of Lung Ping Road and the Lung Cheung Road off line link.
Extension of Existing Cut Slope	Three large cut slopes north of the minaline between Chainage 3600 and 3900 will be further cut back.	Small area cut back further at junction of new slip road and Lung Cheung Road.
Fill Slope	Fill slope supporting slip roads for the off line link at Chainage 3900.	Small fill slope south of the westbound slip road from Lung Cheung Road to Tai Po Road.
Retaining Wall Construction	At bridge abutments and south of the off line link between Chainage 3600 and 3750.	At bridge abutments.
Noise Barrier Construction		Noise barrier to the north of Chak On Estate on mainline and to the south on off line link.
Vegetation Removal	Vegetation removed from cut slopes and where at grade roads will be constructed for the off line link.	From small areas where road will be widened at grade.
Planting Operations	Planting on cut slopes and beside at grade roads.	Roadside and slope planting.
Modification	High	High
ASSESSMENT OF WORKS	High	High
VISUAL IMPACT	HIGH	HIGH

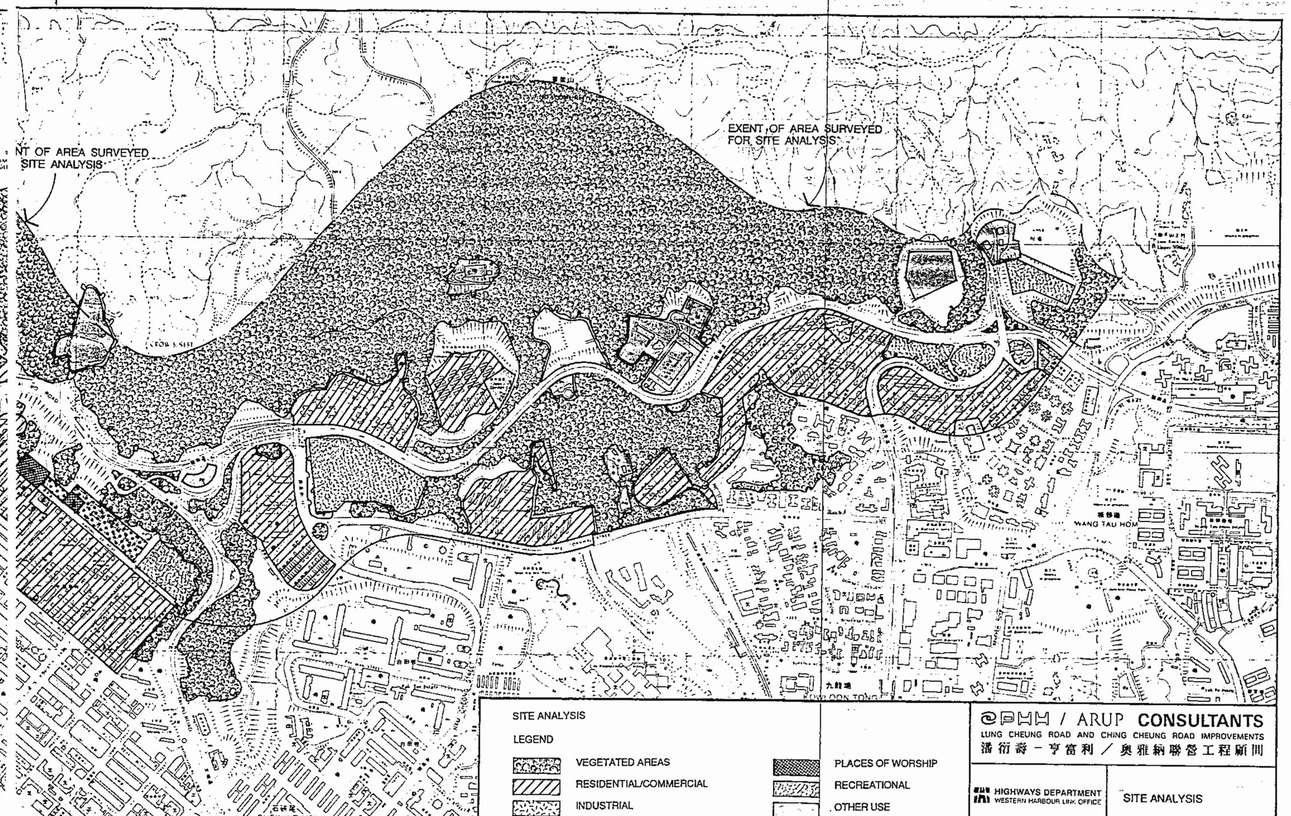
TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONES K & L (OPERATION PHASE)

CHARACTER ZONE	K Lookout	L Beacon Hill
VISUAL QUALITY ZONE	K1 Lookout	L1 Beacon Hill
Chainage	4850 - 5500	5300 - 6140
VISUAL QUALITY	High	Medium
VISIBILITY	High	Medium
VISUAL SENSITIVITY	High	Medium
PROJECT CHARACTERISTICS		
Major Interchange		
Road Widening at Grade	Road widening to the north between Chainage 4850-5050 and 5450-5500 and widening to the south between Chainage 4950-5050.	Road widening to the south between Chainage 5300-5520 and to the north between Chainage 5450-6100.
Bridge/Viaduct		
Cut Slope	Cut slopes north of the mainline between Chainage 4780-5000.	New and extended cut slopes to the north (Area F4).
Soiled Nailed Slope	Small section of soil nailed slope between Chainage 5400-5500.	
Fill Slope	Two fill slopes east of the lookout.	
Retaining Wall	Retaining walls below fill slopes to reduce their extent (RW7, 8 and 9).	Large retaining wall, 18-20 metres high south of the road behind residential buildings on Beacon Hill Road (RW10).
Noise Barrier		3m noise barrier above retaining wall adjacent to buildings on Beacon Hill Road.
Loss of Vegetation	Vegetation removed from area where fill slopes will be formed to accommodate realigned access to Lung Cheung Road Lookout.	Loss of vegetation from cut slopes to the north (Area F4).
Roadside Planting		Adjacent to at grade roads.
Slope Planting (Cut)	Hydroseeding and planting on cut slope opposite Lookout.	On cut slopes to the north (Area 4).
Slope Planting (Fill)	Replanting on slopes south east of Lookout.	
Modification	High	Low
ASSESSMENT OF WORKS	Medium/Improved	Medium
VISUAL IMPACT	MEDIUM	MEDIUM

TABLE 5.2 VISUAL IMPACT ASSESSMENT - CHARACTER ZONES K & L (CONSTRUCTION PHASE)

CHARACTER ZONE	K Lookout	L Beacon Hill
VISUAL QUALITY ZONE	K1 Lookout	L1 Beacon Hill
Chainage	4850 - 5500	5300 - 6140
PROJECT CHARACTERISTICS		
Works Area		
Road at Grade/Road Construction	At grade construction supported by fill slopes and retaining walls.	At grade road construction supported by retaining wall.
Road Resurfacing	Yes	Yes
Foundation Works/Bridge & Flyover Construction		
Cut Slope (New)		
Extension of Existing Cut Slope	Slope opposite lookout extended.	
Fill Slope	Fill slopes formed east of lookout to accommodate proposed access road for lookout.	
Retaining Wall Construction	Retaining walls, constructed to reduce extent of fill slopes.	Large wall between Chainage 5320-5520, RW10.
Noise Barrier Construction		3m noise barrier between Chainage 5260-5900.
Vegetation Removal	Vegetation removed from area east of lookout where fill slopes will be formed.	
Planting Operations	Roadside and slope planting.	Roadside planting adjacent to at grade roads.
Modification	High	Medium
ASSESSMENT OF WORKS	High	Medium
VISUAL IMPACT	HIGH	MEDIUM





SITE ANALYSIS

LEGEND

- VEGETATED AREAS
- RESIDENTIAL/COMMERCIAL
- INDUSTRIAL
- EDUCATIONAL/HOSPITALS AND CLINICS
- PLACES OF WORSHIP
- RECREATIONAL
- OTHER USE

CLOUSTON

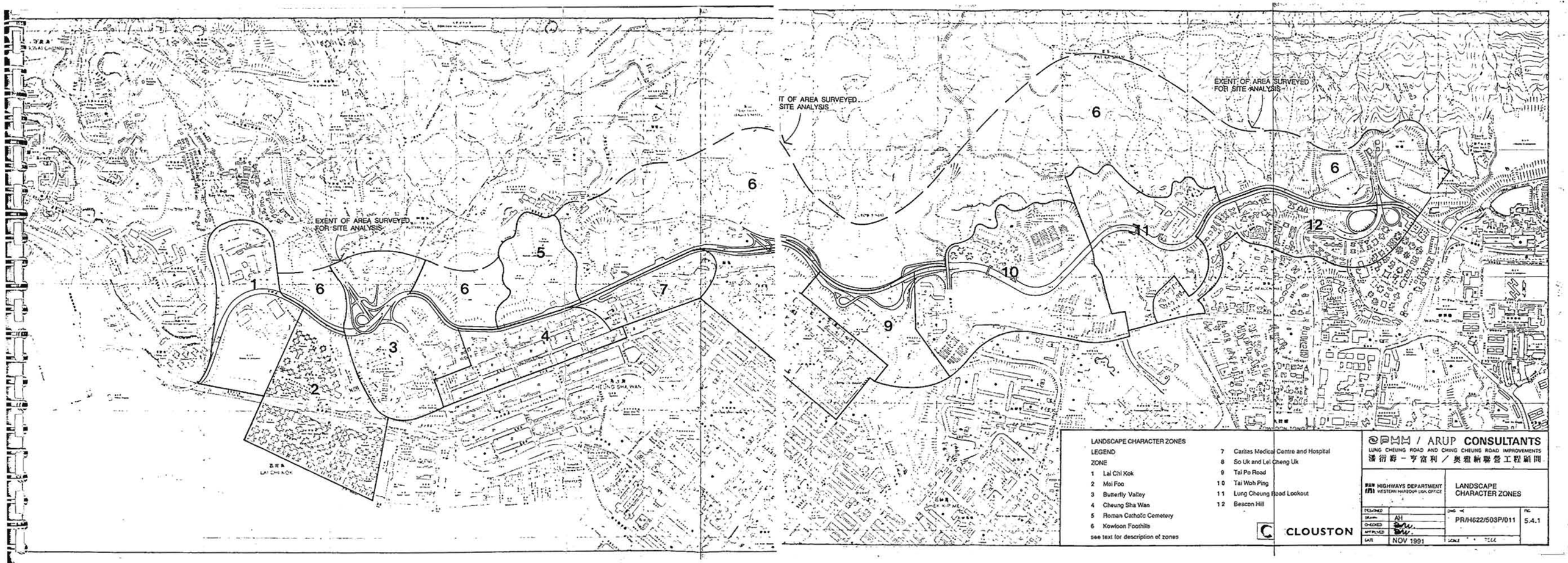
PHH / ARUP CONSULTANTS

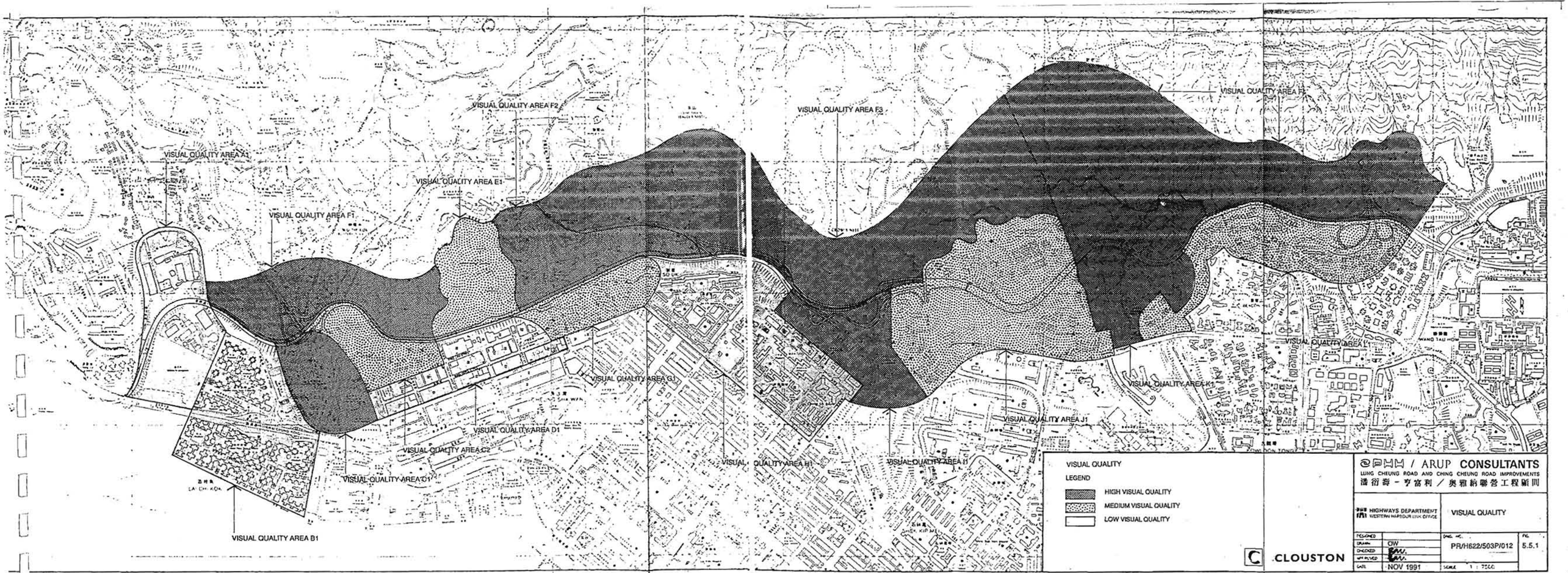
LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS
潘衍壽－亨富利／奧雅納聯營工程顧問

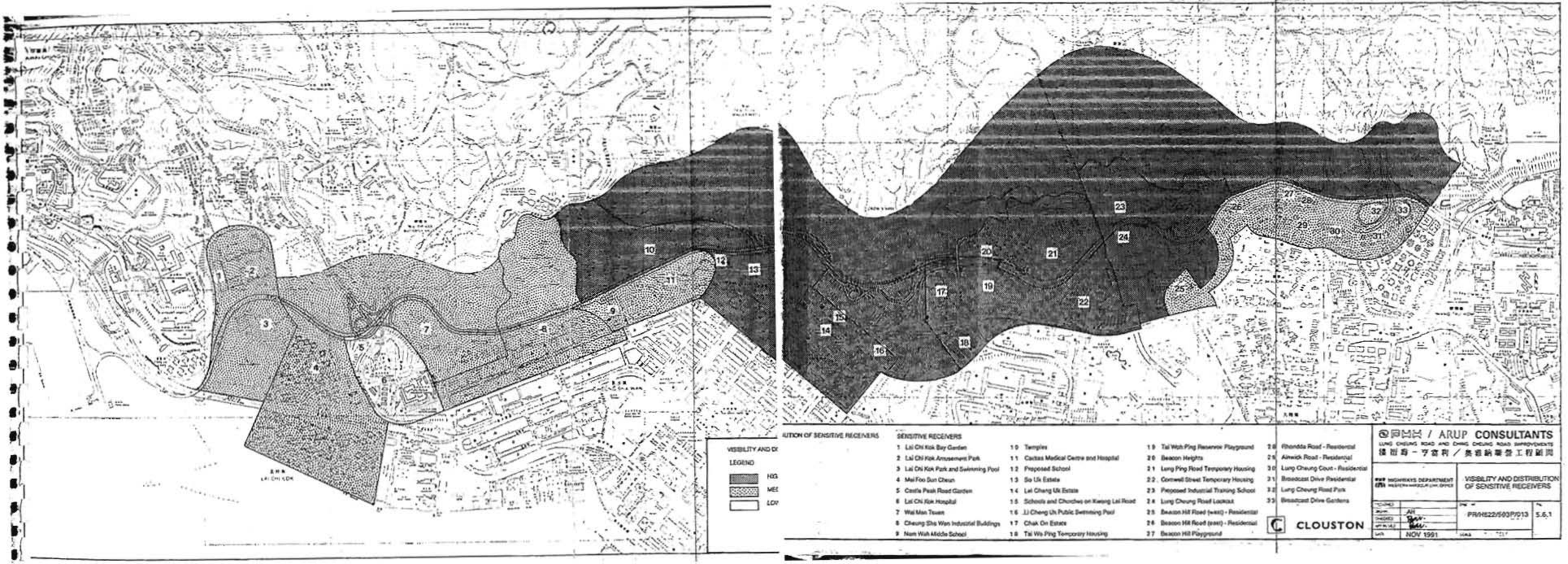
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

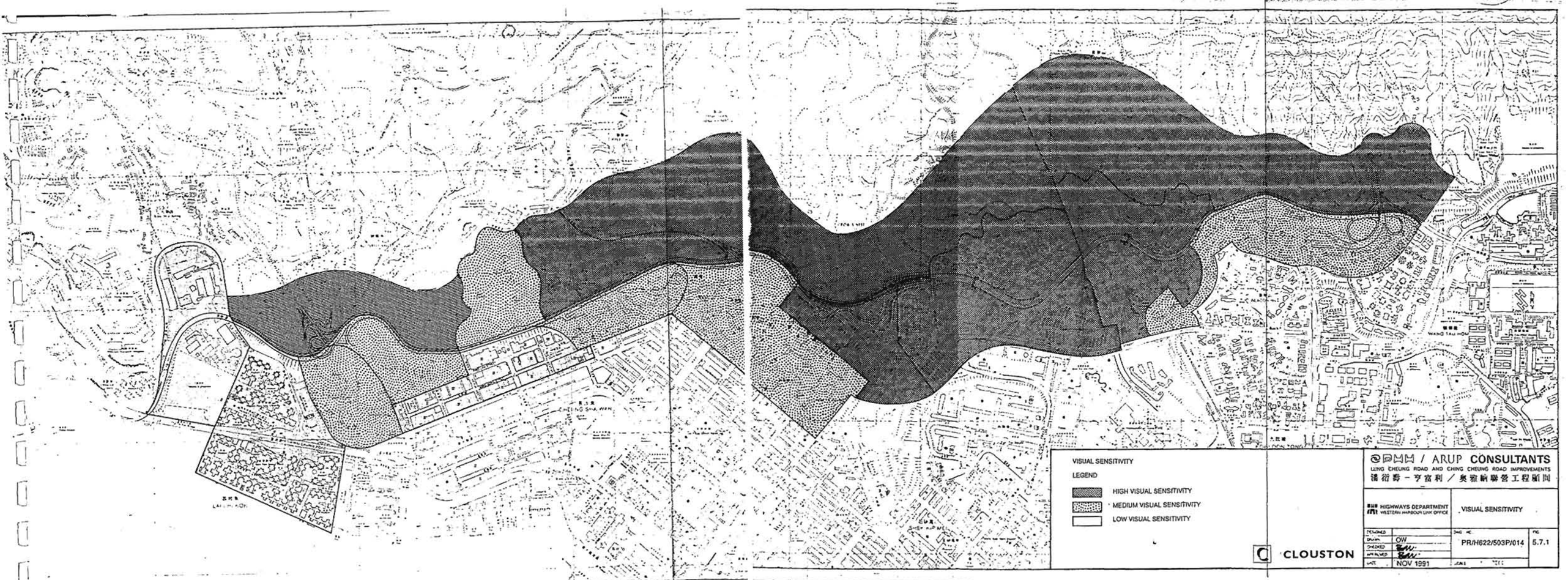
SITE ANALYSIS

		DWG. NO.	FIG.
DESIGNED		PR/H622/503P/010	5.3.1
DRAWN	OW		
CHECKED			
APPROVED			
DATE	NOV 1991	SCALE 1 : 7500	


EXENT OF AREA SURVEYED FOR SITE ANALYSIS
EXENT OF AREA SURVEYED FOR SITE ANALYSIS
1
2
3
4
5
6
6
6
6
7
9
10
11
12
LAI CHI KOK
CHEUNG SHA WAN
LANDSCAPE CHARACTER ZONES
LEGEND
ZONE
1 Lai Chi Kok
2 Mei Foo
3 Butterfly Valley
4 Cheung Sha Wan
5 Roman Catholic Cemetery
6 Kowloon Foothills
see text for description of zones
7 Caritas Medical Centre and Hospital
8 So Uk and Lei Cheng Uk
9 Tai Po Road
10 Tai Woh Ping
11 Lung Cheung Road Lookout
12 Beacon Hill
CLOUSTON
PPHH / ARUP CONSULTANTS
LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
LANDSCAPE CHARACTER ZONES
DESIGNED
DRAWN AH
CHECKED
APPROVED
DATE NOV 1991
DWG. No. PR/H622/503P/011
FIG. 5.4.1
SCALE 1 : 7500


VISUAL QUALITY AREA A1
VISUAL QUALITY AREA B1
VISUAL QUALITY AREA C1
VISUAL QUALITY AREA C2
VISUAL QUALITY AREA D1
VISUAL QUALITY AREA E1
VISUAL QUALITY AREA F1
VISUAL QUALITY AREA F2
VISUAL QUALITY AREA F3
VISUAL QUALITY AREA G1
VISUAL QUALITY AREA H1
VISUAL QUALITY AREA I1
VISUAL QUALITY AREA J1
VISUAL QUALITY AREA K1
VISUAL QUALITY AREA L1
VISUAL QUALITY AREA F3
WANG TAU HOM
LAI CHI KOK
SHEK KIP MEI
VISUAL QUALITY
LEGEND
HIGH VISUAL QUALITY
MEDIUM VISUAL QUALITY
LOW VISUAL QUALITY
CLOUSTON
PPHH / ARUP CONSULTANTS
LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS
滙衍道－亨富利／奧雅納聯營工程顧問
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
VISUAL QUALITY
DESIGNED
DRAWN OW
CHECKED
APPROVED
DATE NOV 1991
DWG. NO. PR/H622/503P/012
FIG. 5.5.1
SCALE 1 : 7500


LEGEND
SENSITIVE RECEIVERS
1 Lei Chi Kok Bay Garden
2 Lei Chi Kok Amusement Park
3 Lei Chi Kok Park and Swimming Pool
4 Mei Foo Sun Chuen
5 Castle Peak Road Garden
6 Lei Chi Kok Hospital
7 Wai Man Tsuen
8 Cheung Sha Wan Industrial Buildings
9 Nam Wah Middle School
10 Temples
11 Caritas Medical Centre and Hospital
12 Proposed School
13 So Uk Estate
14 Lei Cheng Uk Estate
15 Schools and Churches on Kwong Lei Road
16 Li Cheng Uk Public Swimming Pool
17 Chak On Estate
18 Tai Wo Ping Temporary Housing
19 Tai Wah Ping Reservoir Playground
20 Beacon Heights
21 Lung Ping Road Temporary Housing
22 Cornwall Street Temporary Housing
23 Proposed Industrial Training School
24 Lung Cheung Road Lookout
25 Beacon Hill Road (west) - Residential
26 Beacon Hill Road (east) - Residential
27 Beacon Hill Playground
28 Rhondda Road - Residential
29 Aimwick Road - Residential
30 Lung Cheung Court - Residential
31 Broadcast Drive Residential
32 Lung Cheung Road Park
33 Broadcast Drive Gardens
CLOUSTON
HMH / ARUP CONSULTANTS
LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS
HIGHWAYS DEPARTMENT
VISIBILITY AND DISTRIBUTION OF SENSITIVE RECEIVERS
PR/H522/503/P/013
5.6.1
NOV 1991


VISUAL SENSITIVITY
LEGEND
HIGH VISUAL SENSITIVITY
MEDIUM VISUAL SENSITIVITY
LOW VISUAL SENSITIVITY
CLOUSTON
PMH / ARUP CONSULTANTS
LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
VISUAL SENSITIVITY
DRAWN OW
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DATE NOV 1991
PR/H622/503P/014
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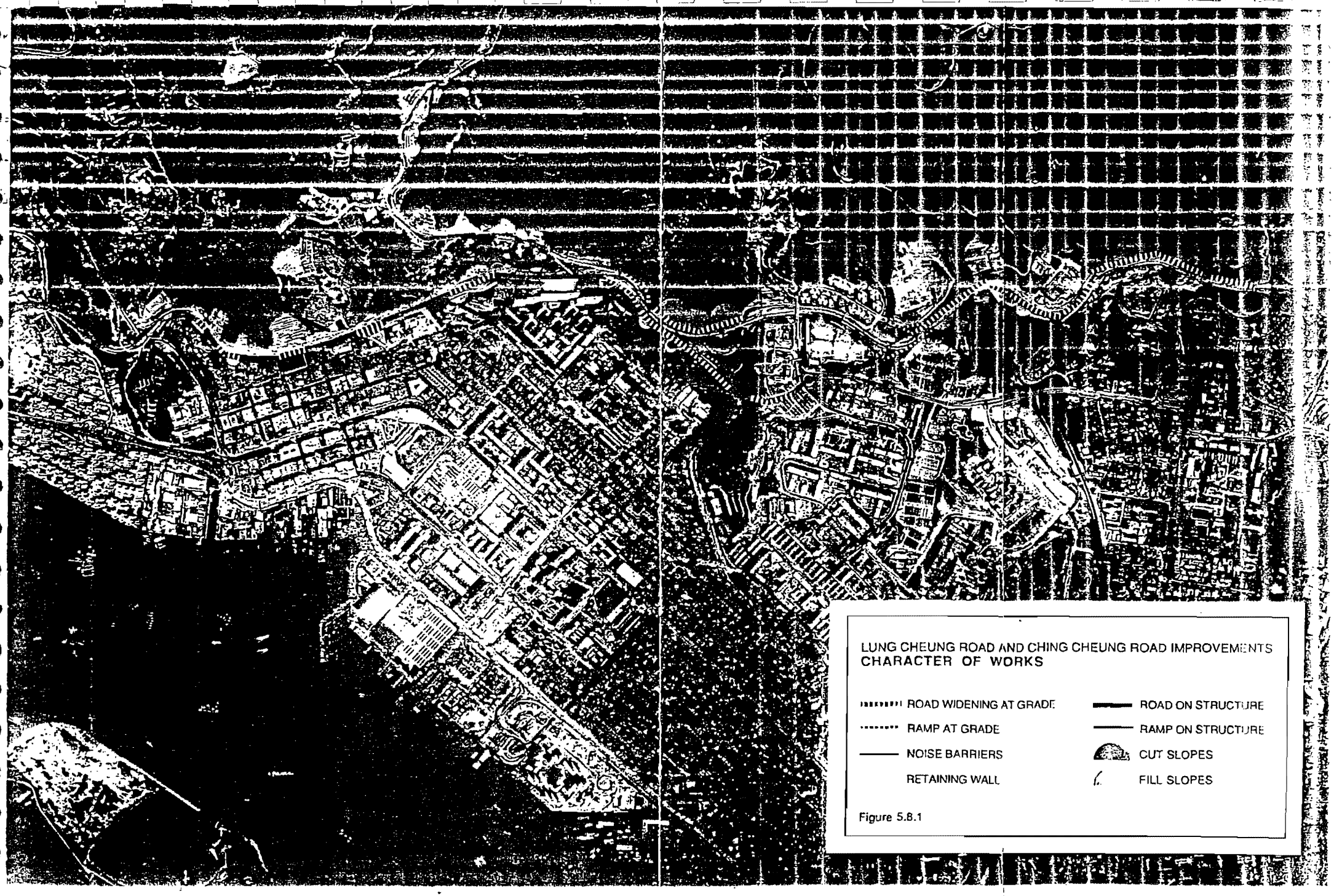
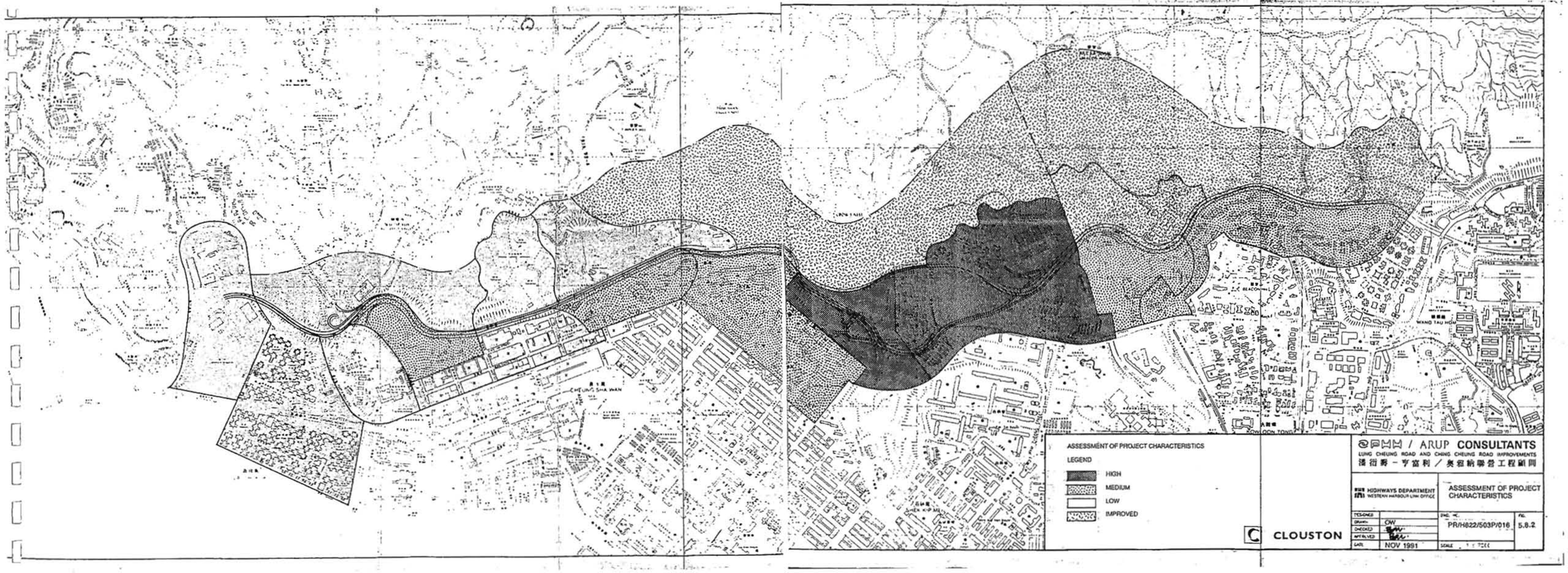

LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS
CHARACTER OF WORKS
ROAD WIDENING AT GRADE
RAMP AT GRADE
NOISE BARRIERS
RETAINING WALL
ROAD ON STRUCTURE
RAMP ON STRUCTURE
CUT SLOPES
FILL SLOPES

Figure 5.8.1


ASSESSMENT OF PROJECT CHARACTERISTICS
LEGEND
HIGH
MEDIUM
LOW
IMPROVED
CLOUSTON
EPHH / ARUP CONSULTANTS
LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
ASSESSMENT OF PROJECT CHARACTERISTICS
DESIGNED
DRAWN
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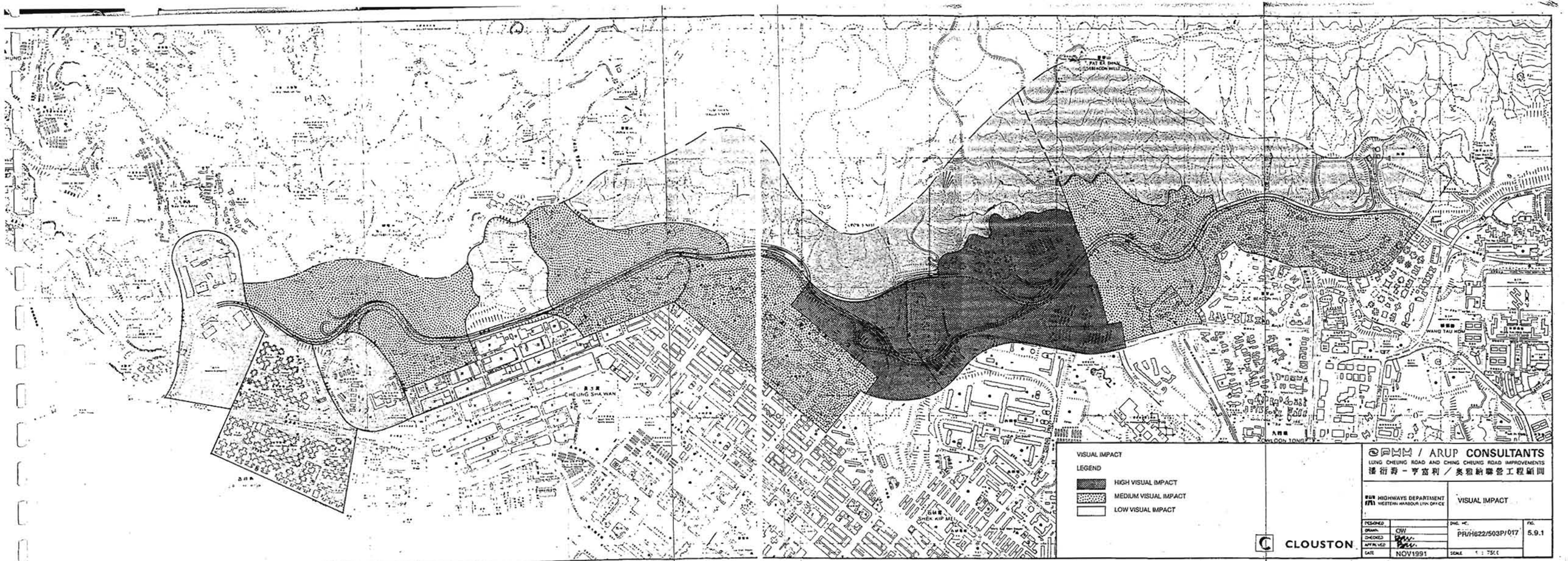
CHECKED
APPROVED
DATE
NOV 1991
DWG. No.
PR/H822/503P/016
FIG.
5.8.2
SCALE


CHEUNG SHA WAN
SHEK KIP MEI
WANG TAU HOM
KOWLOON TONG
VISUAL IMPACT
LEGEND
HIGH VISUAL IMPACT
MEDIUM VISUAL IMPACT
LOW VISUAL IMPACT
CLOUSTON
ARUP CONSULTANTS
LUNG CHEUNG ROAD AND CHING CHEUNG ROAD IMPROVEMENTS
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
VISUAL IMPACT
DESIGNED
DRAWN OW
CHECKED
APPROVED
DATE NOV1991
DWG. NO. PR/H622/503P/017
FIG. 5.9.1
SCALE 1 : 7500

CHAPTER 6

6 WATER QUALITY IMPACT

6.1 Introduction

6.1.1 This chapter describes and assesses the water quality impact during the construction and operational phases of the Road Improvement Scheme.

6.1.2 As mentioned in section 2.4, the road alignment is distant from the seafront and other water sensitive uses. The water quality impact concerns are therefore centred on discharges and surface run-off to the drainage systems.

6.2 Statutory Requirements

6.2.1 The effluent standard for discharges into storm water drains under the Technical Memoranda of Water Control Ordinance is used for the water quality assessment for both construction and operational phases. It is stated that for effluent discharged into storm water drains, the water quality standards should be as for the downstream receiving waters. Victoria Harbour, which is subject to considerable amount of pollution, is the likely receiving water for the drainage system along the Lung Cheung Road and Ching Cheung Road.

6.3 Operational Phase

Introduction

6.3.1 In general, operational impacts are less significant than construction impacts, as no major effluent will normally be discharged from an operational road. In view of the catchment boundaries and the possible sensitive water bodies along the route, it is considered that the main area of potential impact would be from storm water run-off of the improved road under normal operation. The main sources of contamination are:-

- o accumulation of sediment on the improved carriageway;
- o spillage of hydrocarbons and other contaminants resulting from normal vehicular usage of the carriageway;
- o possible spillage of hazardous materials (which may include environmentally persistent chemicals or wastes) following a road traffic accident.

Sources of Impact

6.3.2 Sediment is most likely to accumulate at the main carriageway where silt and debris from adjacent developments and hill slopes could be carried due to gravity and air turbulence created by vehicle movements.

6.3.3 Road surface run-off contains oil and petroleum as a result of drippage and spillage from motor vehicles on the road. Typical urban run-off also contains lead, zinc and cadmium that are present largely as a result of large volumes of traffic on the carriageway.

6.3.4 Large numbers of heavy goods vehicles are utilizing LCR/CCR, and it is possible that if traffic accidents occur large quantities of hazardous materials could be spilled onto the road. Such an event is difficult to predict and assess. However, the risk of spillage on this road is no greater than on any other trunk road. While a number of service reservoirs were identified below the road, no road drainage is installed near the reservoirs and the kerb would effectively contain spills to the carriageway and the road drainage network. Therefore, it is not likely that any accidental spillage would affect the water quality of the identified water sensitive uses within the vicinity of the main carriageway.

6.3.5 Although the quantities of these sources of contamination would be small, they have been considered in the drainage design and will be presented in the Final Report.

Mitigation Measures

6.3.6 In order to prevent water pollution appropriate drainage design measures should be taken, such as sediment traps and oil interceptors installed within the drainage system.

6.3.7 Impacts resulting from spillage of hazardous materials can be reduced by the installation of isolating valves at strategic points in the drainage system. Such devices would allow interim storage of effluent also carried to the system by wash down procedures. Insert absorbent materials might also be considered as an alternative to wash down procedures. In the absence of such a system, any spillage should be properly contained and recovered where possible.

Conclusion

6.3.8 As Lung Cheung Road and Ching Cheung Road Improvements are located inland, there would not be any direct effluent impacts on sea waters. Also as none of the road drainage would go near any of the identified service reservoirs, there would not be any water quality impacts to the associated water uses. With frequent inspection and maintenance of the drainage system along LCR/CCR in order to ensure that sediment traps within the system are regularly cleared, water quality impacts from road traffic are considered to be minimal and would meet the standards laid down in the Technical Memorandum.

6.4 Construction Phase

Source of Impact

6.4.1 There are a number of major sources of pollution associated with the various construction activities which could lead to contamination of run-off water. The drainage system close to the construction sites and surface run-off water have the potential to become contaminated by the following:

- o washout from ready mixed concrete deliveries;
- o soil and spoil;
- o fuel and oil spillage;
- o construction chemicals;
- o bentonite slurries;
- o site sewage; and
- o silt from dust suppression activities.

Mitigation Measures

6.4.2 Chemicals used in significant quantities on site are the lubricating oils. Widespread oil contamination on the ground can be prevented by careful handling during the application to the machinery.

6.4.3 Oil interceptors and sediment traps should be provided, and regularly emptied to prevent release of fuels, oils and grease to the drainage system after any accidental spillage on construction sites as well as to prevent blockage to the drainage due to accumulation of soil and spoil from the construction sites.

6.4.4 Sewage discharges should be properly connected to the existing foul sewage system. Given the limited worker population, sewage discharge should not add significant loading to the system. Alternatively chemical toilet facilities with appropriate disposal arrangements could be considered if necessary.

6.4.5 If bentonite is to be used on site, it should be cleaned and re-used. Interception channels should be provided to prevent discharge of bentonite into the site drainage.

Conclusion

6.4.6 As the construction sites have no sensitive water bodies in close proximity, impacts to their water quality will not be a problem. Good site management practices and adherence to normal contractor codes of practice should be sufficient to avoid any adverse effects to the nearby roadside storm drains.

CHAPTER 7

7 SOLID WASTE

7.1 Waste Disposal

7.1.1 The principal sources of potential impact are surplus soil from excavation for the cut slopes or retaining walls and other construction waste, such as wooden boards, metal scraps broken concrete etc. No solid wastes would be generated from the operation of the improved roads.

7.2 Significance of Impact

7.2.1 The amount of spoil resulting from excavation and earthworks was estimated to be 250,000m^3 whereas the volume of fill required would be 100,000m^3.

7.2.2 Since the excavation sites have no previous developments, much of the spoil should be clean and acceptable for the use of marine fill or as backfill. There is scope for much of the material to be used as fill on the Lung Cheung Road and Ching Cheung Road project. There are numerous reclamation schemes currently under way around the territory, the timing of which may coincide with that of the road improvement scheme and the remaining fill would be largely suitable for those sites.

7.2.3 The quantities of the other miscellaneous construction wastes cannot be estimated at this stage but are unlikely to be large. The wastes would include wood and metal scraps. The wood should be reused as far as possible.

Conclusions and Recommendations

7.2.4 No specific transportation and dumping measures are necessary as the wastes are unlikely to be contaminated. It will be the contractor's responsibility to identify suitable sites for disposal of construction wastes. However, it is expected that much of the topsoil and decomposed granite will be used for landscaping purposes.

7.2.5 Other construction wastes should also be recycled wherever possible. Only when recycling is not feasible on technical and/or economic grounds, should the contactor dispose the wastes of at an approved landfill site.

CHAPTER 8

8 SUMMARY

8.1 Noise Impacts

Operational Phase

8.1.1 Currently, the NSRs close to the proposed road improvements are already affected by high levels of traffic noise. The noise monitoring programme carried out by the Consultants along the mainline indicated that the L_{10} levels recorded in all cases have exceeded the HKPSG level of maximum 70dB(A) for residential areas. The purpose of the road scheme is to improve the road to have adequate capacity up to the year 2011. In the process of designing the road alignment, a number of noise reducing factors have been built in for possibly abating the future traffic noise. The factors include maximising free flow of traffic, maximising distance from NSRs where possible, minimising gradients and maximising soft ground where noise absorption could be expected to be significant. Therefore, the predicted noise impacts from the proposed scheme will not be significantly greater than the "do-nothing" option, except for NSRs which are closer to the proposed off line link. Increase in traffic noise at NSRs along the mainline are predicted in large part due to increase in traffic volume and percentage of heavy vehicles and are for the most part to be in the order of 2dB(A).

8.1.2 As most NSRs along the proposed scheme are highrise blocks, noise barriers are not effective in many cases. The proposed road scheme has nonetheless included barriers at the nearside and/or at the median strip for protecting the following sensitive receivers:-

- o Nam Wah Middle School;
- o Caritas main wards;
- o proposed school for mentally handicapped in Caritas Medical Centre;
- o Fu Chak House, Chak On Estate;
- o Wah Chak House, Chak On Estate;
- o Wing Chak House, Chak On Estate; and
- o Residential lots on Beacon Hill Road and Rhondda Road.

8.1.3 The barriers included in the scheme in front of Wah Chak House and the residential lots on Beacon Hill Road and Rhondda Road will reduce the traffic noise at the target NSRs to levels lower than HKPSG, the resulting noise levels are comparable to their existing.

8.1.4 The Draft Preliminary Report recommends the adoption of a rigid (i.e. concrete) pavement for the route on grounds of pavement life and maintenance commitment. This and the fact that the scheme proposals do not significantly worsen the noise environment has led to the conclusion that open textured wearing course should not be considered part of the scheme. Nonetheless a number of locations have been identified which might benefit, in noise terms, from the use of such materials. These are put forward for separate consideration.

Construction Phase

8.1.5 As most of the NSRs are already experience high traffic noise levels, noise impacts from construction activities, whilst important, need not be severe by comparison. With good on-site management, such as using silencer equipped plant and equipment, careful scheduling of activities, siting of the noisiest equipment or activities as far from the NSRs as practical, and with proper maintenance of plant and equipment, the noise impacts from construction activities can be minimized. 2m high temporary noise barriers in the form of noise panels are recommended to protect Caritas wards, Nam Wah Middle School and Beacon Hill residential buildings.

8.2 Air Quality Impacts

Operational Phase

8.2.1 In general, the predicted levels of 1-hour CO remain well below the air quality standard of 30 mg m^{-3}, whereas 1-hour NO_2 and the 24-hours RSP levels are likely to exceed the AQOs standard within 40m of the carriageway. Depending on the background levels of NO_2 and RSP and the geometry of the alignment, air sensitive receivers located between 40m to 70m of the carriageway may experience NO_2 and RSP levels exceeding the air quality standard.

8.2.2 Future developments should be at least more than 40m from the main carriageway in order to safeguard their air quality or be otherwise planned to accordance with HKPSG.

8.2.3 The predicted high levels of NO_2 and RSP are a result of the high average vehicle speed and the high percentage of heavy goods vehicles predicted for the improved road. With further emission control technologies and strategy (especially on HGVs), the overall air quality impacts at the sensitive receivers will be reduced and be better than the predicted levels. Long term commitment by the Government to progressively reduce vehicle emissions and the control in the growing number of vehicles (especially goods vehicles) are strongly supported, and would reduce NO_2 levels adjacent to the carriageway accordingly.

8.2.4 Compliance air quality monitoring should be carried out at the most affected sensitive receivers, such as the Caritas Medical Centre and Beacon Heights, in order to assess the extent of the air quality impacts during the operational phase and to compare with the AQOs.

Construction Phase

8.2.5 Caritas wards and Beacon Hill residential buildings are considered to be the most sensitive to construction dust. Dust emissions are the main air pollution source arising from earth moving activities during the construction phase. With proper dust suppression measures used at the construction sites, dust impacts should be reduced and should not cause any nuisance to the sensitive receivers. The dust suppression measures recommended are regular spraying of spoil and fill material, covering of stock-piles, provision of wheel washing facilities at works area exists and the provision of fence walls or dust screens where earth moving activities would be carried out in close proximity to sensitive receivers. No stockpiling of spoil should be allowed near Caritas wards and Beacon Hill residential buildings.

8.3 Visual Impact

8.3.1 The visual impact of the proposed improvements has been assessed for the construction phase and operational phase. The construction stage impacts have been found to be more severe than the operational phase impacts. This is in part due to the landscape design elements which are included as a fundamental part of the road improvement works either would not have been installed, or would not have had time to establish at the time of completion of construction.

8.3.2 The fact that there is a difference between construction phase and operational phase in terms of visual impact emphasises the significance of the landscape works to the overall scheme.

8.3.3 Those areas where combined landscape and engineering design help to ameliorate the effects of visual impact are as follows:-

- o roadside planting
- o slope planting
- o reinstatement/reprovisioning of amenity areas
- o finishes on structures and retaining walls
- o noise barrier construction

8.4 Water Quality Impacts

Operational Phase

8.4.1 The potential sources of water quality impacts would be from the accumulation of sediment, spillage of hydrocarbons or other contaminants from vehicles during normal operation and accidental spillage of hazardous materials following a road accident. As the proposed road improvement scheme is well away from the sea, there would not be any direct discharge of effluent to sea waters. Also it has been identified that none of the existing road drainage system would be close to any of the identified service reservoirs, thus no adverse water quality impacts should arise at any of the water pollution sensitive uses.

8.4.2 In order to prevent water pollution, appropriate drainage design with the installation of sediment traps and oil interceptors should be employed in the road scheme. Water quality impacts should then be minimized by frequent inspection and maintenance of the drainage system.

Construction Phase

8.4.3 No impacts to the water pollution sensitive uses are perceived during the construction phase. However, water quality impacts may arise due to contaminated runoff from the construction sites, but with good on-site management, impacts to the drainage system should be avoided.

8.5 Waste disposal

8.5.1 Spoil arising from the proposed cut slopes are not likely to be contaminated and there should not be any disposal problem. It is recommended that the spoil resulting from excavation or earthworks should be used as on-site backfill or for landscaping purposes as far as possible, the remaining should be used in the current reclamation works. Recycling of construction wastes is recommended if economically feasible. Only when all the recycling means have been investigated and found to be not possible, should the construction wastes be disposed of at approved landfill sites.

ANNEX 1.A

ANNEX 1.A

1. PURPOSE OF THE ENVIRONMENTAL ASSESSMENT

1.1 The purpose of the assessment is to provide information on the nature and extent of potential environmental impacts associated with the proposed Lung Cheung Road and Ching Cheung Road Improvements. This information will contribute to decisions on :-

(i) the conditions for the design, operation and development of the proposed project; and

(ii) the acceptability of any adverse environmental consequences that are likely to arise from the construction and operation of the new installations and related facilities.

2. OBJECTIVES OF THE ENVIRONMENTAL ASSESSMENT

2.1 The objectives of the assessment are as follows :-

(i) to describe the proposed installations and related facilities and the requirements for their development;

(ii) to identify and describe the elements of the community and environment likely to be affected by the proposed development;

(iii) to minimize pollution and nuisance arising from the development and its operation and environmental disturbance during construction and operation of the project;

(iv) to identify and evaluate the net impacts expected to arise during the construction and operation phases of the development in relation to the community and neighbouring land uses.

(v) to identify methods and measures which may be necessary to mitigate these impacts and reduce them to acceptable levels;

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

(vii) to identify any additional studies which may be necessary to fulfil the objectives or requirements of this Environmental Assessment.

3. REQUIREMENTS OF THE ENVIRONMENTAL ASSESSMENT

3.1 The Assessment shall consist of the following :-

(i) an Initial Assessment Working Paper which

(a) satisfies the requirements of objectives 2.1 (i) and 2.1 (ii);

(b) provides an initial assessment and evaluation of the environmental impacts arising from the project sufficient to identify those issues which are of key concern to the project or which are likely to influence decisions on the project;

(c) identifies any monitoring studies necessary to provide a baseline profile of existing environmental quality, particularly for those parameters likely to be affected by the project; and

(d) proposes a detailed programme of investigation able to meet all other objectives of the assessment.

(ii) an Environmental Assessment Working Paper covering those issues of key concern identified through the Initial Assessment Working Paper or the review of the Initial Assessment Working Paper by the Director of Environmental Projection (DEP);

(iii) any revisions or supplements to the above as might be required by the DEP to be carried out; and

(iv) an Executive Summary in English & Chinese of the environmental assessment highlighting the major aspects of the project, perceived issues of public concern, recommendations for implementation and the basis for these, as well as their implications. It is intended that the information contained therein should assist the Government with any requirement for public consultation.

4. TECHNICAL REQUIREMENTS OF THE ENVIRONMENTAL ASSESSMENT

The Environmental Assessment shall include, but shall not necessarily be limited to, the following:-

4.1 CONSTRUCTION PHASE ASSESSMENT

4.1.1 Noise Impact Study

Task 1 : Identification of Sensitive Receivers

From a consideration of existing and future land-use in the study area prepare schedules and plans identifying sensitive receivers. Noise sensitive receivers should include those described in the Environment Chapter of the Hong Kong Planning Standards and Guidelines (HKPSG). The future land-uses should refer to those that will be occupied by the time construction works commence.

Task 2 : Analysis of Construction Activities

From a knowledge of the likely type, sequence and duration of construction activities required for project implementation, identify those activities likely to have an impact on noise sensitive receivers.

Task 3 : Assessment of Construction Noise Levels

Identify interactions between sensitive receivers and, construction activities to determine the extent of potentially unacceptable construction noise impacts. The assessment should follow the requirements contained in all Ordinances & their Regulations for the time being in force in Hong Kong governing the control of construction noise and follow guidelines advised by DEP.

Task 4 : Proposals for Noise Control Measures

Formulate appropriate noise control measures for inclusion in contract documentation.

4.1.2 Air Pollution Study

Task 1 : Identification of Representative Sensitive Receivers

From a consideration of existing and future land use in the study area, prepare plans identifying representative sensitive receivers in the vicinity of the proposed project (including off-site works areas). The locations are to be agreed with DEP.

Task 2 : Analysis of Construction Activities

Identify those construction activities likely to cause potential dust (or other air pollutant) problems to sensitive receivers.

Task 3 : Air Pollution Impact Assessment

As far as is practical, assess the air pollution level at the sensitive receivers due to the proposed project (including constructional traffic arising) using the latest version of UNAMAP ISC Short Term Model.

Task 4 : Proposed for Air Pollution Control Measures

Recommend appropriate air pollution control measures for inclusion in contract documentation.

4.1.3 Water Quality Impact Study

Task 1 : Identification of Sensitive Receivers

From the proposed route alignments identify the watercourses/water bodies which may be affected.

Task 2 : Analysis of Construction Activities

From a knowledge of the likely type, sequences and duration of construction activities required for project implementation, identify those likely to have an impact on the affected watercourses/water bodies.

Task 3 : Assessment of Water Pollution Problems

Identify interactions between sensitive receivers and construction activities to determine the adverse effects (if any) of construction on water quality of watercourses/water bodies.

Task 4 : Proposals for Water Pollution Control Measures

Recommend appropriate control measures for inclusion in contract documentation. Where appropriate, make suggestions for practical mitigation measures and monitoring for compliance.

4.2 OPERATING PHASE ASSESSMENT

4.2.1 Traffic Noise Impact Study

Task 1 : Identification of Representative Sensitive Receivers

Identify representative noise sensitive receivers, as described in the Environment Chapter of the HKPSG, for both existing and planned uses. Locations of representative noise sensitive receivers are to be agreed with DEP.

Task 2 : Calculation of Future Noise Levels

Calculate future road traffic noise using the methods described in the U.K. Department of the Transport's publication " Calculation of Road Traffic Noise: (1988)" published by H>M> Stationery Office. Calculations are to be based on traffic projections for the design year which is defined as 10 years after the completion of the Project.

Future traffic noise is to be calculated at the nearest facade of any existing building classified as a noise sensitive receiver. For planned developments, representative points are to be selected as shown on draft Layout Plans. Noise contours in L_{10} (1 hr) should be presented on a plan of suitable scale showing the noise sensitive receivers as identified in Task 1 above. Traffic at the hour of peak traffic flow shall be used in the calculation.

Quantitative assessment at the identified NSRs for each alignment shall be compared against the criteria set out in the HKPSG. The potential noise impact of each proposed alignment on existing and planned NSRs shall be quantified by estimating the total number of dwellings and/or classrooms that will be exposed to levels above the HKPSG criteria.

Task 3 : Presentation of Existing Noise Levels

Measure existing noise levels in L_{10} (1 hr) and L_{90} (1 hr) at the identified Noise Sensitive Receivers and present them on a plan of suitable scale. This information may be required in the context of Task 5.

Task 4 : Assessment of Need for Noise Amelioration Measures

Assess the need for noise amelioration measures in relation to the extent to which an existing or planned building classified as a noise sensitive receiver would be subjected to a predicted traffic noise level in the design year which is 1 dB(A) or more in excess of the maxima recommended in the HKPSG. The appropriateness of this criteria is dependent on the results of Task 3 above and will be advised by DEP.

Task 5 : Proposals for traffic Noise Amelioration Measures

Propose traffic noise amelioration measures for each situation where the predicted traffic noise level exceeds the HKPSG maxima, or appropriate criteria as advised by DEP. In the case where an existing building is already subject to noise levels equal to, or in excess of, the recommended maximum, measures to avoid (as far as possible) deterioration of the situation are to be put forward. Proposals for the implementation of noise amelioration measures are to be framed with regard to their cost effectiveness in terms of the following parameters :-

(a) Estimated number of persons affected

(b) Effective reduction in predicted noise level

(c) Estimated construction costs

4.2.2 Air Pollution Modelling Study

Task 1 : Identification of Sensitive Receivers

Form a consideration of existing and future land-use in the study area, prepare plans identifying sensitive receivers within 50m of the proposed project.

Task 2 : Assess air pollution impact from traffic

Assess the air pollutant levels at the sensitive receptors due to the proposed project using a recommended mobile source dispersion model approved by DEP.

Pollutants considered should include carbon monoxide, nitrogen dioxide and particulates. Maximum hourly averages of the pollutants under the design year peak-hour traffic projections, and "worst-case" meteorology (neutral atmospheric stability, 2 m/s wind speed and worst impact wind direction) are to be given. Emission factors of vehicles are to be based on USEPA AP-42 (Compilation of Air Pollutant Emission Factors) pre-1975 emission data. Traffic mix is to be based on appropriate monitoring station results in the Annual Traffic Census Report by Transport Department or predictions by the consultants. The report should contain sample calculations and input parameters used in the computer modelling..

Task 3 : Proposals for Amelioration Measures

Propose cost effective amelioration measures in situations where the predicted air pollutant levels exceed the Hong Kong Air Quality Objectives.

4.2.3 Water Quality Impact Study

Task 1 : Assessment of Water Pollution Impact from Traffic & the Route Alignments

Assess the adverse effects if any of traffic & the route alignments on water quality of the watercourses/water bodies traversed by the route. This should include surface runoff and spillages due to traffic accidents.

Task 2 : Proposals for Amelioration Measures

Recommend appropriate cost effective amelioration measures to minimise any adverse effects identified in Task 1.

4.2.4 Visual and Land Use Impacts

Task 1 : Assessment of Visual Impacts

Assess the visual impacts, if any, caused by the proposed project.

Task 2 : Assessment of the Implications on Land Use

Assess the implications on land use in the vicinity of the project (including works areas), both the long and short terms implications have to be assessed.

Task 3 : Proposals for Mitigation Measures

Recommend appropriate cost effective mitigation measures such as landscaping, to minimise any adverse effects identified in Tasks 1 and 2 above.

Special attention should be paid to minimise the restraints on the development potential of the area in the vicinity of the project.

4.3 MONITORING AND POST-PROJECT AUDIT REQUIREMENTS

4.3.1 Environmental Monitoring

Define environmental monitoring requirements including any necessary programmes for baseline, impact and compliance monitoring.

4.3.2 Post-Project Audit

Formulate environmental audit requirements including any necessary compliance and post-project audit programmes to review the environmental monitoring data. Assess compliance with regulatory requirements, policies and standards and identify any remedial works required to redress unacceptable consequential or unanticipated environmental impacts.

5. PROPOSED ADMINISTRATION

5.1 The Environmental Assessment will be managed by an Environmental Working Group chaired by the Director of Environmental Protection or his representative.

5.2 In accordance with LWB TC 9/88, if there is any disagreement on the findings of the Environmental Assessment or on the necessary environmental protection and pollution control measures to be included in the design and implementation of the project. DEP will refer the issue to SPEL, who will resolve the differences in consultation with the appropriate branches and departments.

ANNEX 2.A

ANNEX 2.A

A list of the likely Sensitive Uses in regard of Air, Noise and Water were identified along the proposed specific Ching Cheung Road (CCR) and Lung Cheung Road (LCR) Improvement Scheme.

1. RESIDENTIAL AREAS

Sensitive Receiver	Height (storey)	Distance from Alignment (m)	Remarks
• Kau Wah Keng Comprehensive Development Area		fronting CCR	Reference to Kwai Chung OZP (S/KC/7), no layout plans Development includes : - private housing - open space - G/IC
• Mei Foo Sun Chuen	20	55	The road is level with (approx) the 13th floor
• Wai Man Tsuen	1	35	Recognized village; might about 10m below the road; designated for industrial in OZP (S/K5/6), but the village is unlikely to be cleared in the next 4-5 years.
• Quarters in Caritas Hospitals			
- Wai Oi	20	50	All air conditioned
- Wai Lok	8	8	Top floors not air conditioned
- Wards	8	8	Not air conditioned
• Carlton Hotel	4	50	Along the 100m contour, will be demolished in the future for a R_B development. (May be low density) under Special Control Area K5/1
• Park Mansions	4	30	Adjacent to slip road will be demolished for a R_B development (may be low density) under special Control Area K5/1
• Pine Hill	3		
• So Uk Estate	17	55	Road is level with the 12/F (approx.)
- Orchid House			
- Marigold House			
- Peony House			
- Carnation House			
• Lei Cheng Uk Estate	25	100	Close to proposed off line link

1. RESIDENTIAL AREA (Cont'd)

Sensitive Receiver	Height (storey)	Distance from Alignment (m)	Remarks
• Chak On Estate			
- Wah Chak House	13		Road is level with the 3/F
- Fu Chak House	7		Close to proposed off line link
• Tai Woh Ping Residential Development	6 - 9	70 m from LCR	Proposed as a low-medium density private residential development north of LCR. (OZP S/K4/3) Northern portion will be an urban fringe park
• Tai Woh Ping THA	2	> 400	Tenure will expire on 1993. Undetermined land use
• Beacon Heights	8 - 10	20	Close to the road
• Cornwall Street Development Area		50	Will be very close to the proposed off line link and is proposed for private residential (R_2), tertiary educational industrial/community (IC) uses (max building height - 16 storeys) in OZP (S/K4/3)
• Lung Ping Road THA	2	85	Partly sheltered by a hill side, newly built and tenure will expire on late 1993. The site is proposed (OZP S/K4/3) for private hospital development with 250 beds and quarters for staff (max 4 storeys)
• Chak Yan Centre, hostel for boys	4	Very close to new alignment	Proposed in OZP (S/K4/3) to be a welfare centre
• SKH Li Ka Shing Care and Attention Home (Proposed home for elderly)	4	c.100m	Proposed in OZP (S/K4/3)
• 43 - 67 Beacon Hill Road		25	6-15m below the alignment
- Beverley Height	12		- air conditioning
- Elizabeth Court	12		- utilities rooms facing LCR
- Lung Cheung Villa	12		
- Beacon Hill Court	11		
- 43 - 53 Beacon Hill Road	c. 3		
• Rhonda Road buildings		c. 10	c. 5 m below the alignment
- Vigta Panorama	12		
- Pearl Court	12		
• Alnwick Road buildings		100 - 190	c. 25 m below the alignment, next to Waterloo Road
- Joy Garden	7		
- Fortune Villa	6		

2. RECREATIONAL AREAS

Sensitive Receiver	Height (storey)	Distance from Alignment (m)	Remarks
• Lai Chi Kok Amusement and Sung Dynasty Village		70	Active district open space planned to be redeveloped
• Lai Chi Kok Park & Swimming Pool		27.5	Active district open space
• Lai Chi Kok Indoor Games Hall		15	Partly air-conditioned & air ventilation
• Lei Cheng Uk Swimming Pool			Close to new alignment, but at a much lower elevation
• Shek Kip Mei Reservoir Playground (a football court)		12.5	Some part is more than 10m below the road
• Beacon Hill Road Playground		7.5	
• Lion Rock Park		75 - 100	

3. EDUCATIONAL INSTITUTION

• Schools in Wai Man Tsuen			Closed down
• Nam Wah Middle School	4	55	Much lower down than the road; also sheltered by trees along the road
• Proposed school for severely mentally handicapped Caritas Lok Yan School	3	10	North of So Uk Estate, Close to LCR (under OZP S/K5/6)
• San Wui Commercial Primary School Society of HK School	5	105	Not air-conditioned; at a much lower contour than the alignment
• St. Lawrence School	4	80	same as above
• Tsung Tsin Middle School	4	40.6	same as above
• Buddhist Chi Yun School	4	105	same as above
• Kei Oi School	7	57.5	same as above
• Chak Yan Centre Day School for underprivileged boys	3-4	Very close to proposed alignment	Proposed in OZP (S/K4/3) will be a welfare centre comprises three buildings

4. HOSPITALS AND CLINICS

Sensitive Receiver	Height (storey)	Distance from Alignment (m)	Remarks
• Lai Chi Kok Hospital	2	112.5	More than 10m below the mainline; surrounded by a dense brushes and knoll to the east
• Caritas Medical Centre	6-8	50	
• Jockey Club Clinic (Cheung Sha Wan)	3	180	Much lower down than the road
• Social welfare facilities - Clinic - Family service Centre - home for the elderly	4 - 5		Clinic within the proposed Swaton Baptist Church, OZP (S/K4/3). The site is close to the proposed alignment

5. PLACES OF PUBLIC WORSHIP (NOISE SENSITIVE USES)

• St. Lawrence Catholic Church (Kwong Lee Road)		100	Within the St. Lawrence Catholic School
• Kei Oi Church (Kwong Lee Road)		65	Within the Kei Oi School
• Proposed Swatow Baptist Church		Very close to proposed alignment	Site at the junction of Nam Cheong Street and Cornwall St with social welfare facilities, OZP (S/K4/3)

WATER BODIES

- Covered service reservoir to the north of Caritas Medical Centre
- Open salt water reservoir to the west of Chak On Estate
- Covered Shek Kip Mei service reservoir below Tai Wo Ping Park
- Covered service reservoir to the north of Beacon Hill Road
- Covered Second Lion Rock High Level Service Reservoir

ANNEX 3.A

ANNEX 3.A

Ambient Noise Monitoring for Seven Selected Sites along the Proposed Lung Cheung Road/Ching Cheung Road Improvements Scheme

1. Mei Foo Sun Chuen

Location : 21/F, Block 5, Mei Foo Sun Chuen Stage 1

Noise Source : - Traffic on Mei Lai Road and Ching Cheung Road
- Aircraft noise

Remarks : Ching Cheung Road is approximately level with 15/F of the block. The monitoring station has a wide view angle to Ching Cheung Road and the results can represent the noise levels experienced by the sensitive facades of the blocks facing the road.

2. Caritas Medical Centre

Location : 11/F, Wai Oi Block (quarters for hospital staff)

Noise Source : - Traffic on Ching Cheung Road

Remarks : The results can represent the noise levels for those floors of the staff quarters above the road.

3. So Uk Estate

Location : 18/F., Poeny House, So Uk

Noise Source : - Traffic on Lung Cheung Road

Remarks : The mainline is approximately level with 15/F of the building. The monitoring station has a wide of view angle to the main line and the Tai Po Interchange. Mid floors should experience a lower noise level due to the protection of the 2m high earth berm under the bridge.

4. Chak On Estate

Location : Roof top, Fu Chak House (facing the Nam Cheong Street Roundabout)

Noise Source : - Traffic on the Nam Cheong Street Roundabout
- Aircraft
- Construction work

Remarks : The southern facade of Fu Chak House has very limited view angle to the roundabout and should experience a much lower noise level. On the other hand, the eastern facade of Fu Chak House will have a wide angle to the Nam Cheong Street traffic and the roundabout should have a higher traffic noise.

5. **Beacon Heights**

Location : Roof top, Block 7

Noise Source : - Traffic on Lung Cheung Road
- Aircraft

Remarks : The results can represent the noise levels experienced by the southern facades of Beacon Heights

6. **Residential buildings on Beacon Hill Road and Rhonda Road**

Location : Roof top, Elizabethan Court

Noise Source : - Traffic on Lung Cheung Road
- Aircraft

Remarks : The monitoring site has a limited angle of view to Lung Cheung Road. For the other residential blocks having a wider view angle should experience slightly higher levels.

7. **Lung Cheung Court**

Location : Roof top, Block 37

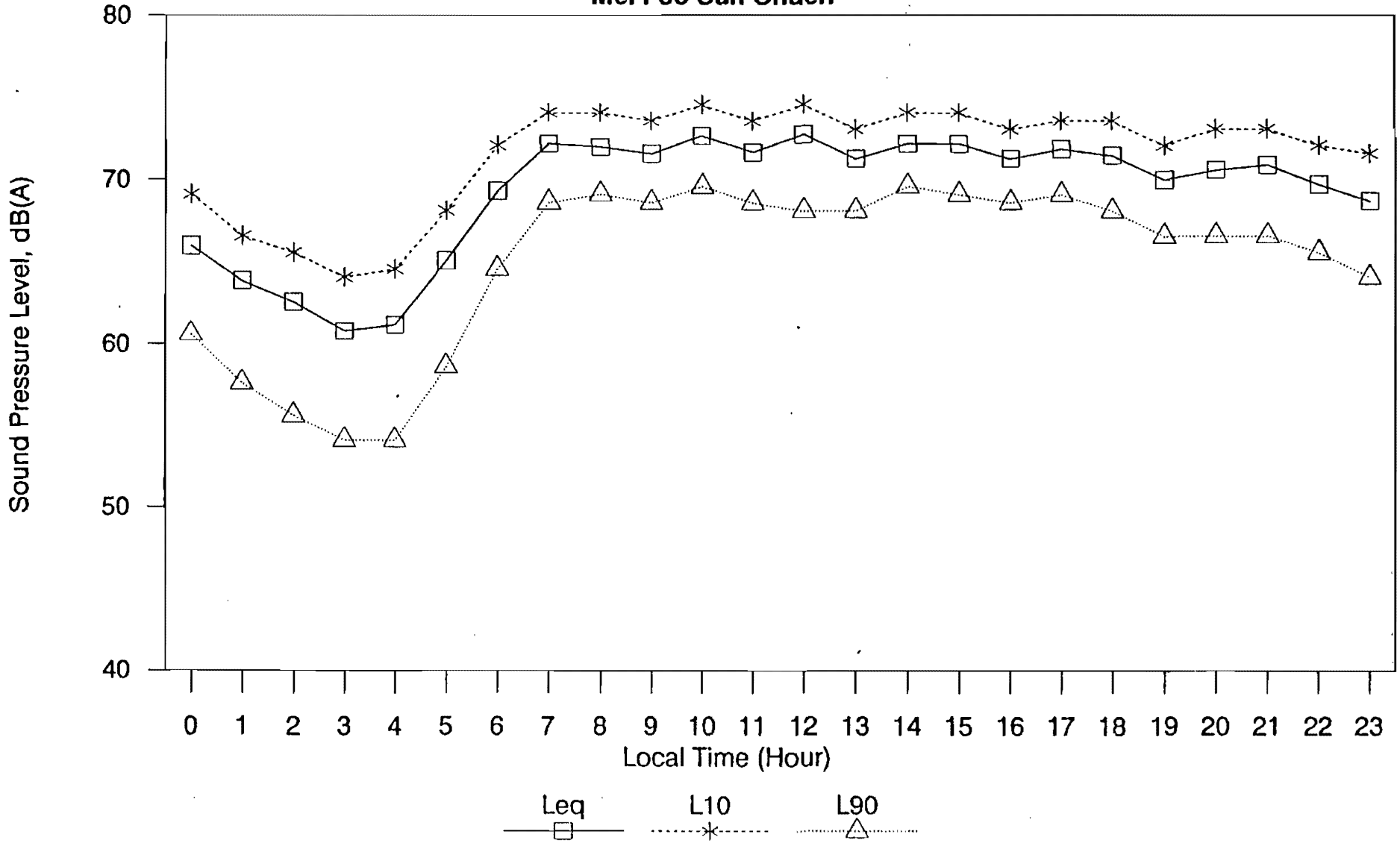
Noise Source : - Traffic on Lung Cheung Road

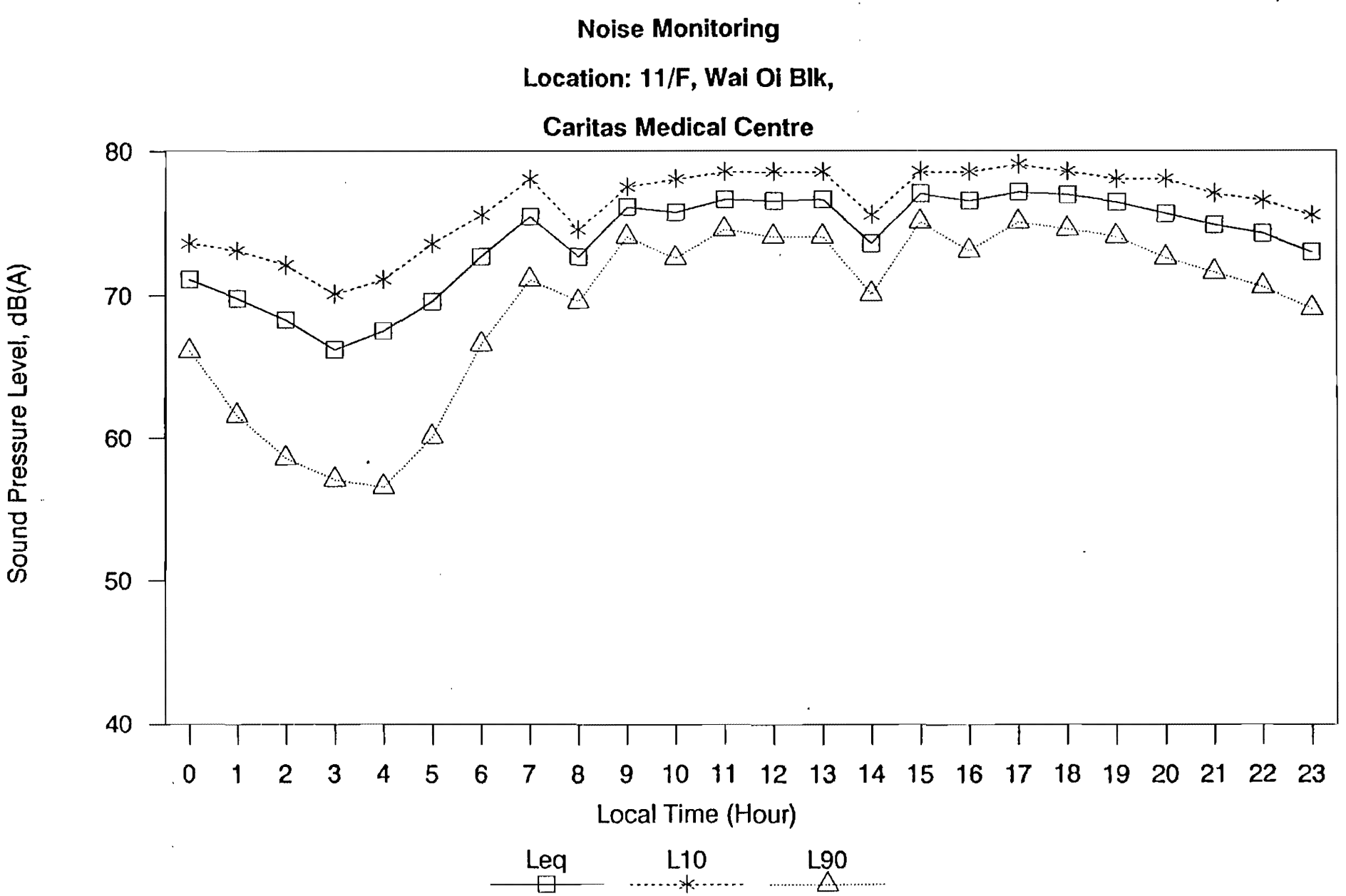
Remarks : The results can represent the noise levels experienced by the northern facade of Lung Cheung Court.

Noise Monitoring

Location: 7 Humbert Street,

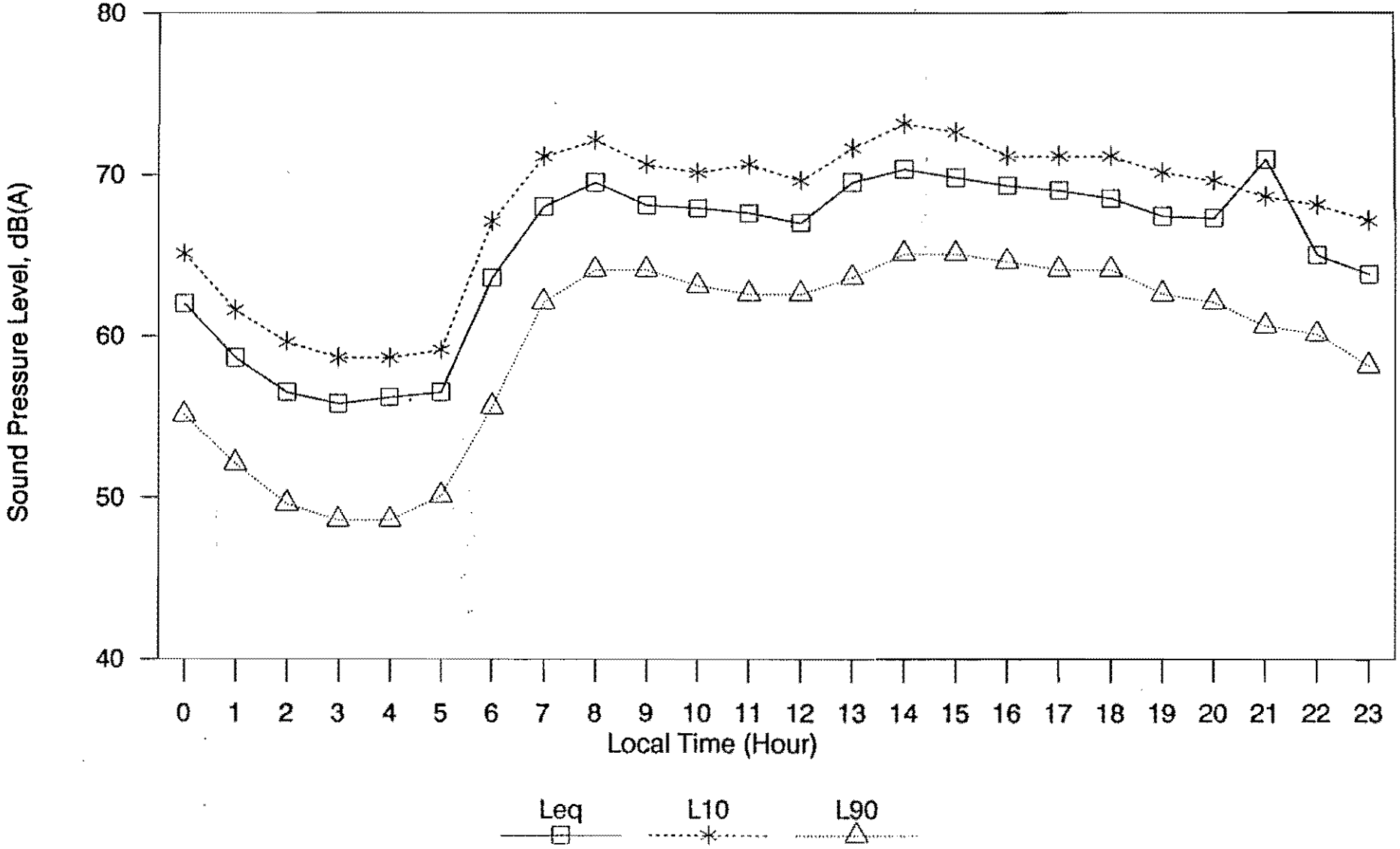
Mei Foo Sun Chuen




Noise Monitoring
Location: 11/F, Wai Oi Blk,
Caritas Medical Centre
Sound Pressure Level, dB(A)
80
70
60
50
40
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Local Time (Hour)
Leq
L10
L90

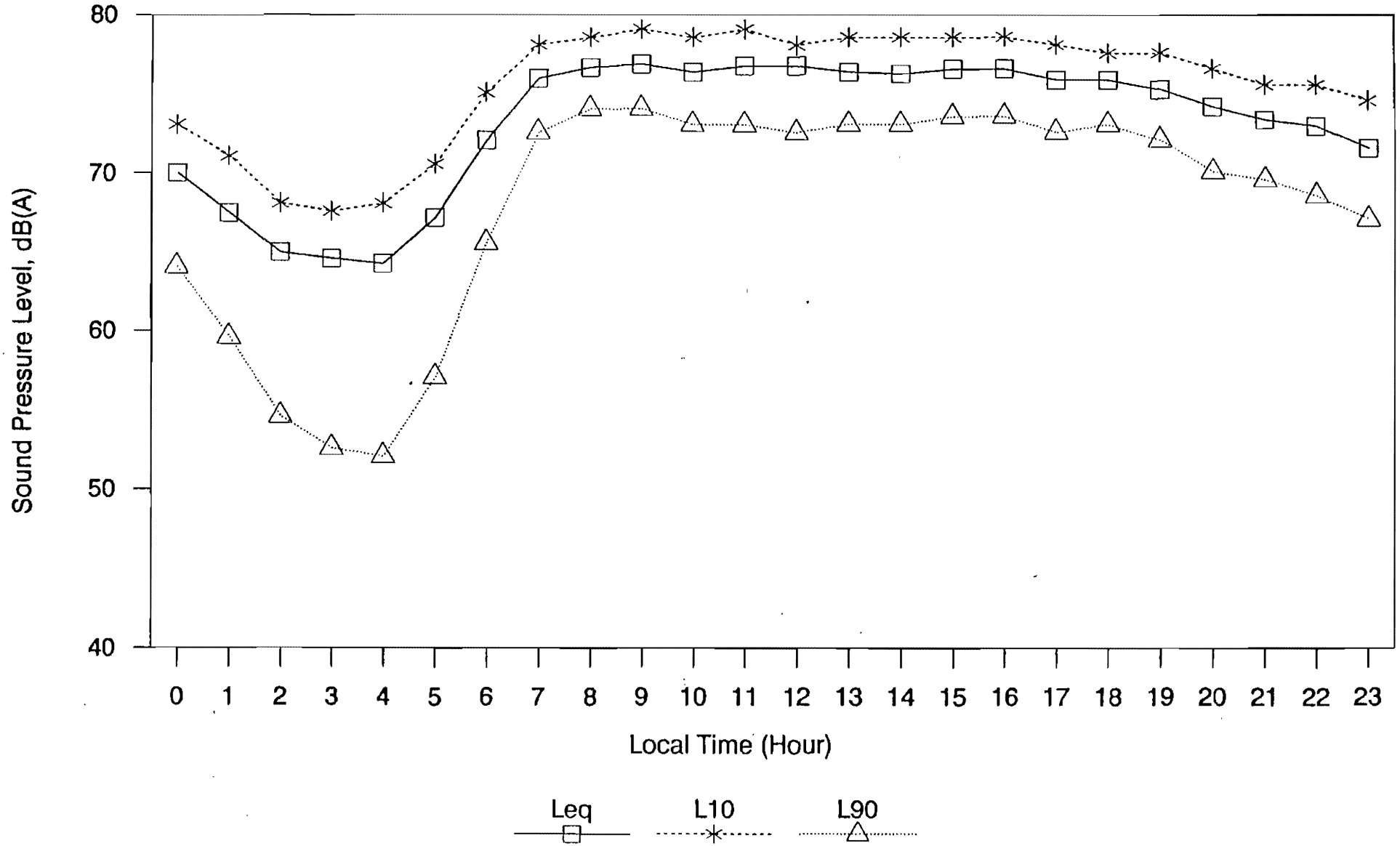
Noise Monitoring

Location: Fu Chak Hse,Chak On Est



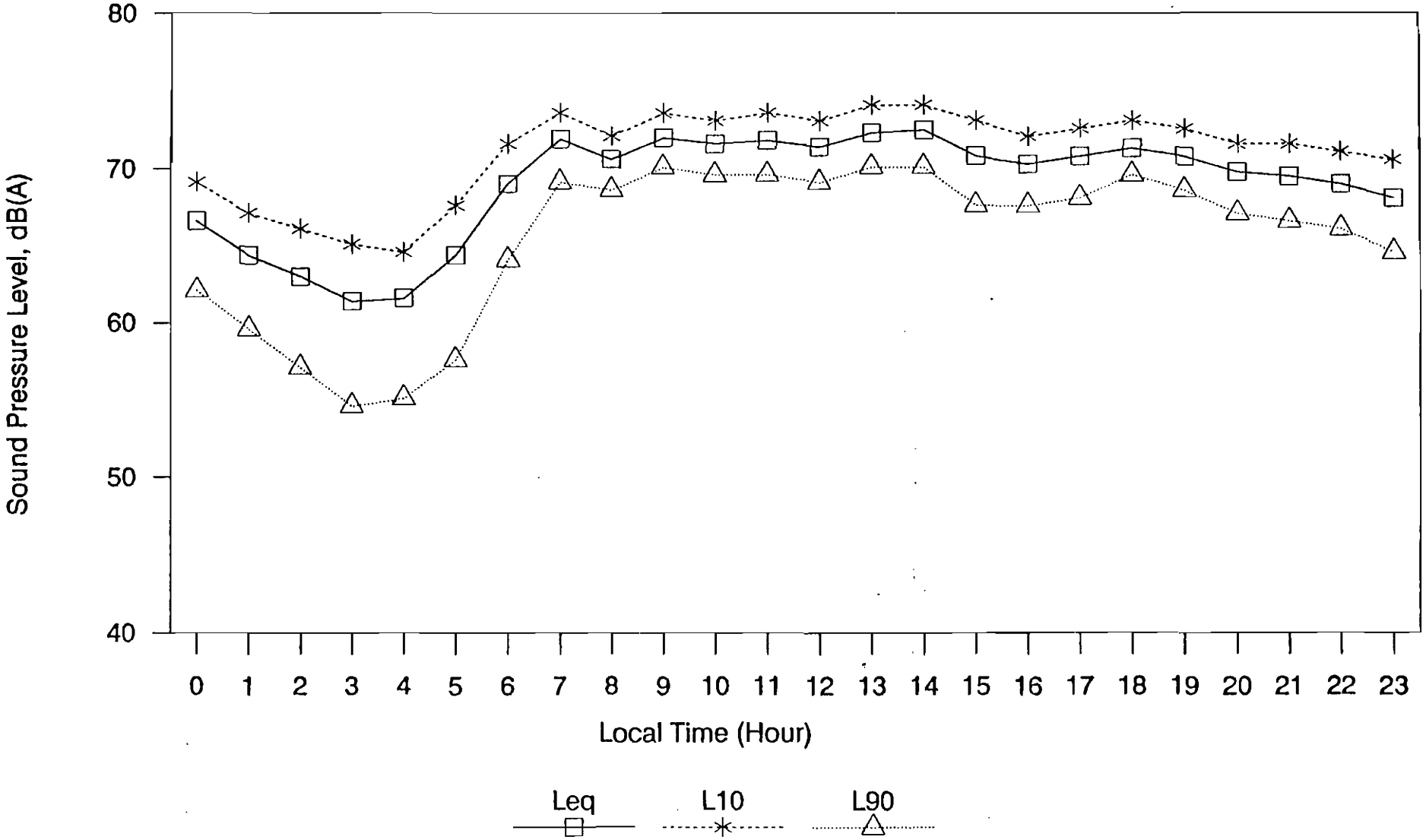
Noise Monitoring

Location: Roof, Blk 7, Beacon Height



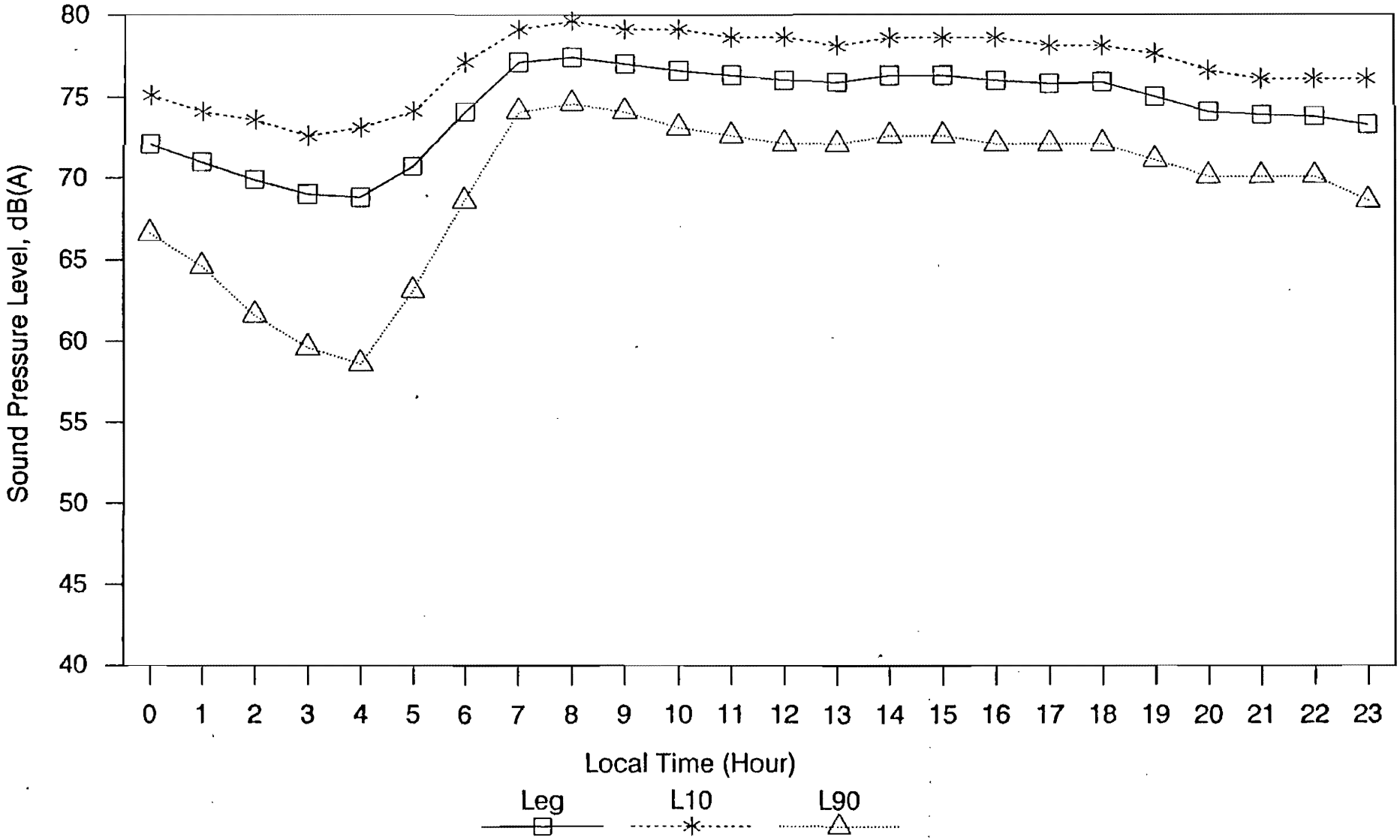
Noise Monitoring

Location: Rm 1831,Peony Hse,So Uk Est



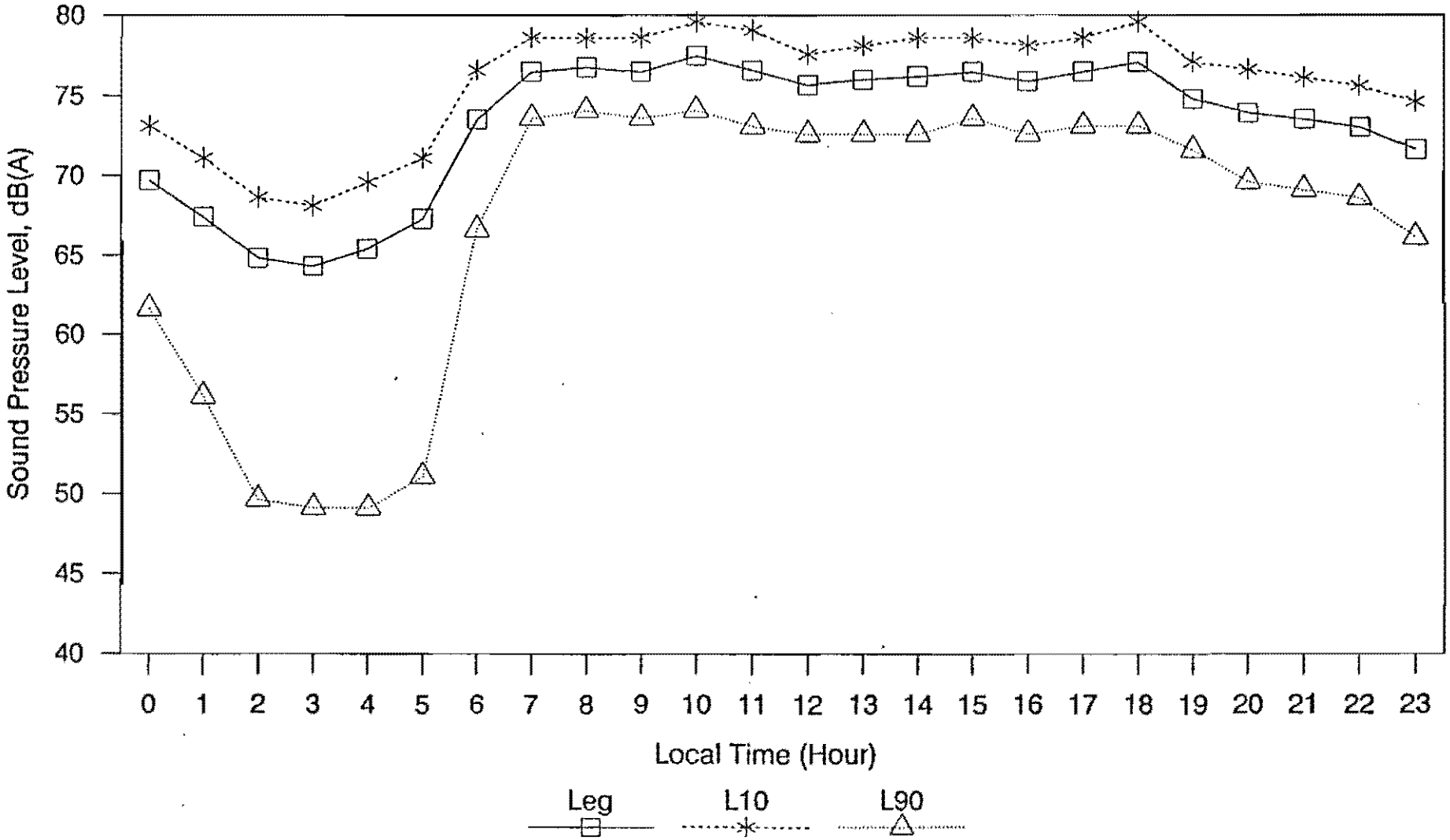
Noise Monitoring

Location: Roof, Blk.37, Lung Cheung Court



Noise Monitoring

Location: Elizabethan Court



ANNEX 3.B

Annex 3.B Sample Construction Noise Calculation

NSR	Location (Bridge)	Distance Away (m)	Distance Attenuation (m)	Barrier Attenuation dB (A)	Facade Correction dB (A)	Predicted SPL dB (A)
Caisson SWL = 111 dB (A)						
Wai Man Tsuen	B3	35	39	-	+3	75
	B4	20	34	-	+3	80
Nam Wah Middle School	B6	160	49	-	+3	65
	B7	23	35	-	+3	79
Caritas Wai Oi Block	B7	31	38	-	+3	76
Caritas Wards	B7	35	39	-	+3	75
So Uk Estate	B8	46	41	-	+3	73
GICs along Kwong Lee Road	B10	47	41	-	+3	73
	B11	57	43	-	+3	71
	B12	67	45	-	+3	69
Southern facade of Fu Chak House - Chak On Estate	B16	88	47	-	+3	67
Eastern facade of Fu Chak House - Chak On Estate	B17	45	41	-	+3	73
Beacon Heights	B18	121	50	-	+3	64
	B20	141	51	-	+3	63
Chak Yau Centre	B18	88	47	-	+3	67
	B20	80	46	-	+3	68
Cornwall Street THA	B18	114	49	-	+3	65
	B20	95	48	-	+3	66

Annex 3.B Sample Construction Noise Calculation

NSR	Location (Bridge)	Distance Away (m)	Distance Attenuation (m)	Barrier Attenuation dB (A)	Facade Correction dB (A)	Predicted SPL dB (A)
Piling SWL = 115 dB (A)						
Mei Foo Sun Chuen	B1	212	55	-	+3	63
Lai Chi Kok Hospital	B1	165	52	-	+3	66
Wai Man Tsuen	B2	45	41	-	+3	77
GIC Along Kwong Lee Road	B13	119	50	-	+3	68
Beacon Heights	B19	127	50	-	+3	68
Earthwork SWL = 116 dB (A) **(Cut slope)**						
Mei Foo Sun Chuen	N1	235	55	-	+3	64
Wai Man Tsuen	S13	30	38	-	+3	81
Caritas Wards	S31 S33	35 42	39 41	- -	+3 +3	80 78
Residential lots on Beacon Hill Road	N50 N51	40 53	40 43	- -	+3 +3	79 76
Residential lots on Rhondda Road	N53 N54	57 48	43 42	- -	+3 +3	76 77

Annex 3.B Sample Construction Noise Calculation

NSR	Distance Away (m)	Distance Attenuation (m)	Barrier Attenuation dB (A)	Facade Correction dB (A)	Predicted SPL dB (A)
Roadworks SWL = 124 dB (A)					
Mei Foo Sun Chuen	63	44	-	+3	83
Lai Chi Kok Hospital	134	51	-	+3	76
Wai Man Tsuen	20	34	10	+3	83
Nam Wah Middle School	23	35	10	+3	82
Caritas Wei Oi Block	31	38	-	+3	89
Caritas Wards	35	39	-	+3	88
So Uk Estate	46	41	-	+3	86
GIC along Kwong Lee Road	43	41	-	+3	86
Wah Chek House, Chak On Estate	53	43	-	+3	84
Southern facade of Fu Chak House Chak On Estate	88	47	-	+3	80
Eastern facade of Fu Chak House Chak On Estate	45	41	-	+3	86
Beacon Heights	34	39	-	+3	88
Chak Yai Centre	77	46	-	+3	81
Cornwall Street THA	92	47	-	+3	80
Residential lots on Beacon Hill Road	21	34	-	+3	93
Residential lots on Rhondda Road	12	30	-	+3	97

Annex 3.B Sample Construction Noise Calculation

NSR	Location (Bridge)	Distance Away (m)	Distance Attenuation (m)	Barrier Attenuation dB (A)	Facade Correction dB (A)	Predicted SPL dB (A)
Excavation SWL = 116 dB (A)						
Mei Foo Sun Chuen	RW3	212	55	-	+3	64
Wai Man Tsuen	RW8	52	42	-	+3	77
Nam Wah Middle School	RW12	40	42	10	+3	67
So Uk Estate	RW16	98	48	-	+3	71
Beacon Hill Road	RW34	7	25	-	+3	94

ANNEX 4.A

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1. CONSTRUCTION NOISE MONITORING

1.1 The Contractor shall carry out, to the satisfaction of the Engineer, the following construction noise monitoring procedures:-

(a) All measurements shall be carried out by suitably experienced staff, who have been approved by the Engineer.

(b) Sound level readings shall be recorded on forms provided by the Contractor, and approved by the Engineer.

(c) A schedule of proposed sound measurement times and locations shall be produced by the Contractor on a monthly basis and submitted to the Engineer for his approval at least two weeks before the commencement of the scheduled period. The measurement times shall be at least once per week and chosen to fairly represent normal construction activities. The Engineer may direct amendments to the schedule at short notice. If the Contractor obtains a permit for working during restricted hours then additional noise monitoring shall be required.

(d) The measurements taken are for the information of the Engineer, Employer and the Contractor and shall not form a basis for prosecution under the Noise Control Ordinance.

(e) Noise monitoring shall be carried out using approved equipment, which shall be tested at regular intervals in a manner and in a laboratory approved by the Engineer.

(f) The sound level meters used shall comply with the International Electrotechnical Commission Publications 651:1979 (type 1) and 804:1985 (type 1), specification as referred to in the Technical Memorandum to the Noise Control Ordinance.

(g) The Construction noise level monitoring shall be carried out at 1 metre from the external facade of the following locations, and the Contractor shall be responsible for arranging access. Alternative locations may be agreed or directed by the Engineer if difficulties arise in obtaining access, or if the locations become unsuitable.

- Nam Wah Middle School;
- Caritas nurses quarters or wards;
- Peony House, So Uk Estate;
- Fu Chak House, Chak On Estate;
- Wing Chak House, Chak On Estate;
- Wah Chak House, Chak On Estate;
- Beacon Heights; and
- Elizabethan Court.

(h) The location and direction of the noise monitoring is to be agreed with the Engineer on site and recorded for use in all subsequent monitoring.

(i) Construction noise levels shall be recorded as the average of three consecutive L_{eq} 5-min measurements, at each of the above locations, to the agreed schedule.

(j) The Contractor shall prior to the commencement of the construction works carry out baseline monitoring to determine and agree ambient sound levels. The baseline monitoring shall be carried out on a typical day to a schedule agreed with the Engineer. From the baseline measurements an agreed ambient noise levels at each location (L_{eq}5-min) and (L_{10} 1-hr) shall be calculated.

(k) Checking of ambient noise levels shall be carried out by the Contractor on at least four occasions during the year, at not less than one monthly intervals, for each location. The checking shall be carried out when construction activities are not taking place.

2. EVALUATION, REPORTING AND ACTION ON CONSTRUCTION NOISE LEVELS

2.1 The Contractor shall submit to the Engineer, no later than the 10th day of the month following the month following the monthly reporting period, three copies of a report giving the dates and times of each series of measurements. The actual measurements of each recording, together with comments on any discarded measurements shall also be provided. For each location and series of measurements the Contractor shall calculate a construction noise level, and shall compare this level with the agreed comparable ambient noise level. Where the Contractor is required to undertake further action as described in sub-clause 2.2, the monthly report shall include the need for such action, the action carried out and the results of such action.

2.2 Where the agreed comparable ambient noise level, is less than 70dB(A), and any of the construction noise levels are more than 75dB(A) or if the agreed comparable ambient noise level is greater than 70dB(A) and any of the construction noise levels are more than 5dB(A) above the agreed comparable ambient noise levels then the Contractor shall:-

(a) review all construction noise sources contributing to the recorded construction noise levels, and instigate any changes to scheduling of activities, installation of plant soundproofing, provision of alternative plant, erection of sound barriers around part of the site or the location of construction noise sources, or any other measures as may be required to reduce the noise level to an acceptable level.

(b) as part of the monthly report referred to sub-clause 2.1, submit a report of the review and action taken, together with further measurement of construction noise levels at the locations concerned.

3. DUST (TSP) LEVELS ARISING FROM THE WORKS

3.1 In order to demonstrate compliance with the specification clauses limiting the disturbance to the general public caused by construction dust, (measured as total suspended particulates and herein referred to as "dust (TSP)"), the Contractor shall carry out, to the satisfaction of the Engineer, the following construction dust (TSP) monitoring procedures:-

(a) All measurements shall be carried out by suitably experienced staff, who have been approved by the Engineer.

(b) Dust (TSP) level readings shall be recorded on forms provided by the Contractor, and approved by the Engineer.

(c) A schedule of proposed dust (TSP) measurement times and locations shall be produced by the Contractor on a monthly basis and submitted to the Engineer for his approval at least two weeks before the commencement of the scheduled period. The measurement times shall be at least once per week and chosen to fairly represent normal construction activities. The Engineer may direct amendments to the schedule at short notice.

(d) The measurements taken are for the information of the Engineer, Employer and the Contractor and shall be used to evaluate the Contractors performance in undertaking the requirements for controlling construction dust (TSP) levels.

(e) Construction dust (TSP) monitoring shall be carried out using approved equipment, which shall be tested at regular intervals in a manner and in a laboratory approved by the Engineer.

(f) The dust (TSP) levels shall be measured by the "High Volume Method for total suspended particulates" as described by the United States Environmental Protection Agency in 40 CFR Part 50.

(g) The construction dust (TSP) level monitoring shall be carried out at the following locations, and the Contractor shall be responsible for arranging any access. Alternative locations may be agreed or directed by the Engineer if difficulties arise in obtaining access, or if the locations become unsuitable.

(i) Adjacent to the wards buildings of Caritas Medical Centre Hospital.
(ii) Rooftop of residential lots nos. 43-53 on Beacon Hill Road.

(h) Monitoring shall consist of:-

(i) The collection of one hour samples on an ad hoc basis.
(ii) The collection of 24 hour samples, once a month at each location.

(i) The location of the dust (TSP) monitoring is to be agreed with the Engineer on site and recorded for future compliance. The agreed locations shall not be located at the site of major roads and shall be free from local obstructions or sheltering.

(j) The Contractor shall prior to the commencement of the construction works carry out baseline monitoring to determine and agree ambient dust (TSP) levels. The baseline monitoring shall be carried out for a period of at least two weeks, with measurements to be taken every day at each location and to a schedule agreed with the Engineer. From the baseline measurements an agreed ambient dust (TSP) level shall be calculated.

(k) Checking of ambient dust (TSP) levels shall be carried out by the Contractor on at least four occasions during the year, at not less than one monthly intervals, at each location. The checking shall be carried out when construction activities are not taking place.

4. EVALUATION, REPORTING AND ACTION ON CONSTRUCTION DUST (TSP) LEVELS

4.1 The Contractor shall submit to the Engineer, no later than the 10th day of the month following the monthly reporting period, three copies of a report giving the dates and times of each series of measurements. The actual measurements of each recording, together with comments on any discarded measurements shall also be provided. for each location and series of measurements the Contractor shall compare the construction dust (measured as total particulates and herein referred to as "dust (TSP)") level with the guideline dust (TSP) levels given in PS Clause 1.38(h)(viii) and PS Clause 1.38(i)(ii) as applicable. where the Contractor is required to undertake further action as described in sub-clause b), the monthly report shall include the need for such action, the action carried out and the results of such action.

4.2 Where the recorded dust (TSP) level is greater than the required levels as given in PS Clause 1.38(h)(viii) and PS Clause 1.38(i)(ii) as applicable the Contractor shall:-

(a) Review all construction dust (TSP) sources contributing to the recorded construction dust (TSP) levels, and instigate any changes to working procedures or introduce any other measures as may be required to reduce the dust (TSP) level to the required level.

(b) As part of the monthly report referred in sub-clause a), submit a report of the review and action taken, together with further measurement of construction dust (TSP) levels at the locations concerned.