AGREEMENT No. CE 77/95
HIRAM'S HIGHWAY IMPROVEMENT
IMPROVEMENT BETWEEN NAM WAI AND HO CHUNG AND
UPGRADING OF LOCAL ACCESS ROADS

ENVIRONMENTAL IMPACT ASSESSMENT REPORT
(FINAL)

Report No. BBHK/96044/D/010

March 1997

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1 INTRODUCTION

1.1 BACKGROUND

Babtie BMT (HK) Ltd in association with ENPAC Ltd., Ho Tin & Associates Consulting Engineers Ltd, Urbis Limited and MVA Asia Ltd were commissioned by Highways Department/NT Region to carry out the Environmental Impact Assessment and Drainage Impact Assessment Studies for the Hiram's Highway Improvement between Nam Wai and Ho Chung and upgrading of Local Access Roads. This report presents the results of the Environmental Impact Assessment.

In order to remove the sharp bend and to improve road safety and capacity, improvement works to Hiram's Highway have been proposed. The works include: (a) the construction of a 0.7 km long, two lane carriageway on elevated embankments and structures between Nam Wai and Nam Pin Wai, (b) the formation of road reserve for two future traffic lanes, (c) the construction of a roundabout at the junction of Hiram's Highway and Nam Pin Wai Road, (d) local improvement to the existing Hiram's Highway between Nam Wai and Nam Pin Wai, and (e) the associated works. **Figure 1.1** shows the location and limit of the scheme. In addition, a preliminary general layout plan in the scale of 1:1 000 (Drawing No. BBHK/96044/G1/P/001 A in **Appendix F**) is enlcosed for ease of reference.

1.2 OBJECTIVE OF ENVIRONMENTAL IMPACT ASSESSMENT STUDY

The purpose of the Study is to provide information on the nature and extent of the potential environmental impacts on the environment arising from the construction and operation of the Project and all concurrent activities in the area.

The objectives of the assessment are as follows:

i) to describe the proposed project and associated works together with the environmental requirements for carrying out the proposed project;

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

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

iv) to identify and quantify any potential losses or damage to flora, fauna and natural habitats;

v) to propose the provision of infrastructure or mitigation measures so as to minimise pollution, environmental disturbance and nuisance during construction and operation of the project;

vi) to identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and cumulative effects expected to arise during the construction and operation phases of the project in relation to the sensitive receivers and potential affected uses;

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

viii) to design and specify the environmental monitoring and audit requirements necessary to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted;

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

x) to identify constraints associated with the mitigation measures recommended in the study; and

xi) to identify any additional studies necessary to fulfil the objectives to the requirements of this EIA Study.

1.3 KEY ENVIRONMENTAL ISSUES ADDRESSED

An Environmental Review (ER) was conducted by the Environmental Protection Department (EPD) in October 1994. One of the key issues identified was the likely degradation of the noise environment. Section 2 of this report specically addresses the likely noise impacts during both the construction and operation phases of the Project.

Another key issue addressed in this report is the effect of the scheme on the landscape and the visual impact caused by it, including the proposed mitigation measures. A full assessment of this issue is detailed in Section 3 of the report.

The ER envisaged that there would be no significant air pollution impacts but required that pollution control measures should be implemented to control noise, dust and site run-off during construction. Recommended pollution clauses covering the above have been prepared and are contained at Appendix A.

Although plain barriers and inverted-L barriers are proposed to reduce noise in the Project, the consequential air quality impacts arising from the plain barriers are not considred to be significant in view of the openness of the Study Area. As a result, no quantitative assessment of the air quality impact is made. Notwithstanding this, EM&A requirements with respect to air quality during the construction phase are included in a stand-alone EM&A Manual to monitor the short-term construction dust impact.

With respect to ecological impacts, discussions were held with Agricultural and Fisheries Department on the scope of assessment and survey requirements for the project. A vegetation survey was then carried out to identify all the affected tree species within the Study Area. Additional surveys on the stream courses and the secondary woodland near Wo Mei Village were carried out. The results of the surveys are presented in Section 4 of the report.

2. NOISE IMPACT ASSESSMENT

2.1 INTRODUCTION

A noise assessment has been carried out for the scheme in accordance with the Project Brief and following the methodology described in the Environmental Impact Assessment Inception Report.

The noise assessment includes assessment of the existing operational noise levels, anticipated construction noise levels, during road improvement works stage, and operational noise levels for the design year, when the traffic projection within a 15 years period upon the commencement of operation of the Project is the maximum.

Results of the noise assessment have been used as the basis for the evaluation of the noise impacts of the proposed road improvement works on both existing and planned communities, as well as for the identification of locations where the acceptable noise level criteria are exceeded and appropriate noise mitigation measures may be required.

2.2 PROPOSED ROAD IMPROVEMENT WORKS

In order to remove the sharp bend and to improve road safety and capacity, improvement works to Hiram's Highway have been proposed. The works include: (a) the construction of a 0.7 km long, two lane carriageway on elevated embankments and structures between Nam Wai and Nam Pin Wai, (b) the formation of road reserve for two future traffic lanes, (c) the construction of a roundabout at the junction of Hiram's Highway and Nam Pin Wai Road, (d) local improvement to the existing Hiram's Highway between Nam Wai and Nam Pin Wai, and (e) the associated works.

The additional two traffic lanes mentioned in (b) above will be provided in the form of another carriageway as part of the Hiram's Highway Phase 4 Dualling proposal which is scheduled to commence construction in late 2000 with completion in 24 months.

Figures 2.1, 2.2 and **Appendix F** depict the preliminary general layout of the improved / new alignment.

2.2.1 Construction Programme and Activities

A preliminary construction programme for the road improvement works has been scheduled as shown in **Table 2.1** (also see **Figure 2.3**).

Table 2.1 Preliminary Construction Programme

Month/Year	Construction Activity	
	No.	Description
Jul - Aug 98	1	Preliminaries, site clearance and mobilisation
Sept - Dec 98	3	Cutting
Jan - Feb 99	4	Piling
Mar - May 99	5	Col/Abut
Jun - Aug 99	6	Decks
Sept 99 - Feb 2000	7	Embankment
Mar - May 2000	8	Drainage
Jun - Sept 2000	9	Carriageways
Oct - Nov 2000	10	Tie-in Works
Dec 2000	11	Completion

Equipment requirements for each activity are provided in **Table 2.2**, along with sound power levels (SWLs) for individual and groups of equipment. Equipment SWLs other than that for piling activity are based on those contained in Table 3 of *Technical Memorandum on Noise from Construction Work other than Percussive Piling* and Table 11 of *BS 5228: Part 1: 1984*.

Piling will be needed for the construction of the two elevated structures in front of Wo Mei, and equipment SWL is obtained from Table 2 of *Technical Memorandum on Noise from Percussive Piling.*

Table 2.2 Typical Equipment Requirements

Construction Activity	Equipment and Quantity		CNP Code	SWL, dB(A)		
				Per piece	% On-time	Total [1]
Preliminary works and mobilization	Truck with crane	1	048	112	20	115
	Backhoe (Excavator)	1	081	112	40	
	Pneumatic breaker	2	023	117	20	
Cutting	Backhoe (Excavator)	1	081	112	100	121
	Dump truck	2	067	117	100	
Piling	Piling rig H-piles	1	-[2]	132	-	132
Col/Abut	Truck with crane	1	048	112	25	116
	Concrete mixer truck	1	044	109	80	
	Vibrating poker	2	170	113	80	
Decks	Concrete mixer truck	1	044	109	80	116
	Vibrating poker	2	170	113	80	
Embankment	Backhoe (Excavator)	1	081	112	50	122
	Dump truck	2	067	117	100	
	Bulldozer	1	030	115	100	
	Road roller	1	185	108	100	
Drainage	Truck with crane	1	048	112	20	114
	Backhoe (Excavator)	1	081	112	80	
	Concrete mixer truck	1	044	109	20	
	Vibrating poker	2	170	113	20	
Carriageways	Road roller	1	185	108	80	117
	Asphalt truck	2	-[3]	112	100	
	Paver	1	004	109	100	
Tie-in Works	Backhoe (Excavator)	1	081	112	20	115
	Pneumatic breaker	2	023	117	20	
	Concrete mixer truck	1	044	109	10	
	Vibrating poker	2	170	113	10	
Completion	Truck with crane	1	048	112	20	115
	Backhoe (Excavator)	1	081	112	40	
	Pneumatic breaker	2	023	117	20	

Notes: (1) An adjustment of percentage on-time to the SWL has been allowed according to Figure 4 of *BS 5228: Part 1: 1984.*

(2) Classified as diesel hammer driving steel pile.

(3) SWL based on Table 11 of *BS 5228: Part 1: 1984.*

2.2.2 Predicted Traffic Flows

A comprehensive survey has been conducted for the prediction of the maximum traffic flow within 15 years after the opening of the Project in the Study Area (i.e. the worst traffic scenario), including the "realigned" and "existing" Hiram's Highway, and other village access roads nearby.

Upon reviewing the traffic survey results and CTS-2 data, it was concluded that the daily traffic peak in the Study Area occurs in the AM period. As such, the predicted traffic flows in the AM peak hours have been adopted in this noise impact assessment.

Projected worse case scenario AM peak hour traffic flows and vehicle composition for the roads under consideration are contained in *Hiram's Highway Improvements between Nam Wai and Ho Chung Traffic Forecasts, July 1996* prepared by MVA Asia Limited, and are summarised in Table 2.3 below (see **Figure 2.4** for traffic flow direction).

For the purpose of this EIA, operational noise impact assessment has been based on traffic on both carriageways of the dual-2 carriageway of the straightened Hiram's Highway alignment.

Table 2.3 Predicted Worst Case Scenario AM Peak Traffic Flows

Movement/Road (1)	Nature		Traffic Flows	% of Heavy	Speed
	New	Existing			
A1		•	750	30.7	50
A2		•	1940	16.5	50
B1	•		750	30.7	70
B2	•		1790	17.9	70
C1	•		750	30.7	70
C2	•		1790	17.9	70
D1		•	790	30.4	50
D2		•	1850	18.4	50
E		•	160	6.3	50
F1		•	40	0	50
F2		•	100	20.0	50
G1		•	50	0	50
G2		•	80	25.0	50
H1		•	50	0	50
H2		•	80	25.0	50
J1	•		760	30.3	50
J2	•		780	29.5	50
J3	•		1850	18.4	50
J4	•		1820	17.6	50
Nam Pin Wai Road		•	80 (2)	50.0	50

Table 2.3 (Cont'd) Predicted Worst Case Scenario AM Peak Traffic Flows

Movement/Road [1]	Nature		Traffic Flows	% of Heavy	Speed
	New	Existing			
New Access Road to Wo Mei	•		30 [2]	33.3	50
Access Road to Wo Mei		•	50 [2]	20.0	50
Access Road to Heung Chung		•	10 [2]	0	50
Nam Wai Road		•	230 [2]	17.4	50

Notes: (1) See Figure 2.4 for traffic flow direction.
(2) 2-way traffic flow.
(3) The assumed speed in the analysis is accepted in principle by the Transport Department

2.3 PROJECT SITE

2.3.1 Existing Noise Environment

The existing noise environment in the vicinity of the Project site is dominated by road traffic on Hiram's Highway. According to the traffic survey conducted by the Traffic Consultant, the highest traffic volume on Hiram's Highway occurs at AM peak hour. **Table 2.4** presents the existing (1996) traffic flows recorded on site (see **Figure 2.4** for traffic flow direction).

Table 2.4 Existing AM Peak Traffic Flows

Movement/Road [1]	Traffic Flows	% of Heavy	Speed
A1	483	46.6	50
A2	1191	26.3	50
D1	510	46.1	50
D2	1146	28.5	50
E [2]	1674 [3]	46.6	50
F1	500	45.0	50
F2	1154	27.6	50
G1	502	44.8	50
G2	1142	27.8	50
H1	512	45.9	50
H2	1152	28.6	50
Nam Pin Wai Road	60 [3]	66.7	50
Access Road to Wo Mei	40 [3]	25.0	50
Access Road to Heung Chung	10 [3]	0.0	50
Nam Wai Road	160 [3]	25.0	50

Notes: (1) See Figure 2.4 for traffic flow direction.
(2) Before improvement works, it is a 2-way traffic lane.
(3) 2-way traffic flow.

The AM peak hour road traffic noise was monitored on 20 May 1996, and the monitoring results are summarised in **Table 2.5**. Three noise monitoring stations, as shown in **Figure 2.5**, were set up for the noise monitoring. Road traffic noise was found to be the dominant noise source in the Study Area.

Table 2.5 Existing Noise Levels during AM Peak Hour

Monitoring Stations	Facade Noise Level, dB(A)		
	L_{10}	L_{90}	L_{eq}
M1	73.3	60.8	69.5
M2	76.8	67.3	73.6
M3	73.6	61.6	70.7

The calculated existing traffic noise levels at stations M1, M2 and M3, based on the traffic count for the existing Hiram's Highway obtained during the noise monitoring (1730 veh/hr and 25% heavy vehicles), are 74.2, 78.1 and 75.4 dB(A) respectively. These predicted levels are consistent with the measured L_{10} (1 hour) noise levels at the stations.

Calculated existing noise levels at the noise sensitive receivers (NSRs) in the Study Area using the Traffic Consultant's 1996 survey data are provided in Section 2.5 below.

As shown by the calculated results, the current traffic noise levels at most of the NSRs along Hiram's Highway exceed the HKPSG maxima. It is apparent that the existing NSRs along Hiram's Highway are being suffered from significant traffic noise impacts.

2.3.2 Existing Noise Sensitive Receivers

Noise sensitive receivers in the vicinity of the Project site are likely to be adversely affected by the proposed road works. Site survey reveals that existing NSRs in the Study Area are low-rise developments, including village houses, villas, a primary school and two churches.

In view of the topographical barrier effect offered by the spur near the southern Project limit, village houses at southern end of Nam Wai are completely screened from the new alignment and no considerable noise impacts are expected (see **Figure 2.6**). These houses are thus excluded from the detailed noise impact assessment.

Representative NSRs have been selected for construction and operational noise impact assessments, as described in **Table 2.6** and depicted in **Figure 2.7**.

2.3.3 Future and Planned Sensitive Uses

Information on future/planned sensitive uses has been obtained from the four draft Outline Zoning Plans (i.e. Ho Chung, Hebe Haven, Pak Kong and Sha Kok Mei, and Tseng Lan Shue) prepared by the Planning Department, as presented in **Figure 2.8**. The areas to the northwest of Wo Mei, which are currently occupied by industrial premises, have been zoned for residential development (R(C)), village development (V) and comprehensive development area (CDA). Representative receptor points (i.e. P1 to P12) at the zone boundary, as shown in **Figure 2.8**, have been chosen for impact assessment. Other areas zoned residential / village developments (i.e. Heung Chung and Wo Mei) can duly be represented by the existing NSRs identified there.

Table 2.6 Representative Noise Sensitive Receivers

NSR	Designation		No. of Storey	Buffer [1] Distance (m)	Noise Impact Assessed	
	Location	Building Type			Construction	Operation
WM1	Wo Mei Village	Low-rise residential building	3	96	•	•
WM2				56	•	•
WM3				58	•	•
WM4				81		•
WM5				149	•	•
WM6 [2]					•	•
WM7 [2]					•	•
WM8 [2]					•	•
CW		Church	2	154	•	•
GV	Nam Wai	Grenville Villas	3	61	•	•
CH		Church	2	119	•	•
NW	Heung Chung	Low-rise residential building	3	26	•	•
PS1	Ho Chung	Sai Kung Central Primary School (south wing)	5	47		•
PS2		Sai Kung Central Primary School (north wing)	5	33	• [3]	•
BB		Berkeley Bay Villa	2	94	•	•
VH1		Village house	1	15	• [3]	•
VH2		Village house	1	105		•
TG		Treasure Spot Garden	3	56	•	•

Table 2.6 (con't) Representative Noise Sensitive Receivers

NSR	Designation		No. of Storey	Buffer [1] Distance (m)	Noise Impact Assessed	
	Location	Building Type			Construction	Operation
P1	Northwest of Wo Mei	Comprehensive Development Area	2 Storeys over 1 level carport (9m)	25 [4]	•	•
P2				3 [4]	•	•
P3		Village Type Development	3	30 [4]		•
P4		Residential (Group C)	3 Storeys over 1 level carport (12m)	55 [4]	•	•
P5				75 [4]	•	•
P6				70 [4]		•
P7		Village Type Development	3	30 [4]	•	•
P8				41 [4]		•
P9				12 [4]		•
P10				16 [4]		•
P11	East of Wo Mei	Village Type Development	3	28 [4]	•	•
P12			3	29 [4]		•

Notes (1) Distance from sensitive facade to edge of carriageway of the Project.
(2) Approved S.16 applications.
(3) The worst construction noise impacted NSR.
(4) Location of sensitive facade has been assumed at the zone boundary.

2.4 NOISE IMPACT ASSESSMENT METHODOLOGY

2.4.1 Environmental Standards and Guidelines

Construction Noise

Non-restricted Hours

Under the existing provisions, there is no legal restriction on noise generated by construction activities (other than percussive piling) between the hours of 07:00 and 19:00 on normal weekdays. However, EPD's *Practice Note for Professional Persons ProPECC PN 2/93* sets a non-statutory daytime noise limit of 75 dB(A) L_{eq}(30 min) at the facades of dwellings, and 70 and 65 dB(A) at the facades of schools during normal school hours and examination period respectively. These criteria have been adopted for the assessment of construction noise during non-restricted hours.

Restricted Hours

It is expected that night works will not be required and therefore the criteria stipulated in the *Technical Memorandum on Noise from Construction Work other than Percussive Piling*, as well as in *Technical Memorandum on Noise from Construction Work in Designated Areas*, issued under the Noise Control Ordinance (NCO) are not applicable to this Project.

Percussive Piling

Percussive piling is anticipated during the construction phase and therefore the criteria stipulated in the *Technical Memorandum on Noise from Percussive Piling* issued under the NCO are applicable to this Project.

As observed on site, all existing NSRs are with windows but without central air conditioning systems. Acceptable Noise Levels (ANLs) applicable to the Project are therefore 75 and 85 dB(A) for schools and other NSRs accordingly.

Blasting

No blasting will be carried out as part of the construction of this project.

Operational Noise

The impact of operational noise has been assessed with reference to the Hong Kong Planning Standards and Guidelines (HKPSG) which stipulates maximum L_{10} (1 hour) road traffic noise levels of 70 dB(A) for domestic premises, and 65 dB(A) for educational institutions and churches.

In case where no practical direct technical remedies can be applied, reference has been made to the Exco directive *Equitable Redress for Persons Exposed to Increased Noise Resulting from the Use of New Roads*. The three conditions (with HKPSG criteria) set down in UK Department of Transport's *Calculation of Road Traffic Noise, HMSO, 1988* (CRTN) have been adopted to test the existing NSRs which may be qualified for indirect technical remedies.

2.4.2 Noise Assessment Methodologies

Construction Noise

The methodologies outlined in both *Technical Memorandum on Noise from Construction Work other than Percussive Piling* and *Technical Memorandum on Noise from Percussive Piling* have been used for the assessment of construction noise. Adjustments for equipment on-time has been made according to Figure 3.4 of *BS 5228: Part 1: 1984.*

Additionally, for the purpose of this EIA, construction noise impact assessment has been undertaken based on the followings:

- All items of powered mechanical equipment (PME) required for a particular construction activity are located at the notional source position of the segment where such activity is performed.
- The highest total sound power level arising from construction activity is used.
- A +3 dB(A) facade correction has been added to the predicted noise levels in order to account for the facade effect at each NSR.

- To represent the worst case scenario, noise impacts at the nearest sensitive facades of the buildings to the notional source positions (i.e. the floors which will be the most impacted receptors) have been examined.

Operational Noise

Road traffic noise levels have been predicted using ENPAC's in-house noise model which is based on the procedures described in the CRTN.

2.5 NOISE IMPACT ASSESSMENT

2.5.1 Construction Phase

As illustrated in the construction programme (see **Figure 2.3**), construction activities will be undertaken on an individual basis during the construction period. As shown in **Table 2.2**, the total SWLs for various construction activities vary from 114 to 122 dB(A).

Construction noise calculation results for different activities are summarised in **Table 2.7**.

With the exception of WM5, CW, CH, BB and TG, all the dwellings will be exposed to noise levels above 75 dB(A). The predicted construction noise level at the most affected dwelling, NW, will exceed the noise limit by 16 dB(A). With regard to the educational establishment (i.e. PS2), the predicted noise level is 81dB(A). Noise impacts are considered significant during both normal school hours and the examination period. Mitigation measures are therefore required to alleviate the construction noise impacts.

For the piling activity, NSRs WM2 is the most affected house and has been selected for the worst scenario assessment. According to Table 1 of *Technical Memorandum on Noise from Percussive Piling*, the ANL for the NSR is 85 dB(A). The corrected noise level (CNL) at WM2 is shown in **Table 2.8**. Also shown in **Table 2.8** is the noise calculation for NSR PS2, with ANL being 75 dB(A).

As illustrated in **Table 2.8**, the maximum exceedance over the ANL is 9 dB(A) and thus the permitted hours of operation on any day not being a general holiday is 0800 to 0930, 1200 to 1400, and 1630 to 1800 hours.

Table 2.7 Construction Noise Levels for different activities (Unmitigated)

NSR	Intervening Distance (m)	Noise Level, dB(A)								
		Preliminary works and mobilization	Cutting	Col/Abut	Decks	Embankment	Drainage	Carriageways	Tie-in Works	Completion
WM1	88	71	77	72	72	78	70	73	71	71
WM2	56	75	81	76	76	82	74	77	75	75
WM3	52	76	82	77	77	83	75	78	76	76
WM5*	146	57	63	58	58	64	56	59	57	57
WM6	32	80	86	81	81	87	79	82	80	80
WM7	50	76	82	77	77	83	75	78	76	76
WM8	64	74	80	75	75	81	73	76	74	74
CW*	150	56	62	57	57	63	55	58	56	56
GV	60	74	80	75	75	81	73	76	74	74
CH*	130	58	64	59	59	65	57	60	58	58
NW	18	84	90	85	85	91	83	86	84	84
PS2	56	74	80	75	75	81	73	76	74	74
BB	135	67	73	68	68	74	66	69	67	67
VH1	45	77	83	78	78	84	76	79	77	77
TG*	116	59	65	60	60	66	58	61	59	59

Note: (*) A correction of -10 dB(A) has been applied to account for the screening effect of buildings.

Table 2.7 (Cont'd) Construction Noise Levels for different activities (Unmitigated)

NSR	Intervening Distance (m)	Noise Level, dB(A)								
		Preliminary works and mobilization	Cutting	Col/Abut	Decks	Embankment	Drainage	Carriageways	Tie-in Works	Completion
P1	39	78	84	79	79	85	77	80	78	78
P2	17	85	91	86	86	92	84	87	85	85
P4	58	75	81	76	76	82	74	77	75	75
P5	77	72	78	73	73	79	71	74	72	72
P7	34	79	85	80	80	86	78	81	79	79
P11	30	80	86	81	81	87	79	82	80	80

Table 2.8 Piling Noise Levels for the Worst Case Scenario

NSR	SWL dB(A)	Distance m	ANL dB(A)	Distance Correction dB(A)	Facade Correction dB(A)	CNL dB(A)
WM2	132	51	85	-45	+3	90
PS2	132	90	75	-51	+3	84

2.5.2 Operational Phase

The traffic noise levels at the sensitive facades of the chosen NSRs have been calculated and modelled in accordance with the UK Department of Transport's CRTN procedures. The traffic flows used in the computer simulation are those shown in **Tables 2.3** and **2.4** previously.

The results of the noise analysis are presented in **Table 2.9**.

Table 2.9 shows that the current (1996) traffic noise impact is already severe. Noise exposure levels at all NSRs except WM1, WM4, WM5, CW, VH1, VH2 and TG exceed the HKPSG maxima by 1 to 10 dB(A).

According to the noise modelling results, most receivers at Nam Wai and Wo Mei (i.e. WM2, WM3, WM7, WM8, GV, CH, NW, PS1 and PS2) will be exposed to lower noise levels when compared with the current traffic noise environment. Notwithstanding this, all existing and planned NSRs except WM1, WM4, WM5, CW, VH2, Roseville Villas and P8 to P10 along the Project alignment will still be subjected to significant operational noise impacts. It should be noted that the predicted noise level at Roseville Villas is represented by that at NSR CH but assessed against with the noise limit of 70 dB(A). The predicted L_{10} noise levels are ranging from 65 to 81 dB(A), representing a maximum noise exceedance of 11 dB(A) and 9 dB(A) for residential development and school/church respectively.

Given that the predicted noise levels at the identified NSRs are well in excess of the HKPSG criteria, appropriate noise mitigation measures should be provided to remedy the adverse noise environment.

Table 2.9 Current and Future Traffic Noise Levels (Unmitigated)

NSR	Assessment Point (Storey)	Assessment Criterion L_{10} dB(A)	Current Noise Level, dB(A)		Future Noise Level, dB(A)		
			L_{10}	Exceedance over Criterion	Improved /New Section	Other Roads	Overall
WM1	3	70	70	-	70	60	70
WM2	3	70	76	6	72	63	73 (1)
WM3	3	70	78	8	73	66	74 (1)
WM4	3	70	69	-	69	59	69
WM5	3	70	69	-	70	59	70
WM6	3	70	71	1	72	58	72
WM7	3	70	76	6	73	62	73 (1)
WM8	3	70	78	8	73	64	73 (1)
CW	2	65	61	-	64	52	65
GV	3	70	76	6	74	62	74 (1)
CH	2	65	75	10	64	69	70 (1)
NW	3	70	73	3	72	56	72 (1)
PS1	3	65	69	4	71	56	71
PS1	5	65	72	7	71	59	71 (1)
PS2	3	65	74	9	72	68	74
PS2	5	65	75	10	72	68	74 (1)
BB	2	70	71	1	65	70	71
VH1	1	70	70	-	74	69	75
VH2	1	70	63	-	64	62	66
TG	3	70	69	-	68	68	71
P1	11.8 mPD	70	-	-	69	81	81
P2	11.3 mPD	70	-	-	71	69	73
P3	11.3 mPD	70	-	-	69	70	73
P4	16.0 mPD	70	-	-	70	66	72
P5	22.0 mPD	70	-	-	71	62	71

Note: (1) Lesser traffic noise impacts when compared with current traffic noise levels, although the noise levels still exceed the HKPSG limits.

Table 2.9 (Cont'd) Current and Future Traffic Noise Levels (Unmitigated)

NSR	Assessment Point (Storey)	Assessment Criterion L_{10} dB(A)	Current Noise Level, dB(A)		Future Noise Level, dB(A)		
			L_{10}	Exceedance over Criterion	Improved /New Section	Other Roads	Overall
P6	30.0 mPD	70	-	-	71	60	71
P7	20.8 mPD	70	-	-	72	57	72
P8	22.6 mPD	70	-	-	67	49	67
P9	22.6 mPD	70	-	-	70	55	70
P10	16.2 mPD	70	-	-	68	55	68
P11	19.0 mPD	70	-	-	71	57	71
P12	21.9 mPD	70	-	-	71	53	71

2.6 NOISE MITIGATION MEASURES

2.6.1 Construction Phase

As discussed in Section 2.5, most of the NSRs will be exposed to significant construction noise impacts. Suitable noise mitigation measures should be provided to protect the affected NSRs throughout the construction period.

While it is not feasible to dictate the methods of construction to be employed by the Contractor, noise control requirements can be incorporated in the contract documents, specifying the noise standards to be met and requirements for noise monitoring on the site. A set of recommended pollution control clauses is provided in Appendix A for incorporation in the contract documents. Also, details of environmental monitoring and audit (EM&A) requirements are contained in the EM&A Manual for the Contractors' observation.

Potential noise control provisions to reduce noise levels from construction activities include, but are not limited to, the following:

- Noisy equipment and activities shall be sited as far from sensitive receivers as is practical.
- Noisy plant or processes shall be replaced by quieter alternatives where possible. For example, pneumatic concrete breakers can be silenced with mufflers and bit dampers. Silenced diesel and gasoline generators and power units, as well as silenced and super-silenced air compressors, can be readily obtained. Manual operations are generally quietest, but may require long periods of time.
- Idle equipment shall be turned off or throttled down. Noisy equipment should be properly maintained and used no more often than is necessary.

- The power units of non-electric stationary plant and earth-moving plant may be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components.

- Construction activities shall be planned so that parallel operation of several sets of equipment close to a given receiver is avoided.

- If possible, the numbers of operating items of powered mechanical equipment should be reduced.

- Construction plant should be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g., bulldozer silencers, compressor panels, and mufflers. Silencing measures should be properly maintained and utilised.

- Temporary noise reducing measures other than noise barriers (e.g. earth embankment) may be used to screen specific receivers. Enclosures for noisy activities such as concrete breaking should be applied where the noise impact is potentially severe.

- Nosiy activities can be scheduled to minimise exposure of nearby NSRs to high levels of construction noise. As far as possible, noisy operations during teaching hours and examination periods should be avoided near the existing schools and should be scheduled in the summer hoildays in order to minimise the impacts.

For mitigation of construction noise at the Project site, the most effective measure is to control noise at source. In the case of PME, this involves either selecting silenced equipment, or reducing transmission of noise using mufflers, silencers, or acoustic enclosures. In the light of the low-rise nature of the NSRs, erecting temporary noise barriers at the site boundary or around the noisy equipment is one of the many effective mitigation options.

Though not effective in reducing noise impacts, the establishment of good community relations can be of great assistance to both the Contractor and local communities. Residents and school administrations should be notified in advance of planned operations and informed of progress. If necessary, a liaison body can be established to bring together representatives of the affected communities, the Government and the Contractor. In addition, residents and school administrations should be provided with a telephone number for the Engineer's office, where they may register complaints concerning excessive noise. If justified, the Engineer may authorise noisy operations to cease or to be conducted at more restricted hours.

The following sample package of noise control measures demonstrates one of many possible mitigation options.

	Mitigation Measures	*Anticipated Noise Reduction*
A	Fit more efficient exhaust or sound reduction equipment, and keep close the machine's enclosure panels	10 dB(A)
B	Erect inverted-L acoustic barrier the equipment and NSRs, and locate the barrier right adjacent the equipment	15 dB(A)
C	Enclose the equipment in acoustic enclosure	20 dB(A)

The above measures are then applied to the construction equipment requirements as indicated in **Table 2.10**. **Table 2.11** illustrates how construction noise could be mitigated at the adversely affected NSRs by providing above-mentioned mitigation measures. Through the proper implementation of the sample package of mitigation measures, the noise levels at all the affected NSRs can be reduced to or below the recommended construction noise criteria.

Table 2.10 Mitigated Construction Activity

Construction Activity	Equipment & Quantity		% On-time	Mitigation Measures	Mitigated SWL dB(A)	Total SWL dB(A)
Preliminary works and mobilization	Truck with crane	1	20	B	90	100
	Backhoe	1	40	A	98	
	Pneumatic breaker	2	20	C	93	
Cutting	Backhoe	1	100	A	102	107
	Dump truck	2	100	B	105	
Col/Abut	Truck with crane	1	25	B	91	98
	Concrete mixer truck	1	80	B	93	
	Vibrating poker	2	80	C	95	
Decks	Concrete mixer truck	1	80	B	93	97
	Vibrating poker	2	80	C	95	
Embankment	Backhoe	1	50	A	99	107
	Dump truck	2	100	B	105	
	Bulldozer	1	100	B	100	
	Road roller	1	100	B	93	
Drainage	Truck with crane	1	20	B	90	102
	Backhoe	1	80	A	101	
	Concrete mixer truck	1	20	B	87	
	Vibrating poker	2	20	C	89	
Carriageways	Road roller	1	80	B	92	101
	Asphalt truck	2	100	B	100	
	Paver	1	100	B	94	
Tie-in Works	Backhoe	1	20	A	95	98
	Pneumatic breaker	2	20	C	93	
	Concrete mixer truck	1	10	B	84	
	Vibrating poker	2	10	C	86	
Completion	Truck with crane	1	20	B	90	100
	Backhoe	1	40	A	98	
	Pneumatic breaker	2	20	C	93	

Table 2.11 Construction Noise Levels for Different Activities (Mitigated)

NSR	Intervening Distance (m)	Noise Level, dB(A)								
		Preliminary works and mobilization	Cutting	Col/Abut	Decks	Embankment	Drainage	Carriageways	Tie-in Works	Completion
WM1	88	56	63	54	53	63	58	57	54	56
WM2	56	61	67	58	57	67	62	61	58	60
WM3	52	61	68	59	58	68	63	62	59	61
WM5*	146	42	49	40	39	49	44	43	40	42
WM6	32	65	72	63	62	72	67	66	63	65
WM7	50	61	68	59	58	68	63	62	59	61
WM8	64	59	66	57	56	66	61	60	57	59
CW*	150	41	48	39	38	48	43	42	39	41
GV	60	59	66	57	56	66	61	60	57	59
CH*	130	43	50	41	40	50	45	44	41	43
NW	18	69	75	67	66	75	71	70	67	69
PS2	56	59	65	57	56	66 (1)	61	60	57	59
BB	135	52	59	50	49	59	54	53	50	52
VH1	45	62	69	60	59	69	64	63	60	62
TG*	116	44	51	42	41	51	46	45	42	44

Notes: (*) A correction of -10 dB(A) has been applied to account for the screening effect of buildings.
(1) 2 dB(A) can be reduced if only one dump truck is used during examination period.

Table 2.11 (Cont'd) Construction Noise Levels for Different Activities (Mitigated)

NSR	Intervening Distance (m)	Noise Level, dB(A)								
		Preliminary works and mobilization	Cutting	Col/Abut	Decks	Embankment	Drainage	Carriageways	Tie-in Works	Completion
P1	39	63	70	61	60	70	65	64	61	63
P2	17	70	77 (2)	68	67	77 (2)	72	71	68	70
P4	58	60	67	58	57	67	62	61	58	60
P5	77	57	64	55	54	64	59	58	55	57
P7	34	64	71	62	61	71	66	65	62	64
P11	30	65	72	63	62	72	67	66	63	65

Notes: (2) 2 dB(A) can be reduced if only one dump truck is used.

2.6.2 Operational Phase

Noise Mitigation Options

Traffic noise may be controlled at source, along its path, or at NSR facades. The various options available for mitigating traffic noise have been reviewed, and their suitability for use in this Project are presented below.

Control at Source

Controlling traffic noise at its source involves the design of quieter vehicles, traffic management and road surface treatments, all of which result in less noise being generated.

Traffic management measures may be introduced, such as reducing traffic flow or vehicle speed or limiting the use of the road by heavy vehicles. However, such measures for traffic noise reduction would be difficult to be effectively enforced, and would reduce the capacity of the road, thus defeating the purpose of the road improvement works. Hence, these noise mitigation measures would be impractical for this Project.

A pervious macadam paving surface (i.e. friction course surfacing) has high acoustic absorption characteristics that can reduce traffic noise levels by 2.5 dB(A) when compared with impervious or concrete road surface for speed below 75 kph, according to CRTN.

The advice given in Highways Department *Guidance Note on Noise Reducing Highway Surfacing (RD/GN/001/A)* states that friction course material should be limited to straight roads with a longitudinal gradient of about 1% and with free flowing traffic running at 70 kph or above. The alignment of Hiram's Highway is sinuous with gradients of up to 10% and subject to a maximum speed limit of 70 kph. Thus, the use of a friction course on this scheme is not recommended.

Potential sources of additional traffic noise can be minimised by omitting manhole covers in the carriageway as far as possible during detailed design and by close supervision of finished pavement level tolerances during construction. Where possible, the existing utilities and drainage services should be diverted to the footpaths or to the central median space, to avoid placing manhole covers and valve chambers in the carriageway.

Control along Noise Path

Controlling traffic noise along its path includes interception by designing the road alignment to incorporate natural or man made topographical barriers or by constructing purpose-built noise screening structures.

Road alignment can be so designed that it incorporates features which will reduce traffic noise at sensitive developments. The road alignment can be altered so that the distance between the carriageway and the affected receiver is increased, thus permitting greater natural attenuation of noise along the path to the receiver.

The straightened alignment of the improved Hiram's Highway is however fixed in view of the road safety concern. Additionally, the existing sensitive developments are located at both sides of Hiram's Highway, shifting the new alignment to any side will not improve the overall noise environment. It would thus not be practical or effective to alter the road alignment to control traffic noise in this Project.

Purpose-built noise screening structures can be in the form of roadside barriers, earth bunds, partial enclosures or full enclosures.

Barriers may be provided along the sides of the carriageway. Under normal circumstances, barriers are more effective when provided close to the noise source. Conventional plain barriers are the simplest noise abatement structure to use. This noise screening option requires minimal space requirements and may easily be erected to suite various road conditions. Given the mix of source-receiver configurations (low-rise developments with small to moderate buffer distances) and the range of noise reduction required, noise barriers would likely be an appropriate and practical mitigation option.

Due to the sightline requirements along the project, any noise mitigation measures will need to be set back from the carriageway. In such situations, the effectiveness of earth bunds or combination of bund and barrier would be reduced as the highest point would have to be located further from the noise source than if a vertical barrier were used. On the embankment sections the earth bunds would have to be located at the top of embankment slopes, and this would require the embankment to be widened which would involve additional land and a substantial increase in the amount of fill material required. In other areas any bunding would affect access to the existing utilities. The use of earth bunds or combinations of bunds and barriers is therefore not considered appropriate for this Project.

Control at NSRs

Control of traffic noise at the receiver includes insulation of sensitive facades, use of self-protecting buildings, orientation of building facades, building setback, and internal arrangement of rooms to screen sensitive areas. Site survey indicates that the existing receivers within the study area do not incorporate any of these measures.

Current practice in noise assessment and mitigation in Hong Kong is that the provision of noise insulation at receivers should only be considered as the last resort should the implementation of all feasible direct technical remedies prove to be impracticable and ineffective. Only those premises which meet the following three criteria are eligible for consideration of indirect technical remedies in the form of window insulations and air conditioning subject to ExCo approval.

- The predicted overall noise level from the new road, together with other traffic noise in the vicinity, must be above the HKPSG criteria of L_{10} (peak hour) 70 dB(A) for sensitive residential facades or 65 dB(A) for that of church / temple / school.
- The predicted overall noise level is at least 1.0 dB(A) more than the prevailing noise level, i.e. the total traffic noise level existing before the commencement of the construction works.
- The contribution to the increase in the predicted overall noise level from the new road must be at least 1.0 dB(A).

Noise Mitigation Scheme

Potential Mitigation Options

A careful consideration of the various traffic noise mitigation options discussed above and other factors, e.g. source-receiver configurations, existing environment and extent of noise impacts, has identified that plain barriers and inverted-L type barriers (only where plain barriers are found to be inadequate) as being the most plausible options available for mitigating traffic noise levels from the improved Hiram's Highway.

To further identify the most practicable form of mitigation, the practicability and effectiveness of the height and the location for the barriers for each section of the improved Hiram's Highway have been duly examined. As a result, a mitigation scheme comprising 3m high plain barrier and inverted-L type barriers is proposed and presented below. The location of the noise barriers are determined to be at least 3m away from the edge of the kerb in order to meet the design criteria such as placement of fire hydrants, provision of kerbside activities, requirement of sightline, and maintenance of utilities and other facilities.

As far as the actual conditions allow, controlling traffic noise at its source and along noise path are more preferable to controlling traffic noise at NSRs. Where it is not feasible to install the above amelioration measures due to site constraints, controlling traffic noise at NSRs with measures such as provision of window insulation and air conditioning units would be inevitable, although it is always seen as the last resort of noise mitigation measures.

While the noise reduction offered by cutting down the number of manhole covers and valve chambers in the carriageway cannot be quantified, this measure should be implemented as far as conditions permit.

Noise Mitigation Proposals

A noise mitigation scheme has been identified for evaluation. It has been developed based on the considerations of critical factors including noise reduction requirements, source-receiver distances, sightline requirements and possible visual impact. The mitigation scheme is aimed to protect the significantly impacted NSRs at Wo Mei, Heung Chung, Grenville Villas, the residential and educational developments near the roundabout, as well as the planned NSRs. Plain barriers and different types of inverted-L barriers are examined for their effectiveness. The mitigation scheme is described in **Table 2.14** and depicted in **Figure 2.9**. The typical positionings of plain and inverted-L type barriers are illustrated in **Figure 2.10** and **2.11** respectively. Due to the sightline requirements on the sinuous Hiram's Highway, the noise barriers are located away from the carriageway (i.e. 0.5m behind the footpath) instead of at the road kerb.

Table 2.14 Noise Mitigation Scheme

Targeted NSR	Length of Direct Mitigation Measures (m)		
	3m Barrier	Inverted-L Barrier Type 1*	Inverted-L Barrier Type 2*
NSRs at Wo Mei, Nam Wai, Heung Chung, Nam Pin Wai Road and Planned NSRs	374	109	253
NSR BB	82	-	-
NSRs PS1 and PS2	-	90	-

* Note : See Figure 2.11 for the details.

Mitigated noise levels at the representative NSRs are shown in **Table 2.15**.

The mitigation scheme will provide considerable noise improvement to most significantly affected NSRs. The mitigated noise levels achieved at existing NSRs along the proposed alignment of road works are 57 to 73 dB(A), representing noise reductions of up to about 13 dB(A). However, five representative NSRs cannot be fully protected by this mitigation scheme, namely CH at Nam Wai, PS1, PS2 and planned NSRs P1 to P3 right adjacent to the roundabout.

Table 2.15 Future Traffic Noise Levels (Mitigated)

NSR	Assessment Point (Storey)	Assessment Criteria L_{10} dB(A)	Future Noise Level, dB(A)		
			Improved/New Section	Other Roads	Overall
WM1	3	70	68	59	69
WM2	3	70	64	63	67
WM3	3	70	66	65	69
WM4	3	70	64	55	65
WM5	3	70	67	59	68
WM6	3	70	63	57	64
WM7	3	70	64	62	66
WM8	3	70	64	64	67
CW	2	65	58	53	59
GV	3	70	69	63	70
CH	2	65	58	69	69
NW	3	70	62	54	63
PS1	3	65	68	55	68
PS1	5	65	68	58	68
PS2	3	65	70	65	71
PS2	5	65	71	66	72
BB	2	70	62	69	70
VH1	1	70	56	49	57
VH2	1	70	54	61	62
TG	3	70	66	68	70
P1	11.8 mPD	70	68	81	81
P2	11.3 mPD	70	70	69	73
P3	11.3 mPD	70	67	70	72
P4	16.0 mPD	70	68	66	70
P5	22.0 mPD	70	68	62	69
P6	30.0 mPD	70	69	59	70
P7	20.8 mPD	70	68	58	68
P8	22.6 mPD	70	63	50	63
P9	22.6 mPD	70	66	56	66
P10	16.2 mPD	70	63	52	63
P11	19.0 mPD	70	69	57	69
P12	21.9 mPD	70	70	51	70

As shown in **Table 2.15**, the total mitigated noise level at NSR CH (i.e. church at Nam Wai) still exceeds the criterion by 4 dB(A) even with the proposed 3m high plain barrier in place. This is mainly attributed to the noise contribution from the existing Hiram's Highway. Hence, even with the provision of a full enclosure, traffic noise from other roads will counteract the noise reduction provided and thus render any mitigation provisions ineffective and impractical. It should also be noted that the implementation of the Project will itself bring about an improvement in the noise environment at the church (see **Table 2.9**) when compared with the current noise environment.

Taking into account of the noise abatement effectiveness of 2 to 3 dB(A), 90m of 3m high inverted-L barriers with an inclined panel of 0.9m near the roundabout are recommended for protecting NSRs PS1 and PS2 (i.e. north and south wings of Sai Kung Central Primary School), although the noise problem still cannot be ameliorated effectively due to: (a) discontinuation of the mitigation structures at the roundabout, and (b) setback of the mitigation measures to suit the sightline requirements. Other locations for noise barrier have also been examined but the effectiveness is very minimal with only about 1 dB(A) reduction in overall noise level. For example, since the noise is mostly genrated by the proposed highway which will be above the level of the existing roads, for the noise barrier to be effective if it is placed in front of the NSRs PS1 and PS2, the height of the noise barrier will be substantially higher than 5m. Therefore, this location is not reccommended.

Residual Impacts and Indirect Mitigations

To cater for the residual impacts, it is recommended that EPD's eligibility criteria should be applied to test whether NSRs CH, PS1 and PS2 are eligible for consideration of indirect technical remedies through the provision of window insulations and room air-conditioners.

Results of the eligibility assessment, as presented in **Table 2.16**, show that NSRs CH, PS1 and PS2 are not eligible for consideration of indirect technical remedies as the implementation of the project will reduce the traffic noise levels at the NSRs.

The estimated number of classrooms exceeding the HKPSG criterion of 65 dB(A) upon the operation of the improved Hiram's Highway with and without direct mitigation measures are 16. It should be noted that NSR PS2 (i.e. north wing) is covered by the *Noise Abatement Programme in Schools* to cater for traffic noise impact from the existing roads. A visit to the school confirms that the classrooms at the north wing have been provided with air-conditioners. In considering next stage of noise abatement programme in schools. This school should be included for appraisal. For the residential developments, while there are about 182 out of 298 number of existing dwellings along the proposed alignment exceeding the HKPSG criterion of 70 dB(A) without noise mitigation measures, the predicted traffic noise levels at all of the dwellings would comply with the noise criterion under the recommended noise mitigation scheme.

Table 2.16 Eligibility Assessment for Indirect Technical Remedies

NSR	Storey Assessed	Assessment Criterion L_{10} dB(A)	Prevailing Noise Level L_{10} dB(A)	Predicted Noise Level, dB(A)			Criteria 1 (5) > (1)	Criteria 2 (5) - (2) ≥ 1.0	Criteria 3 (5) - (4) ≥ 1.0	Indirect Mitigation (Yes/No)
				Improved / New Road	Other Roads	Overall				
CH	2	65	75.0	57.6	68.8	69.1	Yes	No	No	No
PS1	3	65	68.8	67.5	55.0	67.7	Yes	No	Yes	No
PS1	5	65	72.0	68.1	58.4	68.5	Yes	No	Yes	No
PS2	3	65	74.0	69.6	64.8	70.8	Yes	No	Yes	No
PS2	5	65	74.5	70.5	66.0	71.8	Yes	No	Yes	No
Column		(1)	(2)	(3)	(4)	(5)				

Development Constraints for Planned Land Uses

With respect to planned NSRs (i.e. P1 - P12), following the operation of the improved Hiram's Highway, based on the available information such as development area, plot ratio, and average house size, there are approximately 285 number of dwellings exceeding the HKPSG criterion of 70 dB(A) without noise mitigation measures. Under the proposed mitigation scheme, about 90 number of dwellings still exceed 70 dB(A) noise limit and the noise exposure levels are in the range of 63 - 81 dB(A), representing a maximum noise exceedance of 11 dB(A). As a result, in addition to the proposed inverted-L type noise barriers near the roundabout, due considerations should be given to other mitigation measures such as setback, window orientation, internal building layout and use of noise tolerant structures for the NSRs exposed to residual impacts (i.e. P1, P2 and P3). By taking the projected worst case scenario AM peak hour traffic flows into consideration, the required setback distances from the corresponding zone boundary are summarised in Table 2.17.

Table 2.17 Setback Distances for Planned NSRs

NSR	Building Type	Setback Distance
P1	Comprehensive Development Area	97m from eastern zone boundary
P2	Comprehensive Development Area	31m from southern zone boundary
P3	Village Type Development	31m from southern zone boundary

Amelioration of the noise impacts at the planned CDA (i.e. P1 and P2) and Village Type Development (i.e. P3) near the roundabout by building setback of 31m and 97m solely is unlikely to be a practical and workable solution. As such, considerations should be given to any other viable solutions.

Taking into account of the maximum building height on land zoned "CDA" (i.e. 2 storeys over one level of carport) and Village Type Development, since noise barrier cannot be provided along the edge of the roundabout due to the sightline constraint, a 3.5m high inverted-L barrier could be erected at the edge of the zone boundary, coupled with the adequate building setback of 5m, to mitigate the adverse noise impact. The barrier could be in the form of a solid wall boundary, a transparent noise screen or a landscaping feature. On the other hand, however, such recommendation is unlikely to be implemented for Village Type Development. Alternatively, internal arrangement of rooms with a view to orient the sensitive rooms as far from the noise source as practical should be considered. As the last resort, in case where internal arrangement of rooms is not preferred in view of the magnificent seaview, indirect technical remedies in form of window insulation and central air-conditioning system can be provided for the front row of the noise sensitive receivers.

In view of the site constraints, the above development constraints should be taken into account when assessing the Master Layout Plan of the CDA and the applicants of the Village Type Development area near the roundabout should be alerted of the development constraints.

Air Quality Issues

Plain barriers of 3m high and inverted-L barriers of 3m high with an inclined panel up to 1.3m are proposed to mitigate the adverse noise impacts at the noise sensitive receivers in the Study Area. As these barriers have limited potential for trapping air from the carriageway, it is considered that no adverse impact on the air quality near the proposed barriers would result from the installation of these barriers.

2.7 CUMULATIVE NOISE IMPACTS

2.7.1 Concurrent Projects

Concurrent activities with potential contribution to the noise environment in the Study Area include:

(a) Improvement of Nam Wai Road

The project plans to improve the section of the local access road between Heung Chung and Au Tsai Tsuen. Construction works mainly includes widening of the existing road to 7.3 m (with some areas 5.5m wide). The project has been scheduled for construction in March 1998 and completion by March 1999.

(b) Improvement of Access Road to Mok Tse Che

A local access road improvement project between Wo Mei and Mok Tse Che aims to upgrade the existing road to 3.5m wide with a 1.6m footway. The construction of the project will be commenced in December 1998 and completed by March 2000.

Locations of these two projects are shown in Appendix B. Due to the preliminary status of these schemes, no other project details are available at this time.

Two other projects that will be implemented in the vicinity of the Study Area are Port Shelter Sewerage, Stage 3: Sewage Transfer from Ho Chung Catchment to Tseung Kwan O and the construction of a ground level carpark. The proposed construction dates for the Sewerage are commenced from August 1999 to completion by June 2002. This would mean there will be almost 1 year overlap with this scheme. However, no other details for both projects are available at the time of preparing this EIA.

2.7.2 Cumulative Construction Impact

While details of the construction programmes and methodologies for the concurrent activities are unavailable to the present study, it is unlikely that Improvement of Nam Wai Road, Improvement of Access Road to Mok Tse Che, Port Shelter Sewerage Stage 3, and the ground level carpark projects will have a significant cumulative noise impact during the present improvement works.

2.7.3 Cumulative Operation Impact

No cumulative operational noise impact is envisaged as no concurrent road projects have been identified in the project area.

2.8 ENVIRONMENTAL MONITORING AND AUDIT

An environmental monitoring and audit (EM&A) programme performs three functions. It ensures that environmental quality from the construction and operation of the project are kept to acceptable levels; it establishes procedures for checking that mitigation measures, if needed, have been applied and are effective; and it provides the means by which compliance may be checked, exceedances documented, and corrective action recorded.

In view of the close proximity of the Hiram's Highway to the identified NSRs as well as the significance of construction noise and dust impacts, an EM&A programme is considered necessary during the construction period. The proposed EM&A programme for this Project which forms part of this EIA is contained and described in a stand-alone document, Environmental Monitoring and Audit (EM&A) Manual.

Detailed monitoring schedules and audit requirements should be incorporated into the construction contract for the improvement of Hiram's Highway. The clauses containing these schedules and requirements should be formulated in consultation with EPD.

3 LANDSCAPE AND VISUAL IMPACTS ASSESSMENT

3.1 INTRODUCTION

This chapter contains the assessment made of the significant landscape and visual impacts that would occur during the course of the works, (construction impacts), the landscape mitigation measures proposed to ameliorate those impacts, and the impacts that will remain even when the mitigation have become effective (long term impacts). The assessment has been carried out using the methodology described in the inception report.

3.2 DESCRIPTION OF THE PROPOSED WORKS

The elements of the new dual carriageway between Nam Wai and Ho Chung that will have a significant landscape or visual impact include the deep cutting at its upper portion west of Wo Mei Village, the extensive embankments as it passes between Wo Mei and Nam Wai, the two bridge structures where it crosses the existing Hiram's Highway, the new roundabout junction at Nam Pin Wai Road, and noise barriers along various portions of the route.

The works additionally includes improvements to the junction with Nam Wai Road the upgrading of the village access road to Wo Mei along the line of the existing Wo Mei Kapok Road, construction of new car park facilities in the lot adjacent to the Greenfield Nursery and reprovisioning of local footpaths.

3.3 LANDSCAPE CONTEXT OF THE EXISTING SITE

The project site lies to the South of Sai Kung, along the coast on the west side of the Hebe Haven, and at the bottom of the Ho Chung Valley (see **Figure 3.1** - Site Location Plan). To the South are Hebe Knoll and Ta Ku Ling, foothills to the Razor Hill and Kowloon Peak, and to the west is the Ho Chung Valley with the extensive hill country of the Ma On Shan Country Park beyond. The landscape and visual context of the proposed works is given in **Figure 3.2**, an aerial photograph with the proposed route superimposed at **Figure 3.3**, and photographs of the existing site are given in **Figures 3.4** to **3.7**.

The proposed road alignment will cut through the existing slope along the west side of the previously widened section of Hiram's Highway, which was formed, hydro-seeded and extensively planted with trees some three years ago. The trees are now in a semi-mature state, some 4 - 5 metres in high.

The road emerges from the new cutting into the flat land at the foot of the hill slopes North East of the village of Wo Mei Village. The land between the village and the existing alignment of Hiram's Highway is under active horticultural use, occupied by the Yue Sun Horticultural Nursery.

The village of Wo Mei sits on the bottom of the slopes with the houses set in three or four informal terraces up the slope, all facing in a north east direction toward the sea. The houses are a mixture of traditional and modern style village houses, with numerous old buildings.

The flat land to the west of the village along Wo Mei Kapok Road is occupied by low rise factory units (mainly ceramics), the Glowell and Nam Yeung horticultural nurseries. To the North as far as Nam Pin Wai Road the land was previously under agricultural production, but is now all abandoned.

To the south and south west of Wo Mei Village, the land rises as part of the lower Ho Chung Valley and the landscape is characterised by small scale residential developments set on the lower part of the natural slopes on both sides of the valley. The flatter land in the valley bottom is mainly occupied by open storage areas, and industrial and commercial land uses.

At the north west end of the study area there are further low rise factory units on Hiram's Highway at the junction with Nam Pin Wai Road and existing and new residential buildings along Nam Wai Road, near it's junction of Tse Che New Village Road.

One area close to this junction is currently under development and a further two have been identified for future development (see Figure 2.8). These include:

- Village Area (V) immediately to the West of this, partially fronting onto Nam Pin Wai Road, (houses currently under construction),
- Comprehensive Development Area (CDA) at the north west corner of the junction of Hiram's Highway and Nam Pin Wai Road, (no plans available)
- R(C)1 site immediatelly to the south of these occupying the higher ground adjacent to the access road leading to Upper Wo Mei Village. (Master Layout Plans just submitted)

Immediately to the north of Hiram's Highway the landscape along the edge of the bay is dominated by the Sai Kung Central Primary School, with the low rise residential developments at Berkeley Bay Villas and the extensive Marina Cove along the coast line to the north. The villages of Nam Wai and Heung Chung extend along the coast line to the west. To the north of Wo Mei, adjacent to the school there are more low rise factory units, the Greenfield Nursery, and an extension of the Yue Sun Nursery.

The natural slope of the prominent Ta Kwu Ling and Hebe Knoll to the south and west of Wo Mei are heavily vegetated with mature woodland. These form distinctive landscape features in the back drop to many view from within the site and surrounding areas.

Extensive woodland belts and stands of mature trees still exist around the buildings and fields in the valley bottom where they have been retained from larger stands of the woodland, creating a generally enclosed character to the landscape. There are many mature trees along the road side of Hiram's Highway and in small groups in, and around the horicultural nurseries and industrial units.

The study area may be divided into following four broad landscape character zones, each having varying sensitivity to the changes brought by the large scale highway structure proposed.

The areas surrounding the section of Hiram's Highway that has previously been dualled, have a large scale character dominated by the carriageway of the road, and the heavily wooded slopes to either side. This is assessed as having a relatively low sensitively to change.

The complex pattern of residential and commercial land uses, with intermittent trees and small blocks and belts of vegetation along the foot of the natural slopes and along the coast line create a second distinct landscape character, of smaller and more intimate scale, with a moderate sensitivity to change.

The densely wooded slopes of Ta Kwu Ling and Hebe Haven to the south and west form a more natural and largely undisturbed landscape, having a moderate sensitivity to change.

Lastly the low lying to the south of Ho Chung Village, under agricultural or open storage land use, with belts of woodland and individual trees, create a fourth landscape character zone, of intimate character with a moderate sensitivity to change.

A full survey of the existing trees within the study area will be prepared as part of the detailed design of the works and will be submitted together with compensation planting proposals, to the relevant authorities for approval.

3.4 VISUAL ENVELOPE

The complex topography, the diverse low rise land uses predominant in the area and the extensive existing mature tree belts, will result in the proposed road having a mainly localised visual impact.

The visual envelope of the road, (shown on the Landscape and Visual Context Plan - **Figure 3.2**) will effectively be restricted to the areas around Wo Mei, existing and proposed residential areas along Nam Pin Wai Road, Nam Wai, with the low rise residential development at Berkeley Bay Villas to the North, and the older village settlement at Heung Chung to the east, marking the limit of the envelope.

Views from the residential developments along the coast at Marina Cove to the North and Nam Wai to the East, together with the popular recreational areas within Hebe Haven, will be screened by the existing school and low rise industrial buildings and mature vegetation along the coast line.

Potential views from the scattered residential settlements in the main part of the Ho Chung Valley and from the majority of areas within the Country Park to the West will be screened by the topography and the local woodland belts.

There will be clear views of the whole route alignment from the hill slopes to the east, above Chuk Kok, which is a noted local grave site area. (see **Figure 3.4**)

Long range views are possible from Pik Uk and the Razor Hill ridgeline to the South and from Buffalo Hill and Tai Lo Shan ridgeline to the west. These views will be over a considerable distance and the new road would constitute too small an element in the view to have a significant visual impact.

3.5 LANDSCAPE IMPACT

The natural slopes of the prominent Ta Kwu Ling and Hebe Knoll to the south and west of Wo Mei are heavily vegetated with mature woodland. These form distinctive landscape features in the back drop to many views from within the site and surrounding areas.

The landscape impact of the proposed works is indicated on the Landscape and Visual Impact Plan **Figure 3.8.**

The scale and nature of the proposed cutting through the hill slopes to the east of Wo Mei and the large-scale embankment and bridge structures will result in a significant change in the land form pattern of the area, working against the natural slope and bay composition of the landscape. The addition of the artificial noise barriers to the top of the embankment will further heighten the negative impact on the character of the area.

The landscape impact of the cutting through the spur is unavoidable, and will constitute a high landscape impact. The possible use of an elevated structure as an alternative to the embankments to avoid their high landscape impact, was considered at the outset of the project. However, it was assessed as not having significantly less impact, due to the size of the elevated structure required, the need for clearance of a similar area of trees to construct it, and the lack of opportunity for screen planting a suitable height to mitigate the impacts.

In the wider context the proposed road will be set well down at the foot of the hill slopes and along the valley bottom, so will tend to be absorbed into the surrounded by diverse pattern of industrial, commercial nurseries, residential and institutional buildings and land uses around the edge of the bay. It will also be in the same context and of a similar scale as the existing road corridor.

It will have a moderate impact on the character of the natural wooded slopes, as the road is in sharp contrast to the natural woodland landscape in this area. The proposed works will effectively run along the edge of the zone, cutting through the hill slopes, reducing it in size, and extending the landscape character zone around Wo Mei, resulting in a deterioration in the overall quality of the landscape environment.

The construction of the proposed road will result in the loss of a large number of semi mature trees from the slopes on the west side of the recently dualled section of Hiram's Highway, and some mature trees in and around the nurseries and industrial areas immediately to the north and west of Wo Mei Village. The diverse nature of the land use in this area will to some extent reduce the impact on the character of the landscape resulting from this loss of vegetation.

The road will have a high impact on the character of the local landscape, but this impact is not considered to be significant in the context of the wider scale landscape pattern of the Ho Chung Valley and the hill slopes the Country Park, or to nature of the coastline of Hebe Haven.

3.6 VISUAL IMPACT

The visual impact of the proposed works is indicated on the Landscape and Visual Impact Plan **Figure 3.8.**

There will be a high visual impact on all the north facing rooms in the front line houses and general public areas on the two lowest terraces, at Wo Mei. The new road on high embankment with a further 3 to 4 metre high noise barrier on top will become the dominant element in existing views across Hiram's Highway of the Greenfield Nursery and Hebe Haven beyond.

Houses on the west side of the village will have, in addition views down onto the road in its approach to the roundabout and of the new village access roads, and will also experience a high visual impact.

Views from the top floors of houses on the upper terraces, will also be possible but these will be from above the level of the new road and will be screened to some extent by the houses in between. The visual impact is therefore considered to be low.

Further up the slope to the west, there will be a medium visual impact on the houses in the upper part of Wo Mei Village, which will have views down onto the new road. Although these views will be interrupted locally by adjacent industrial and horticultural nursery areas, and the existing stands of trees that will remain, the road will be obvious, through the loss of vegetation and

because the scale of the embankment would be so large in comparison to the other landscape and building features.

At the west end of the route there will be a high visual impact on the single storey houses south of Nam Pin Wai Road, where the new road will occupy the existing open grass areas immediately in front of them.

There will be a similar high visual impact on the upper two storeys of the new and existing village houses north of Nam Pin Wai Road, with views down onto the area of the new roundabout road and along the line of the route to the south. The road will form a much larger scale element than the existing road, and will result in the loss of existing grass and woodland vegetation in the view. The intervening vegetation retained will screen views from lower floor apartments.

There will be a similar high visual impact on the upper two storeys of some six new house units (total twelve apartments) within the adjacent Village Area (V) which face onto Nam Pin Wai Road. The other houses will be screened by the existing factory buildings and associated vegetation and the future CDA if developed.

The changes in the view from the site of the CDA will also be of a similar nature, but as no proposals have been prepared for the development, the type, form and orientation of the buildings are not known. The visual sensitivity of the development and possible change in view, therefore, cannot be determined. It should be assumed that the prospective developers and purchasers would be aware of the new road project, and that the view of the road would be taken into account in the design of the development.

The current Master Layout Plans for the R(C)1 site on the access road leading to Upper Wo Mei Village, indicate that up to thirty houses may be orientated toward the line of the new Road. However, due to the intervening topography and vegetation none of these are likely to have clear views of the road. As the nature of 'existing views' from future properties cannot be determined, accurate assessment of visual inpact is not possible.

If these houses were in existence at present the visual impact would be low, and could successfully be mitigated through the proposed planting along the main embankments. However, the potential for such impact should be taken into account in the design of the site.

There will be a visual impact on the upper floor class rooms of the Sai Kung Central Primary School, with views down onto the area of the new roundabout road and its connections to the existing roadways. The impact is considered to be low, as the class rooms are orientated toward the sea, (with the windows on the road side tend to be small and occupied by air conditioning units), and the existing school boundary wall and line of mature trees along the road forming a partial screen to the new works.

Some views of the new roundabout will be possible from the upper floors of houses at Berkeley Gardens, although as the new road will be partially screened by intervening low rise buildings and vegetation and will be seen in the context of the existing road and factory buildings beyond, the visual impact is considered to be low.

There will be views of the car park from the houses along the waterfront at Heung Chung, but as these are oblique views seen in the context of the existing industrial units in the area, the visual impact is considered to be low.

The road will have a more significant impact on views from the properties at Roseville Villas at the junction of Nam Wai Road, where there will be views down onto the new elevated section of route as it passes in front of Wo Mei. These will be partially screened by existing vegetation, but the visual impact is likely to be medium as a result of the introduction of such a large scale element into the diverse landscape pattern, and the loss of existing vegetation and buildings.

The elevated nature of the road will also raise the level of street lighting against the darker backdrop of the sea, causing further visual impact at night to properties close to the route.

3.7 LANDSCAPE MITIGATION MEASURES

There is very limited scope for the consideration of major alternative alignments within the defined project limit of works. An alternative scheme using an extended bridge structure adjacent to Wo Mei Village was considerd at an early stage in the study as a means of minimising impact on existing land use and trees, but was assessed as having no significant benefit due to the area affected by the works and problems of access during construction. As it was substantially more expensive it was not taken forward in the overall scheme assessment.

Detailed refinement of the road alignment and configuration of structures and associated works is a key element of the mitigation measures and will be undertaken during the detailed design of the works. Opportunities exist for instance, for retaining many of the trees at the toe of proposed embankment slopes, through the imposition of limitations on the Contractor's working area and method.

The landscape mitigation measures seek to screen all sensitive views of the road, to reinstate the vegetation that will be lost and to blend the new road into the landscape pattern of the surrounding area. The proposals are shown on **Figure 3.9** and **Figure 3.10**, the Landscape Mitigation Plan, and on the photomontages **Figures No. 3.11, 3.12, 3.13, and 3.14**

Extensive woodland planting is proposed to the cutting slopes at the southern end of the route to replace the recently planted trees and visually to tone down the cutting slopes in views from the wider landscape.

The main embankment slopes to the north of Wo Mei will similarly be planted with woodland tree and shrub species, to form a large woodland belt throughout the area. The planting next to the carriageway will in time grow to screen the traffic and noise barriers in views from adjacent buildings, and will help to break up the scale of the embankment in the small scale landscape pattern. Additional planting is proposed for areas along the existing Hiram's Highway to increase the screening as general environmental improvements to the areas.

Informal avenues of trees will be planted along side the local village access road Wo Mei Kapok Road, with further woodland planting is proposed for the larger embankments and in pocket areas created by the road alignment, to provide screening from surrounding properties, and to recreate the typical landscape pattern of road side planting on such roads in the area.

Woodland planting is also proposed for the areas within and around the new roundabout to screen views, especially elevated views from adjacent properties, and to tie together existing blocks of woodland into a more contiguous landscape pattern. Amenity shrub and groundcover planting is proposed for the pedestrian areas immediately around the new roundabout junction to create a more distinct character to the area, and as a means of planting within the future sightlines.

Additional tree planting is proposed along Hiram's Highway and Nam Pin Wai Road, within the project limit, to improve the landscape setting to that road and as general environmental improvement works, to increase the proportion of vegetation in long range views from the surrounding hills.

Amenity tree and shrub planting is proposed around the new car park area and along the new Heung Chung access road, to form a screen in views from the houses at Heung Chung and to reinstate the line of vegetation that is growing along most of the waterfront in this area.

Planting design will be undertaken at Detailed Design Stage, and will include the development of different woodland types. Species mixes will be based on the mitigation measures proposed to ameliorate the landscape, visual and ecological impact. Planting mixes for proposed areas of native woodland, for instance, will be based largely on the species recorded on site during the tree and ecological surveys. The design of the planting of areas of native woodland will take into account of the soil conditions required and the need to create a suitable micro-climate environment. Suggested list of species for planting is given in Table 3.1. Planting will be undertaken at the earliest practical time in the construction period.

Table 3.1 Proposed Species List

	Embakments alongside Secondary Woodland (Woodland Mix A)	Other Embankments (Woodland Mix B)
Nurse Species	Acacia auriculaeformis	Acacia auriculaeformis
	Acacia mangium	Acacia mangium
	Eucalyptus robusta	Eucalyptus robusta
	Eucalyptus tereticomis	Eucalyptus tereticomis
		Melaleuca leucadendron
Long Term Species	Ardisia crenata *	Albizia lebbek *
	Alangium chinense *	Averhoa carambola
	Bischofia trifoliata *	Bischofia trifoliata *
	Bridelia monoica *	Bombax malabaricum
	Castanopsis fissa *	Callistemon viminalis
	Celtis sinensis *	Cassia surattensis
	Cinnamomum camphora *	Castanopsis fissa *
	Endospermum chinense * (1)	Celtis sinensis *
	Ficus variegata *	Cinnamomum camphora *
	Ficus virens *	Delonix regia
	Gordonia axillaris *	Ficus variegata *
	Ilex rotunda *	Ficus virens *
	Litsea glutinosa *	Gordonia axillaris *
	Macaranga tanarius *	Ilex rotunda *
	Mallotus paniculatus *	Litsea glutinosa *
	Quercus edithae *	Macaranga tanarius *
	Sapium sebiferum *	Mallotus paniculatus *
	Schefflera octophylla *	Mangifera indica
	Scolopia chinensis *	Melia azedarach
	Sterculia lanceolata *	Michelia alba
	Ternstroemia gymnanthera *	Pterocarpus indicus
		Sapium sebiferum *
		Schefflera octophylla *
(1) Extensive planting of this species will be provided at appropriate location.		Sterculia lanceolata *
		Terminalia catappa
		Toona sinensis

* Native Tree Species in Hong Kong

Where space permits the profile of embankment and cutting slopes will be re-contoured by localised additional filling or trimming to marry them into to adjacent natural slope profiles and soften the angular appearance of the slopes in the landscape setting.

Landscape mitigation measures also include the design of hard landscape elements, including footpaths and raised planter beds, and the architectural treatment of bridge decks and abutments and the pedestrian underpass structure. To reflect the semi-rural nature of the landscape setting, it is proposed that all retaining walls, the abutments to the two bridge structures and entrances to the pedestrian underpass be clad in natural granite, with patterned moulding used to create some architectural detailing on the other engineering structures.

The design concept for the noise barriers will seek to reduce their visual impact by maximising the extent of vision panels, and providing a textured and colour patterned surface to the solid panels, and by reducing the linear elements. The barriers will be constructed from perforated aluminium noise absorptive panels and clear vision panels in a supporting frame. The barriers would be set behind a low wall to reduce their visual depth.

Vision panels have been used extensively, covering more than half the surface area. They have mainly been set above the standard eye level to screen out views of the traffic from pedestrians but allow light and views of adjacent vegetation and reduce visual obstruction.

A number of features have been incorporated into the design in order to break up the continuous flat appearance of the fence, reducing the visual impact of the barrier and helping it blend more readily into the texture of the landscape backdrop.

- variety in the height in the panelled sections of the barriers with a staggered upper and lower line,
- variety in the widths of the panel sections interchanged in sequence,
- variety in the size of the solid and clear vision panels, to reduce the uniformity of the appearance,
- ribbed finish to the solid panels, in alternating directions, in a range of four colours to blend in with the colour tones and textures of the surrounding roadside landscape and mitigation planting proposals.

The architectural treatment of the noise barriers has been given approval in principal by ACABAS, but together with the bridge structures, and pedestrian underpass will be developed during the detailed design and will be presented to ACABAS for approval.

The visual impact of the street lighting could be mitigated through the use of the light shield or recessed flat light to reduce the amount of over-spill onto adjacent areas.

3.8 RESIDUAL LANDSCAPE AND VISUAL IMPACT

The landscape mitigation measures consist of extensive belts of woodland planting which will take some 8 - 12 years to grow and become effective in forming a screen to the road. After that time there would be only some minor residual landscape and visual impacts.

The planting will effectively screen all views of the road from Berkeley Gardens and Heung Chung Village. Although there will still be views of the new roundabout from the upper floors of the Sai Kung Central Primary School, the planting along Hiram's Highway and around the junction should reduce the visual impact considerably, and it should not be significant in the context of the overall view and the general prospect from the classrooms.

The traffic on the road will become screened, and the overall size and shape of the embankment structure would become obscured in views from Roseville Villas by the planting to the embankment slopes and the additional perimeter planting to the new nursery area on the adjacent lot.

The embankment slopes will remain as the dominant feature in the landscape in views from the houses on the lower terraces at Wo Mei. The extensive woodland planting should grow to screen the traffic and the noise barrier structures, but the scale of the slope will still be obvious. As a substitution for much wider existing views of a diverse and well used landscape with some prospect of the sea beyond from upper floors, it is considered that there would be a low long term visual impact. However it is considered acceptable, in the context of the whole project.

The planting should effectively screen the views of the road and its traffic from the houses further up the slope at Wo Mei where the new planting will be seen as a woodland belt in the context of the existing vegetation pattern.

Views form both the existing and new three storey village housing blocks on Nam Pin Wai Road will be screened to some extent by the proposed planting, although their proximity to the junction, views along existing road corridors, and loss of more open views of the school will mean that there will be a low long term visual impact.

3.9 CONCLUSION

The new road will constitute a large element in a small diverse landscape setting, and will result in significant landscape impact as the overall size and shape of the embankment and road features will be in contrast to the complex pattern of existing residential village settlements, horicultural nurseries and low rise industrial and storage land uses which have been arranged around the original agricultural field pattern, and to the broad back drop of densely wooded natural slopes of Ta Kwu Ling and Hebe Knoll to the west.

The construction of the new road will result in the loss of existing mature woodland belts and individual trees, that currently lie in and around the village houses and along the existing roads. There are also a large number of recently planted trees along the slopes to the dualled section of Hiram's Highway that have now reached a semi-mature state, that would also be affected.

The enclosed nature of the existing landscape will mean that the visual envelope of the new road will be localised. Views of the road will be in the context of the existing industrial and commercial land uses and the existing Hiram's Highway which will be retained.

There will be a high impact on the houses on the lower terraces of Wo Mei Village and on a small number of new and existing three storey houses on Nam Pin Wai Road. Properties slightly further away on the upper part of Wo Mei Village, the other new houses within the Village Area on Nam Pin Wai Road, and those at Berkeley Gardens and Heung Chung Village (and for the future R(C)1 development site on the access road to Upper Wo Mei Village) will experience only low to medium visual impact as views will be oblique or partially screened by existing vegetation retained.

There is likely to be low visual impact on the Sai Kung Central Primary School, because although very close to the route, it is orientated out to sea and there is only a limited prospect of the road from the classrooms.

Extensive planting of woodland tree and shrub species is proposed for all new cutting and embankment slopes together with street tree planting along the existing and corridors and ornamental planting in pedestrian areas around the new roundabout.

In time the woodland planting should grow to form an effective screen against views of the road from most properties that would be affected. Due to their proximity to the road and the visual obstruction of existing open views there will a low level of residual visual impact on the properties of the lower terrace at Wo Mei and the houses close to the new junction on Nam Pin Wai Road. In the context of the overall scale of the road this residual impact may be considered acceptable.

3.10 RECOMMENDATIONS

To mitigate the assessed landscape and visual impacts of the scheme, as far as possible it is recommended that the following measures be adopted:

- retention of all existing vegetation within the study area not directly affected by the works
- the refinement of the alignments and configurations of all new carriageways, drainage channels and footpaths to minimise potential impacts, and the localised trimming of engineered slopes to blend them into adjacent natural slope profiles.
- woodland planting to all cut and embankment slopes, and to other open areas within the works limit, with additional street tree planting alongside the new carriageways and ornamental shrub planting in pedestrian areas.
- additional street tree planting along unaffected existing roads within the study area.
- adoption of light shield/recessed flat light on street lighting system along the proposed highway.
- the architectural treatment of bridge decks, abutments, pedestrian underpass and retaining walls, noise barriers, and other engineering structures and the hard landscaping of pedestrian area adjacent to the road.
- Procedures dealing with EM&A requirement on landscape and visual impacts arising from construction and during establishment period should be followed as stated in the stand-alone document, EM&A Manual.

4 ECOLOGICAL IMPACT ASSESSMENT

4.1 INTRODUCTION

Vegetation survey and stream survey were carried out in 18 May 1996 to provide an overview on the character of the vegetation cover and stream courses within the Study Area for evaluation of ecological impacts of the proposed road works. An additional survey on the secondary woodland along the western face of the ridge east of Wo Mei Village was conducted on 31 January 1997.

As the areas to be affected are adjacent to the existing road and village areas, they are already disturbed considerably. Moreover, the trees found are mainly common or introduced species. As such, the wildlife use of the affected areas is not expected to be significant and hence the potential impacts to flora and fauna would be minimal.

4.2 PROPOSED ROAD IMPROVEMENT WORKS

The proposed improvement works of Hiram's Highway between Nam Wai and Ho Chung involve deep cutting at its upper portion west of Wo Mei Village, and the construction of extensive embankments and structures between Nam Wai and Nam Pin Wai, and the new roundabout junction at Nam Pin Wai Road. Additionally, the works will upgrade the village access road to Wo Mei along the line of the existing Wo Mei Kapok Road and other ancilliary works.

As part of the road improvement works, a section of the existing stream at the west of Wo Mei will be replaced by a combination of open channel and box-culvert for those sections under the roads and embankments. Besides, a section of the existing stream at the east of Wo Mei will be diverted and replaced by open channel to be constructed to the north of Wo Mei.

4.3 POTENTIAL IMPACTS

The proposed road alignment will cut through the existing slope along the west side of the previously widened section of Hiram's Highway which is now extensively planted with young or semi-mature trees of 4-5 metres high covering an area of about 1.38 ha (Area A). The main species on the cut slope are *Acacia auriculiformis*, *Acacia mangium* and *Castanopsis fissa*. The new road alignment will also cut through an area of secondary woodland (0.52 ha) within Area A between the cut slope and the Yue Sun Nursery. Furthermore, the construction of the proposed road will result in the loss of some mature trees in and around the horticultural nurseries and industrial areas immediately to the north of Wo Mei Village with an area of about 0.53 ha (Area B). The trees are mainly cultivated by the residents for shading and aesthetic purposes. **Figure 4.1** depicts the areas of the trees affected.

According to the vegetation survey, apart from the secondary woodland area, altogether 32 tree species were inspected in the Study Area. Most of the trees are either mature or semi-mature. A list of the tree species identified during the survey is scheduled in Appendix C. With special regard to the secondary woodland area near Wo Mei Village, a total of 52 species were recorded during the course of the survey. Most of the species in the woodland are common tree species such as *Ficus* species, *Sterculia lanceolata* and *Litsea* species which are of relatively small sizes. However, six trees of one uncommon and regenerating species, *Endospermum chinense*, were recorded. Details of the woodland survey are presented in Appendix D.

The main ecological impact due to the construction of the Project will be the loss of 1.91 ha of vegetation cover. Of them 1.39 ha are plantations or cultivated trees of lower ecological value and 0.52 ha is secondary woodland. As the area of woodland to be lost is relatively small and a major portion is consisted of planted or cultivated species, with compensatory replanting in place, the impact is not expected to be significant.

A detailed tree survey was also carried out and the summary of the tree survey report is attached in Appendix E.

As the streams to be affected are small in size and exhibit large seasonal variation in water flow, the use of the affected streams by fresh water fauna is not expected to be significant. In addition, stream diversion and training works will be carried out only for those sections under the roads and embankments.

To minimise potential water quality impacts during construction phase, the desilting function of the temporary drainage measures will be provided to prevent debris settlement in the existing streams and channels. Foul water effluent should be directed to a foul sewer or to a sewage treatment facility either directly or indirectly by means of pumping or other means approved by the Engineer. During the operational phase, future stormwater runoff from road surfaces should be routed through oil/grit separator(s) and/or vegetative channel(s) before discharging into the subject streams. Through proper implementations of these mitigation measures, water quality impacts arising from these ancillary works would not be significant.

4.4 RECOMMENDATIONS

To compensate for the loss of woodland, extensive planting/transplanting of secondary woodland trees including *Endospermum chinense* and large shrub species for all new cutting and embankment slopes is proposed. The replanting proposal and the soil condition of the slope/embankment for replanting would be taken into considerations at the detailed design stage. Approximately 3.75 ha will be available for the replanting. The species used will be similar to the existing ones to match with the surrounding landscape. More ornamental species will be used in pedestrian areas along the local access road. Moreover, some 108 numbers of the affected trees are found suitable for transplanting.

Ecological impacts arising from construction and during establishment period should be monitored and audited in accordance with EM&A procedures which are summarised in the stand-alone document, EM&A Manual.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS - NOISE

Construction of the Project has been shown to cause significant noise impacts on the noise sensitive receivers in the Study Area. The predicted maximum anticipated construction noise levels are above 75 dB(A) at many of the identified NSR locations. However, the impacts are amenable to control through proper implementation of appropriate noise control measures together with an environmental monitoring and audit programme during the construction of the Project.

Based on the projected maximum traffic figures within 15 years upon the opening of the Project to traffic, it has been shown that the implementation of the Project will bring about both positive and negative noise impacts to the affected NSRs.

Plain barriers of 3m high and inverted-L barriers of 3m high with an inclined panel up to 1.3m are proposed to mitigate the adverse noise impacts at the noise sensitive receivers in the Study Area. While the noise impacts at most of the existing and planned NSRs can be significantly mitigated with the proposed direct technical measures, there are a number of NSRs where the impacts cannot be mitigated in an acoustically-effective manner. According to the results of eligibility assessment for existing NSRs, no NSRs are found eligible for consideration for indirect technical remedies. With respect to the planned NSRs exposed to residual impacts, due considerations should be given to various building design concepts, e.g. building setback, self-protecting building, internal building layout and use of noise tolerant structures, to reduce noise exposure.

Cumulative noise impacts from concurrent projects have been identified and considered. As no major concurrent road development projects have been identified in the vicinity of the Project, no cumulative operational impacts are anticipated.

5.2 CONCLUSION - LANDSCAPE

The new road will constitute a large element in a small scale diverse landscape setting, and will result in significant landscape impact as the overall size and shape of the embankment and the size of the road features will be in contrast to the complex pattern of the existing residential village settlements, horticultural nurseries and low rise industrial and storage land uses which have been arranged around the original agricultural field pattern, and to the broad back drop of densely wooded natural slopes of Ta Kwu Ling and Hebe Knoll to the west.

The construction of the new road will result in the loss of existing mature woodland belts and individual trees, that currently lie in and around the village houses and along the existing roads. There are also a large number of recently planted trees along the slopes to the dualled section of Hiram's Highway that would also be affected. These trees have now reached a semi-mature state.

The enclosed nature of the existing landscape will mean that the visual envelope of the new road will be localised. Views of the road will be in the context of the existing industrial and commercial land uses and the existing Hiram's Highway which will be retained.

There will be a high impact on the houses on the lower terraces of Wo Mei Village and on the single and three storey houses on Nam Pin Wai Road. Properties slightly further away on the upper terraces at Wo Mei Village, further up the slope in the upper part of Wo Mei Village, the new houses on Nam Pin Wai Road, and those at Berkeley Gardens and Heung Chung Village will experience only low to medium visual impact as views will be oblique or partially screened by existing vegetation retained.

Visual impact on the Sai Kung Central Primary School is likely to be low, although very close to the route, it is orientated to the sea and there is only a limited view of the road from the classrooms.

Extensive planting of woodland tree and shrub species is proposed for all new cutting and embankment slopes together with street tree planting along the existing road corridors and ornamental planting in pedestrian areas around the new roundabout.

In time the woodland planting should grow to form an effective screen against views of the road from most properties that would be affected. Due to their proximity to the road and the visual obstruction of existing open views there will be a low level of residual visual impact on the properties of the lower terrace at Wo Mei and the houses close to the new junction on Nam Pin Wai Road. In the context of the overall scale of the road this residual impact may be considered acceptable.

5.3 CONCLUSION - ECOLOGY

According to the vegetation survey, apart from the secondary woodland area, altogether 32 tree species were identified in the Study Area. Most of the trees are either mature or semi-mature. An additional survey with special regard to the secondary woodland area near Wo Mei Village was conducted. A total of 52 species were recorded. Of them, six trees of one uncommon and regenerating species, *Endospermum chinense*, were identified. The main ecological impact of the Project is the loss of 1.39 ha of plantations and 0.52 ha of secondary woodland. With the proposed 3.75 ha of replanting in place and the transplanting of some of the affected trees, the residual lost is not considered as significant.

5.4 RECOMMENDATIONS

The following recommendations are made in respect of traffic and construction impacts:

- Inclusion of pollution control clauses as recommended in Appendix A to the contract documents to control construction noise, dust and runoff from the improvement works.
- Provision of noise barriers: (a) 456m of 3m high plain barriers, (b) 199m of 3m high inverted-L barriers with an inclined panel of 0.9m in length, and (c) 253m of 3m high inverted-L barriers with an inclined panel of 1.3m in length.
- careful considerations should be given to various building design concepts to alleviate the residual impacts on the future developments in the Study Area.
- Implementation of the EM&A programme as detailed in the EM&A Manual.
- Minimisation of manhole covers and valve chambers in the carriageway.

To mitigate the assessed landscape and visual impacts of the scheme as far as possible, it is recommended that the following measures should be adopted :

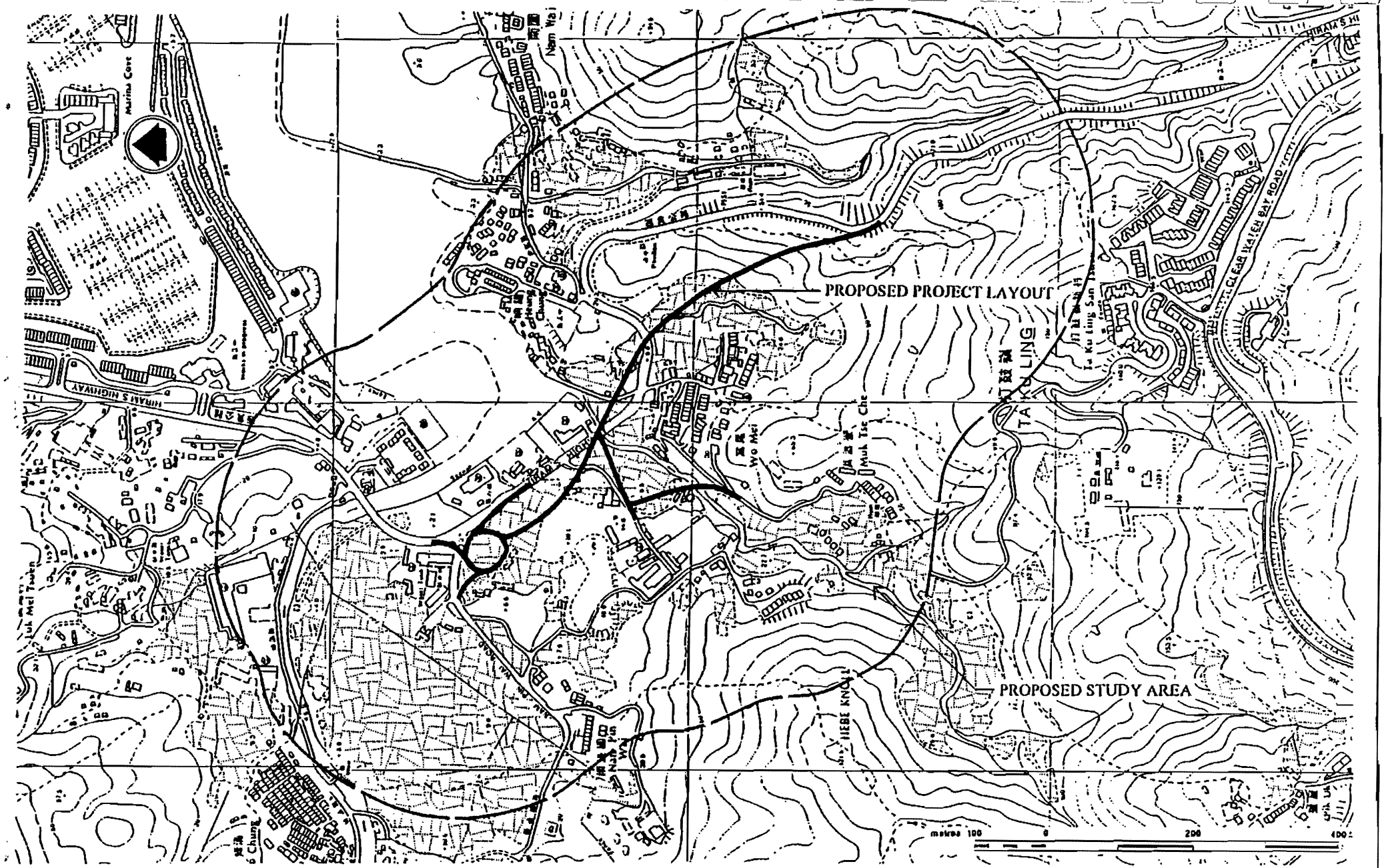
- retention of all existing vegetation within the study area not directly affected by the works
- refinement of the alignments and configurations of all new carriageways, drainage channels and footpaths to minimise potential impacts, and the localised trimming of engineered slopes to blend them into adjacent natural slope profiles.

- woodland planting to all cut and embankment slopes, and to other open areas within the works limit, with additional street tree planting alongside the new carriageways and ornamental shrub planting in pedestrian areas.
- additional street tree planting along the unaffected existing roads within the Study Area.
- adoption of light shield/recessed flat light on street lighting system along the proposed highway.
- architectural treatment of bridge decks, abutments, pedestrian underpasses and retaining walls engineering structures and the hard landscaping of pedestrian areas adjacent to the road.
- Implementation of the EM&A programme as detailed in the EM&A manual.

The following recommendations are made in respect of ecological impacts:

- extensive planting of woodland tree and shrub species for all new cuttings and embankment slopes together with street tree planting along the existing road corridors.
- a full survey of the existing trees within the Study Area as well as compensatory planting schemes containing information on the recommended tree species for replanting should be prepared as part of the detailed design of the works.
- Implementation of the EM&A programme as detailed in the EM&A manual.

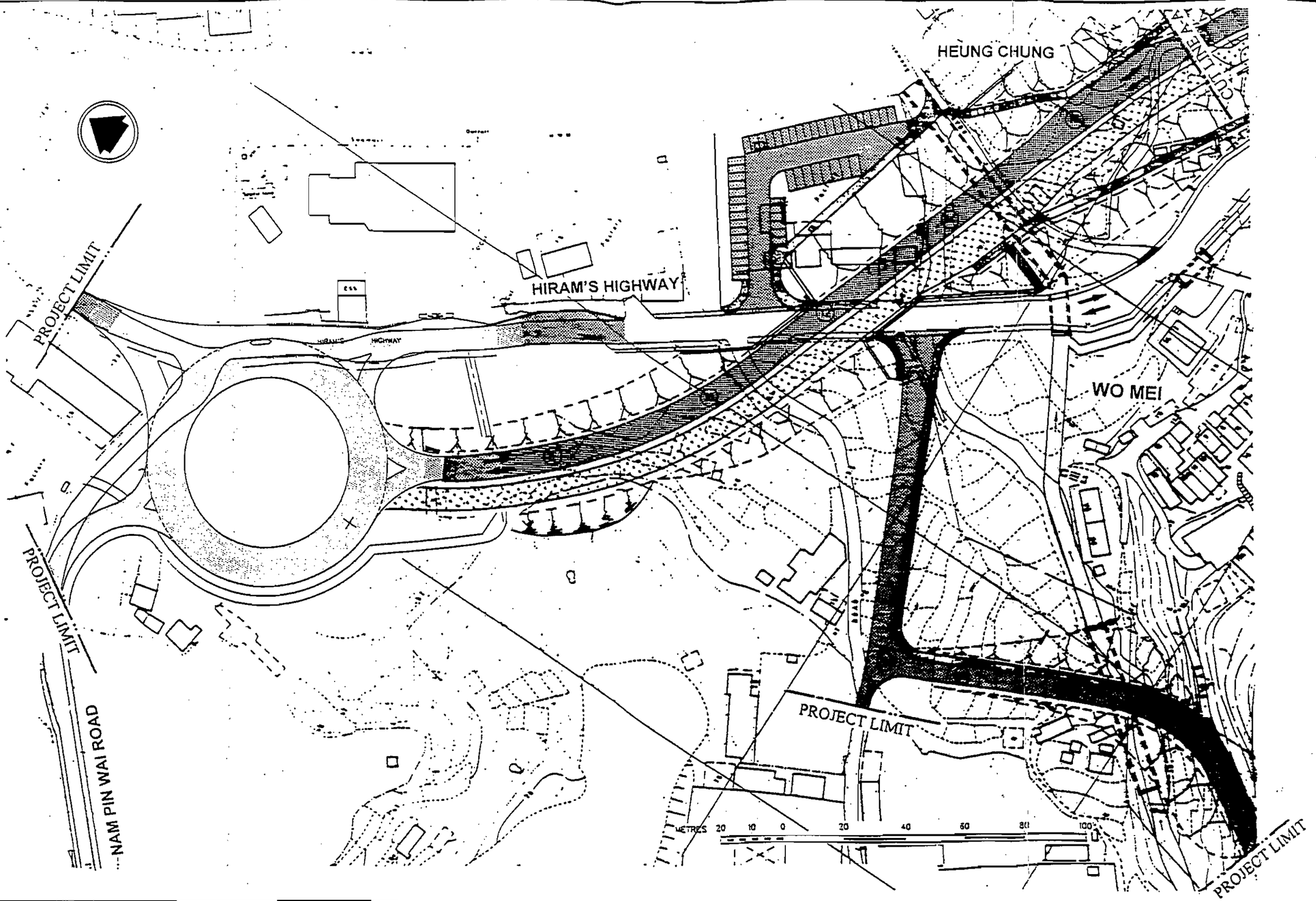
FIGURES



PROJECT LAYOUT AND STUDY AREA

Figure 1.1

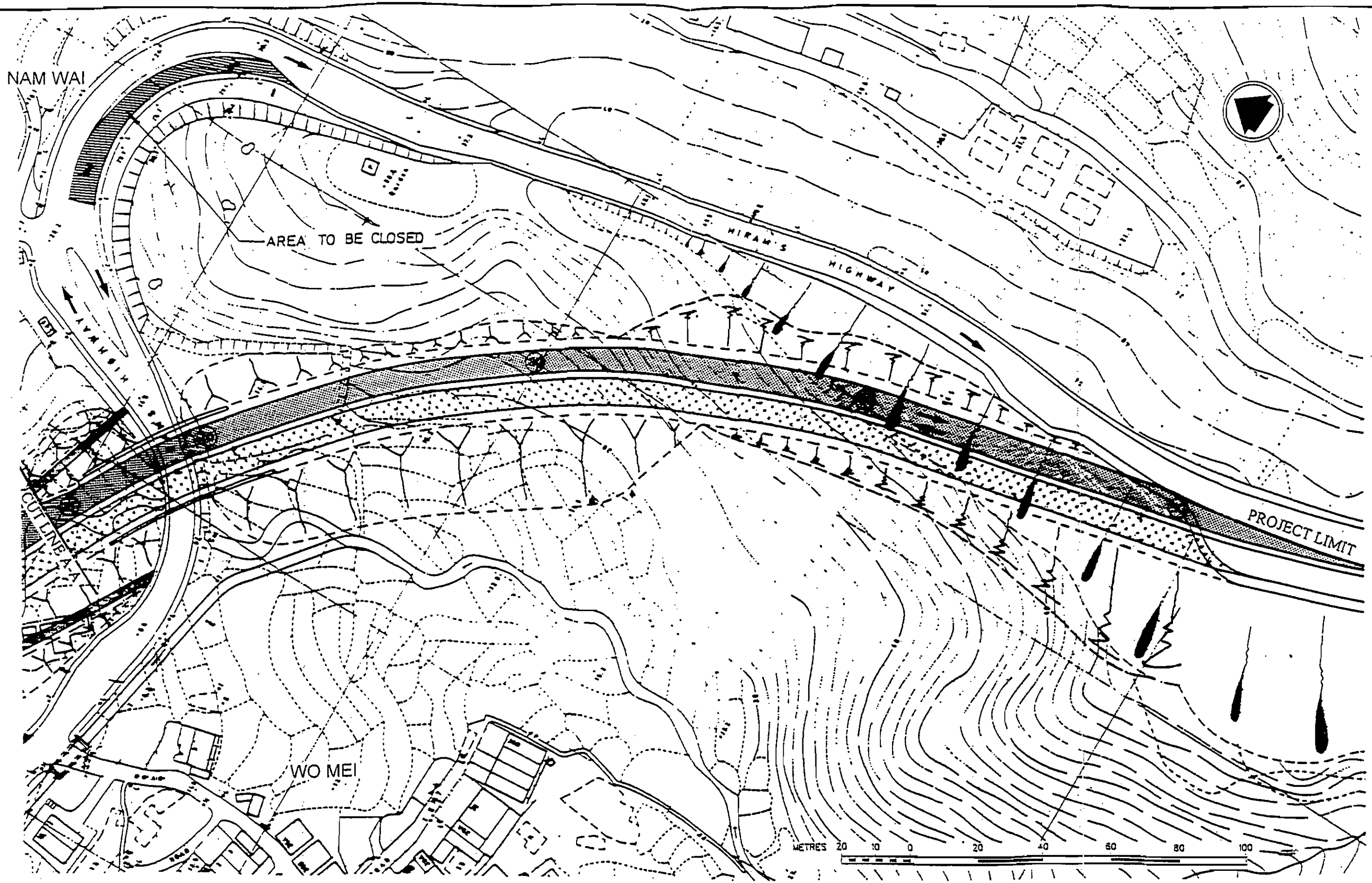
Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



PRELIMINARY GENERAL LAYOUT (SHEET 1 OF 2)

Figure 2.1

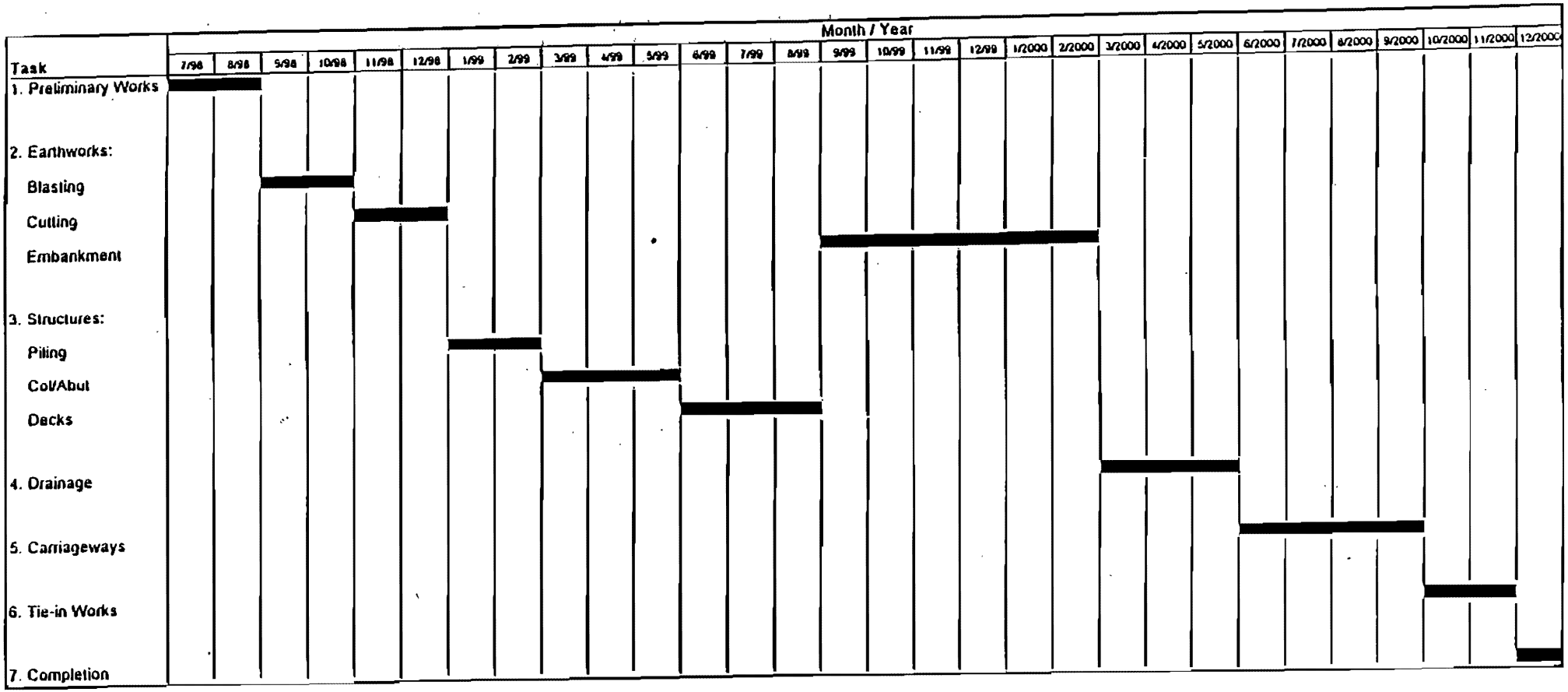
Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



PRELIMINARY GENERAL LAYOUT (SHEET 2 OF 2)

Figure 2.2

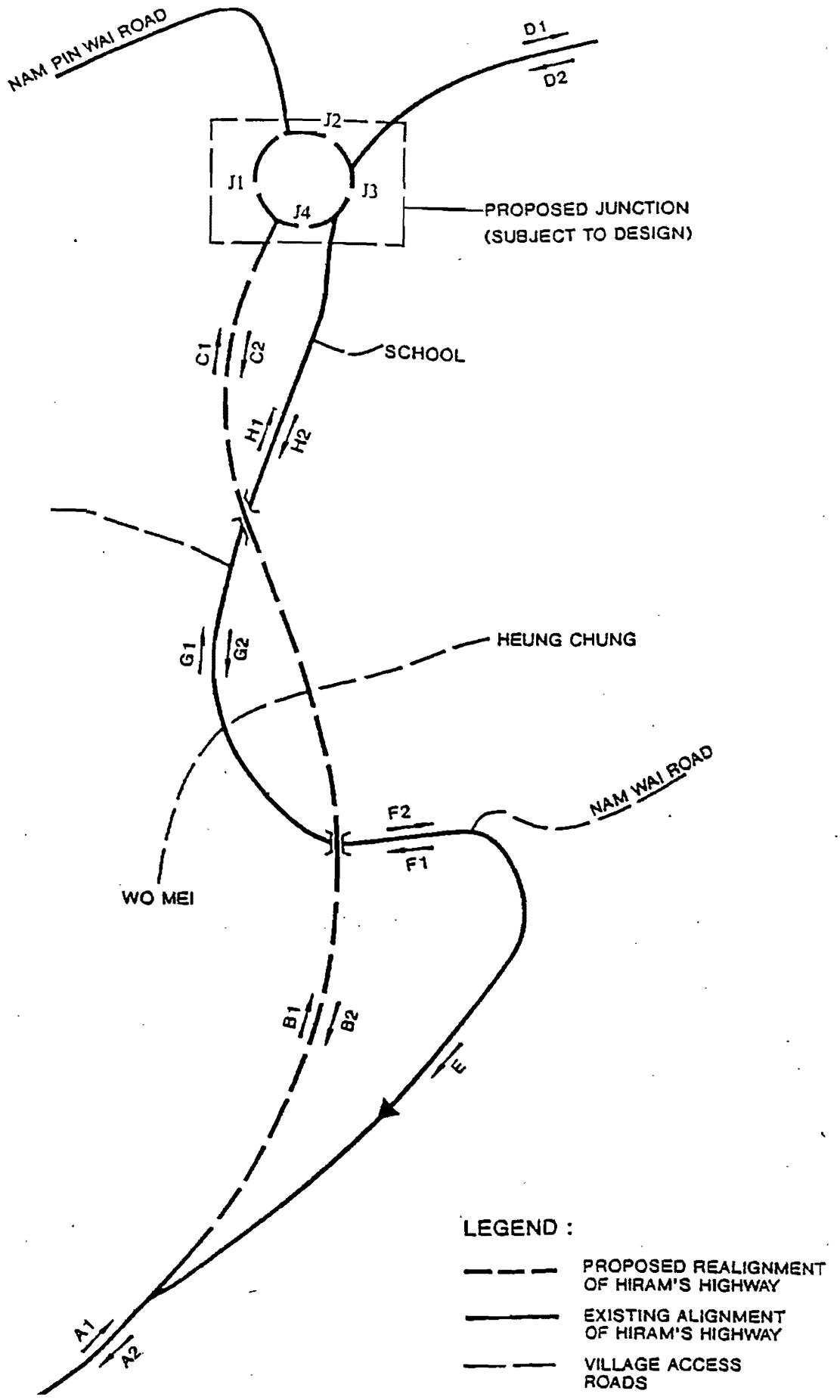
Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



CONSTRUCTION PROGRAMME

Figure 2.3

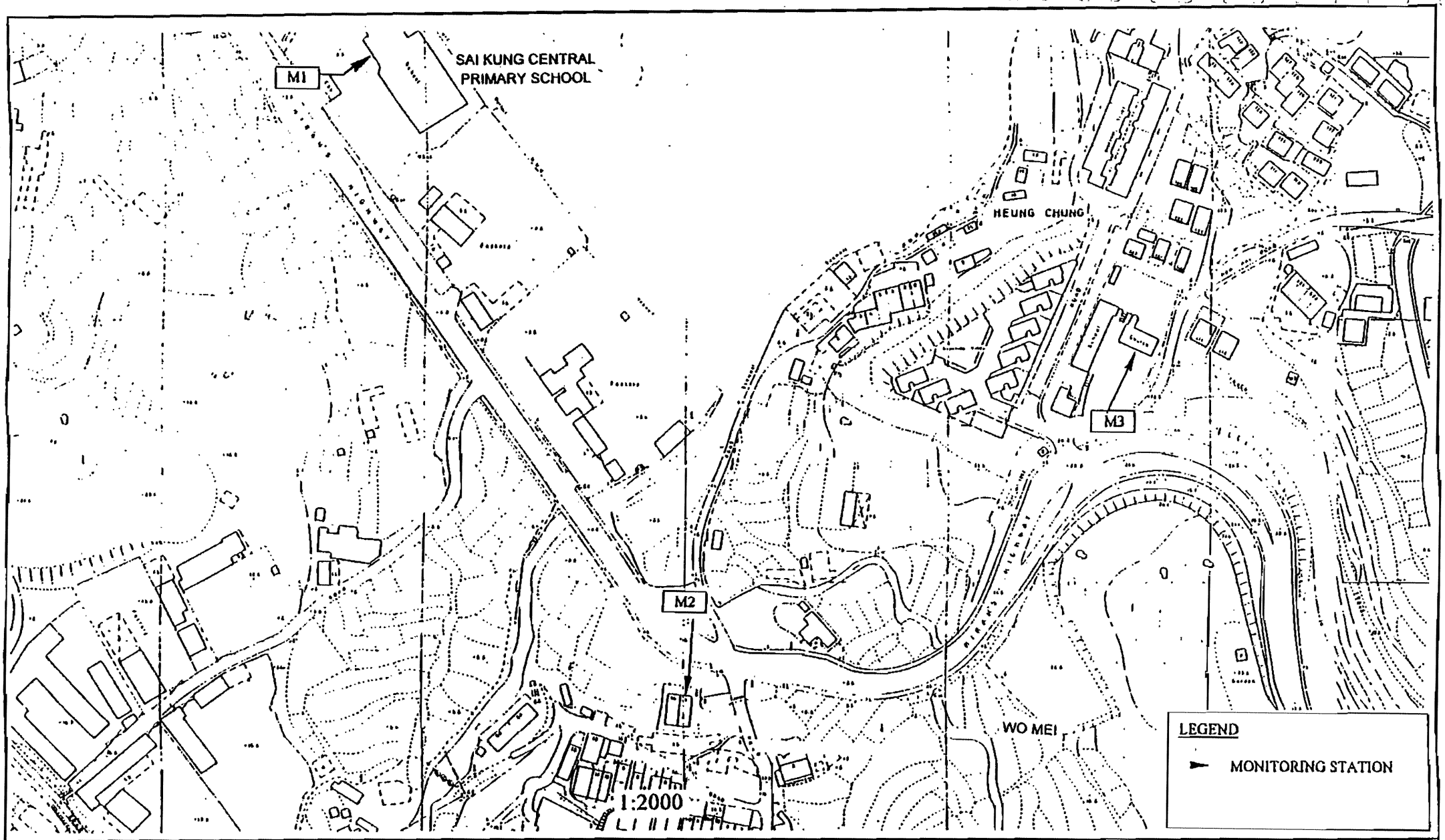
Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



TRAFFIC FLOW DIRECTION
(ENVIRONMENTAL IMPACT ASSESSMENT)

FIGURE 2.4

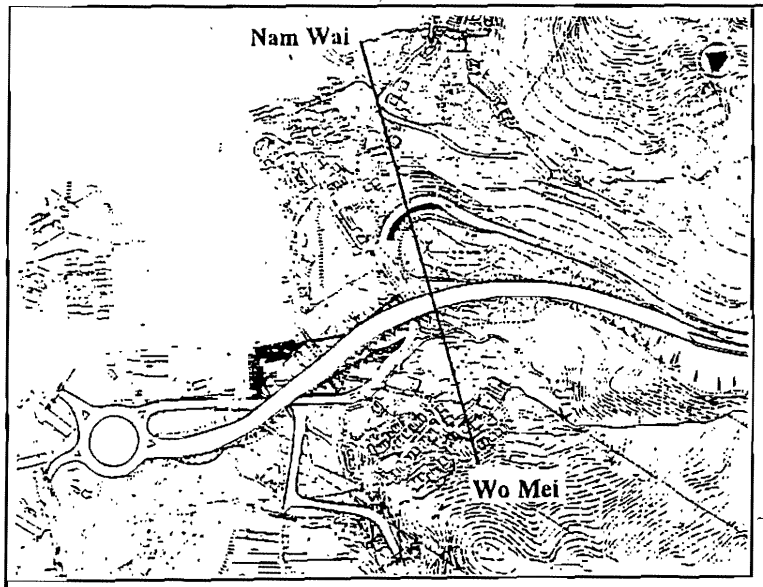
Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



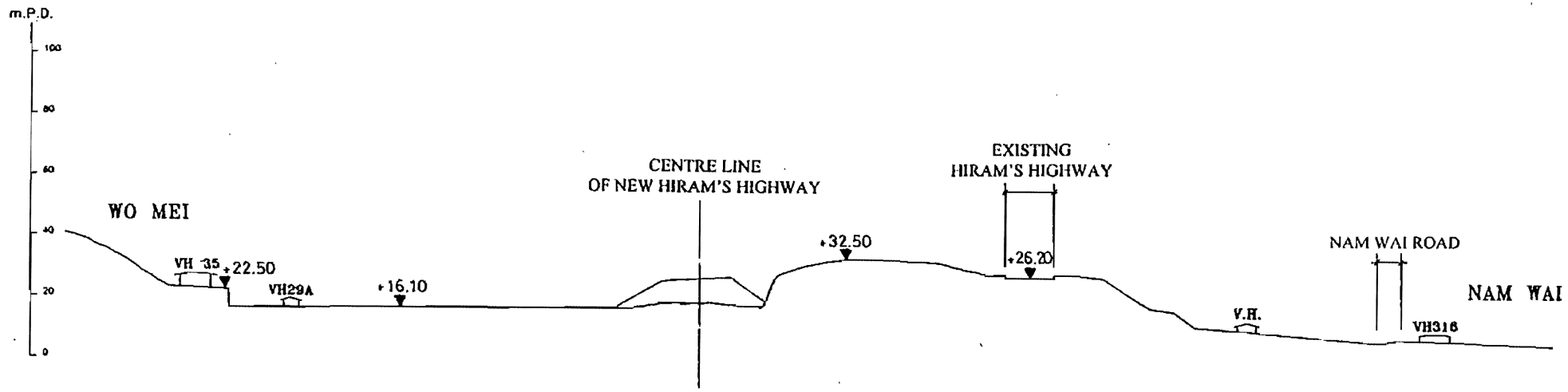
BASELINE NOISE MONITORING LOCATIONS

Figure 2.5

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



SCALE 1:8000



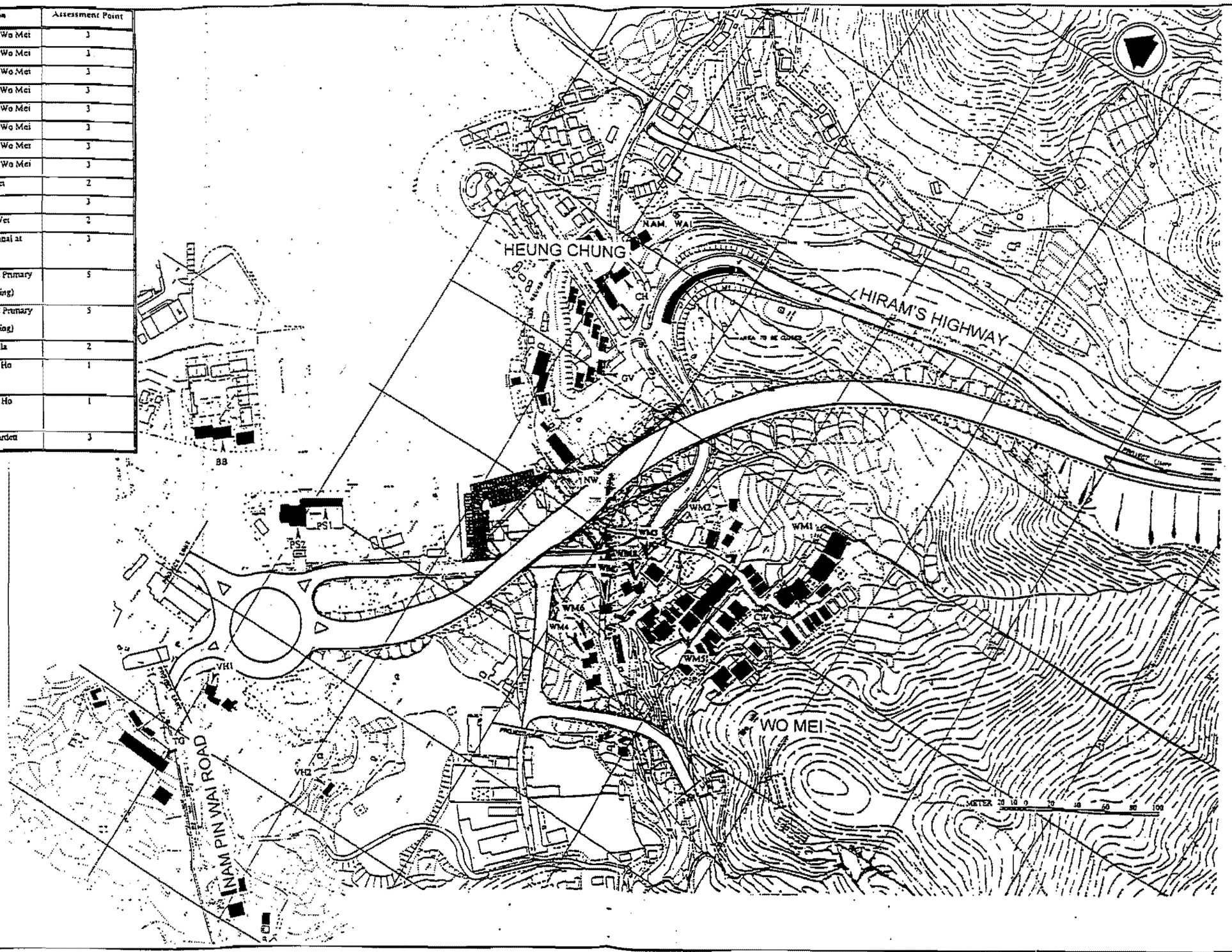
SCALE 1: 2000

SECTION PLAN SHOWING TOPOGRAPHICAL SCREENING EFFECT

Figure 2.6

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers

NSR ID	Name/Description	Assessment Point
WM1	Village House at Wo Mei	3
WM2	Village House at Wo Mei	3
WM3	Village House at Wo Mei	3
WM4	Village House at Wo Mei	3
WM5	Village House at Wo Mei	3
WM6	Village House at Wo Mei	3
WM7	Village House at Wo Mei	3
WM8	Village House at Wo Mei	3
CW	Church at Wo Mei	2
GV	Greville Villas	3
CH	Church at Nam Wai	2
NW	Low-rise Residential at Heung Chung	3
PS1	Sai Kung Central Primary School (South Wing)	5
PS2	Sai Kung Central Primary School (North Wing)	5
BB	Berkeley Bay Villa	2
VH1	Village House at Ho Chung	1
VH2	Village House at Ho Chung	1
TG	Treasure Spot Garden	3



IDENTIFIED EXISTING NOISE SENSITIVE RECEIVERS

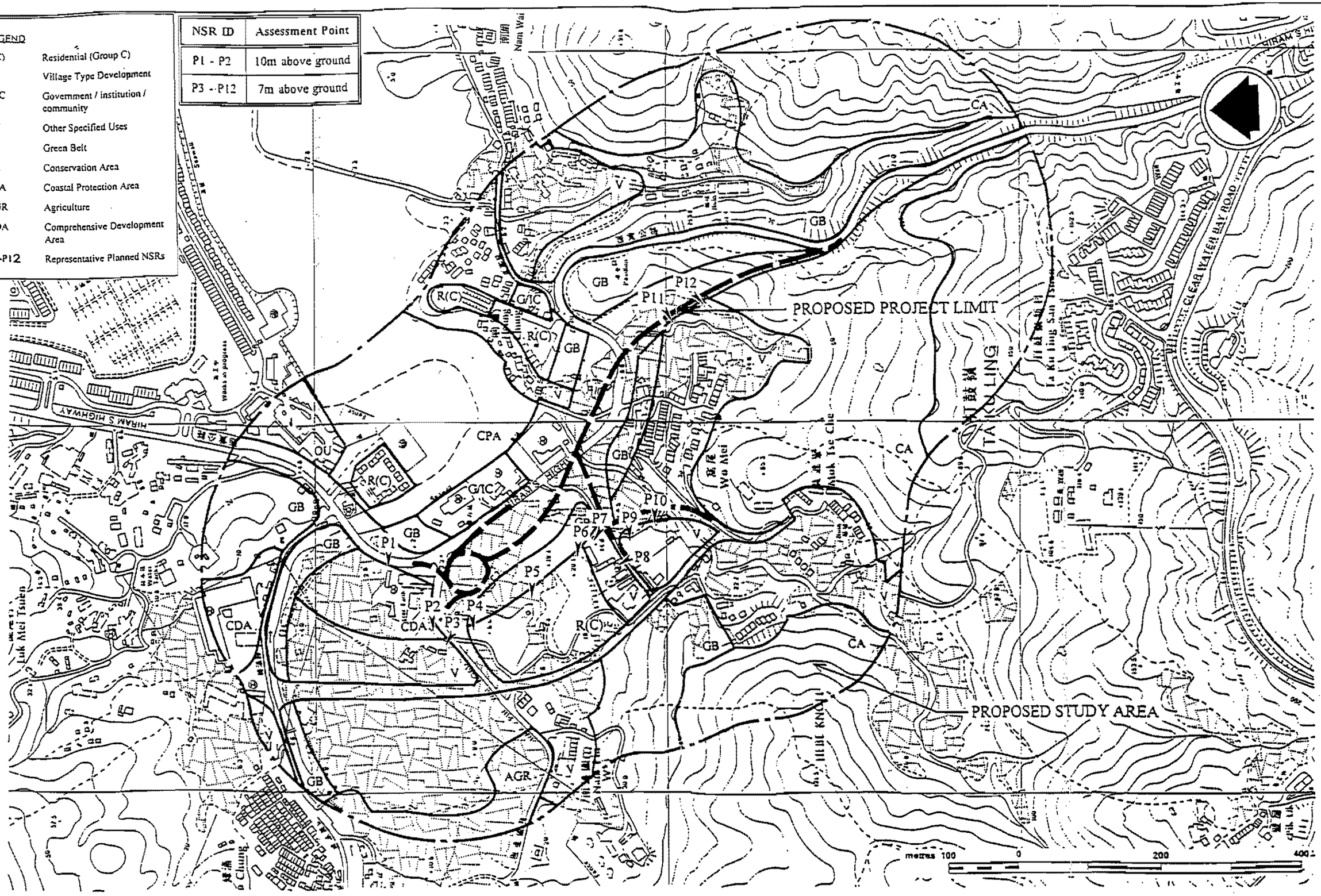
Figure 2.7

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers

LEGEND

R(C)	Residential (Group C)
V	Village Type Development
G/IC	Government / institution / community
OU	Other Specified Uses
GB	Green Belt
CA	Conservation Area
CPA	Coastal Protection Area
AGR	Agriculture
CDA	Comprehensive Development Area
P1-P12	Representative Planned NSRs

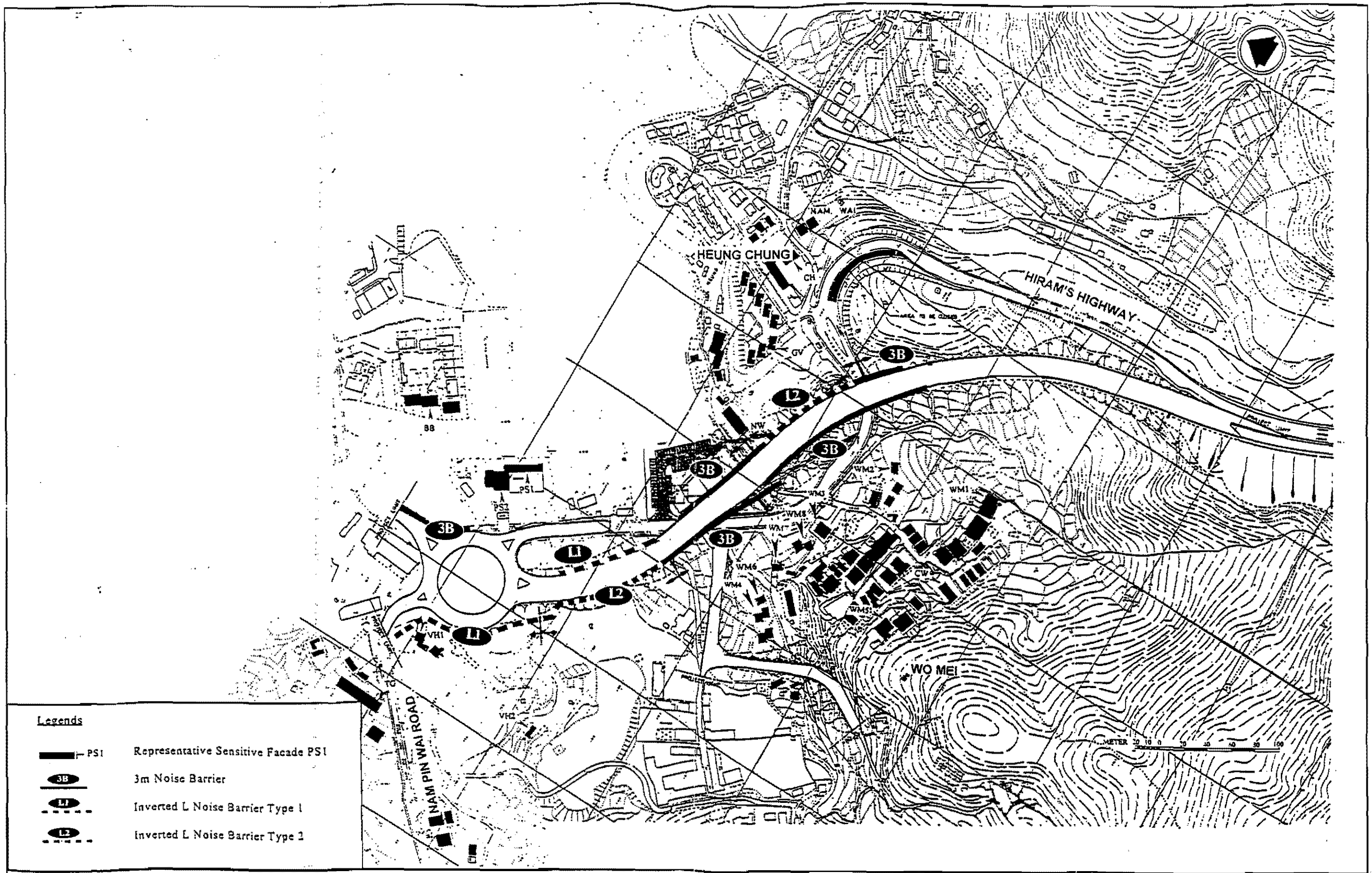
NSR ID	Assessment Point
P1 - P2	10m above ground
P3 - P12	7m above ground



PLANNED LAND USES WITHIN STUDY AREA

Figure 2.8

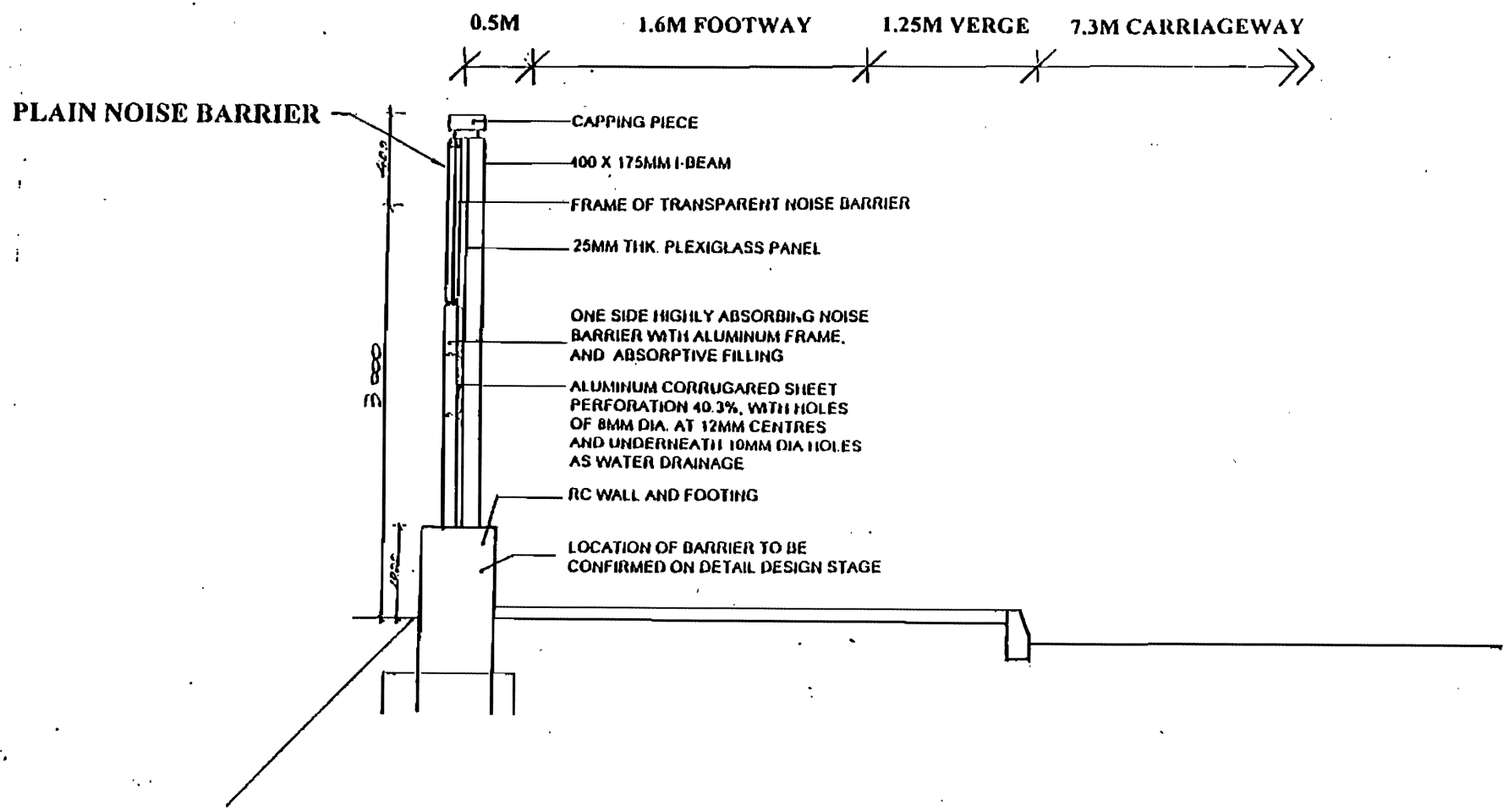
Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



NOISE MITIGATION MEASURES

Figure 2.9

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers

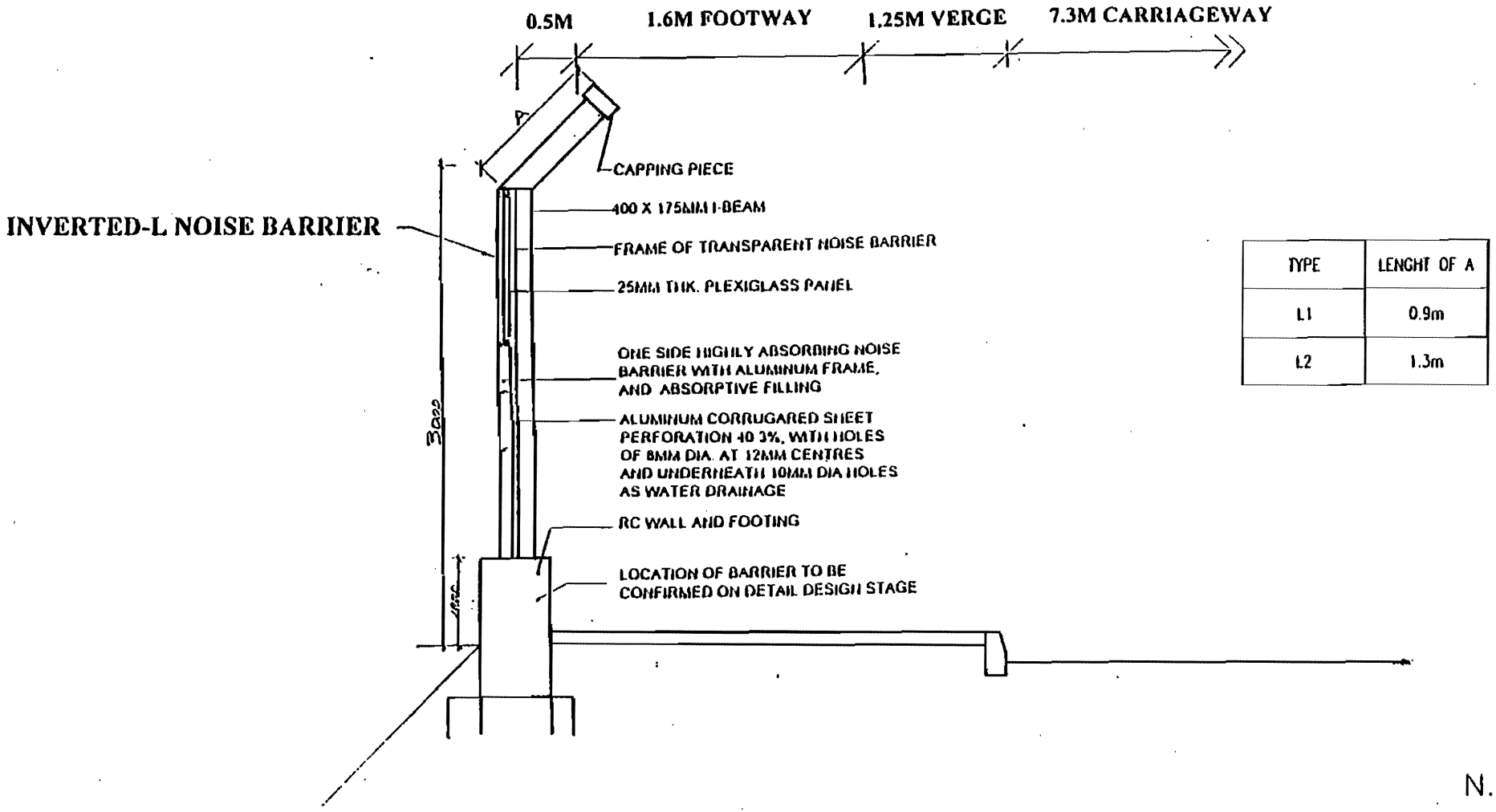


N.T.S.

CONCEPTUAL SECTION OF NOISE BARRIER

Figure 2.10

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



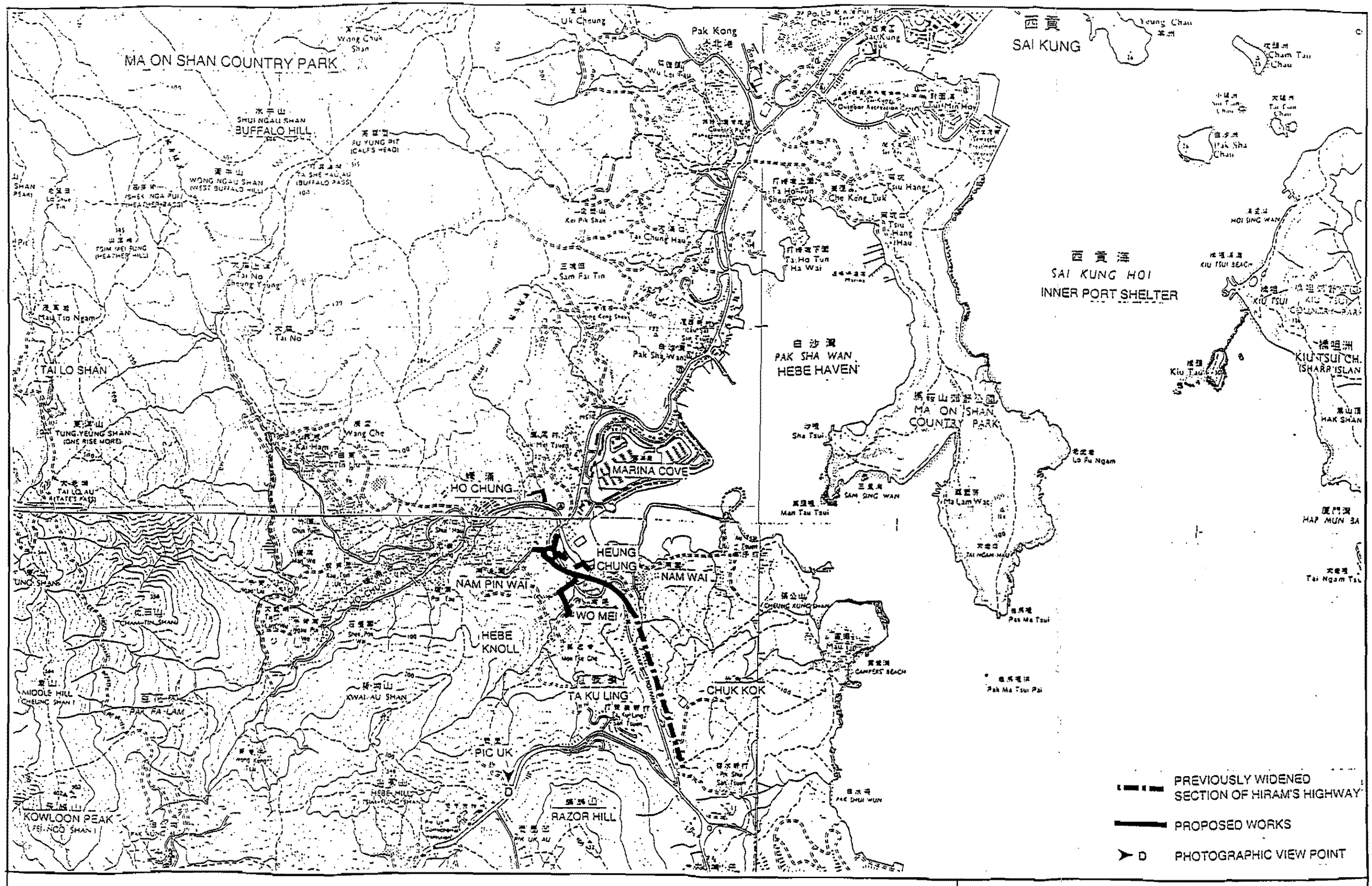
TYPE	LENGHT OF A
L1	0.9m
L2	1.3m

N.T.S.

CONCEPTUAL SECTION OF INVERTED-L NOISE BARRIER

Figure 2.11

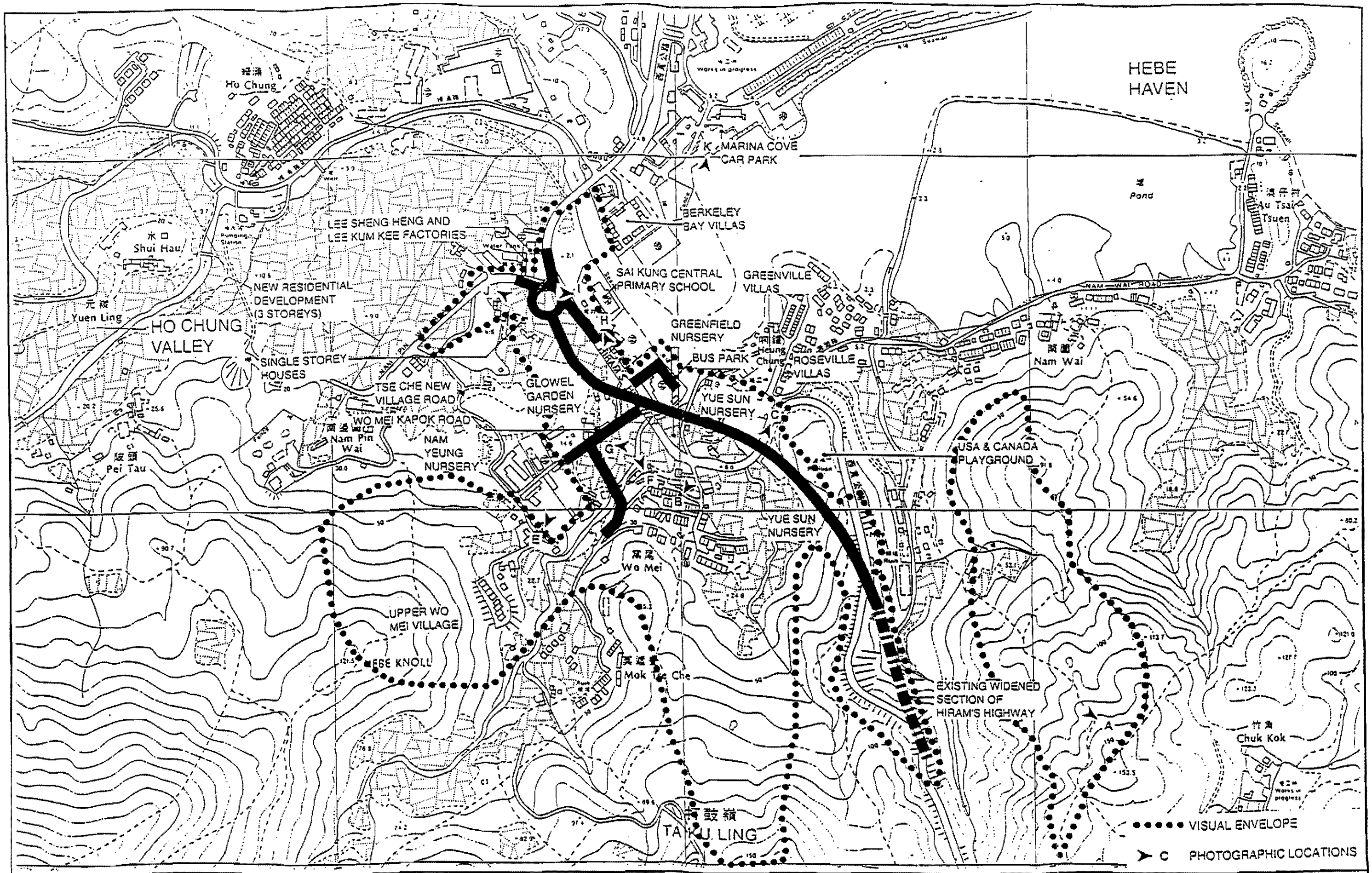
Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



Hiram's Highway Improvements between Nam Wai and Ho Chung
Site Location Plan

FIGURE 3.1

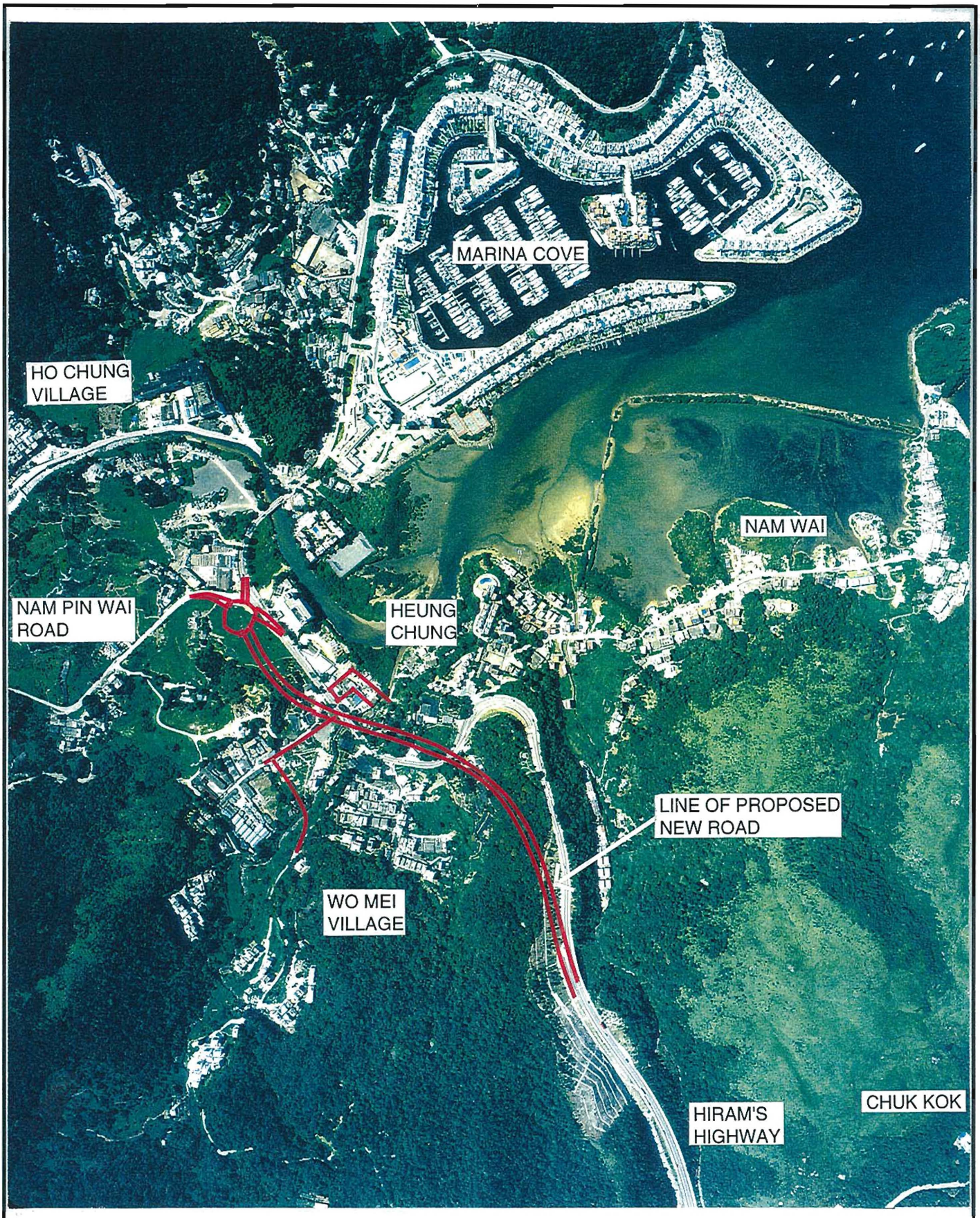
Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



Hiram's Highway Improvements between Nam Wai and Ho Chung
Landscape and Visual Context Plan

FIGURE 3.2

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



NOTE : ARIAL PHOTOGRAPH FROM GOVERNMENT SURVEY DATED 18 - 7 - '95 (3,500')

Hiram's Highway Improvements between Nam Wai and Ho Chung
Aerial Photograph of the Study Area

FIGURE 3.3

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers

PHOTO A
PHOTO FROM HILLSIDE ABOVE CHUK KOK

Hiram's Highway Improvements between Nam Wai and Ho Chung
Existing Site Photographs

FIGURE 3.4

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers

PHOTO B
VIEW OF EXISTING HIRAM'S HIGHWAY, AND YUE SUN AND GREENFIELD NURSERIES, FROM LOWER TERRACE OF WO MEI VILLAGE

PHOTO C
VIEW OF WO MEI VILLAGE FROM JUNCTION OF HIRAM'S HIGHWAY AND NAM WAI ROAD

PHOTO D
VIEW OF STUDY AREA FROM PIK UK

Hiram's Highway Improvements between Nam Wai and Ho Chung
Existing Site Photographs

FIGURE 3.5

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers

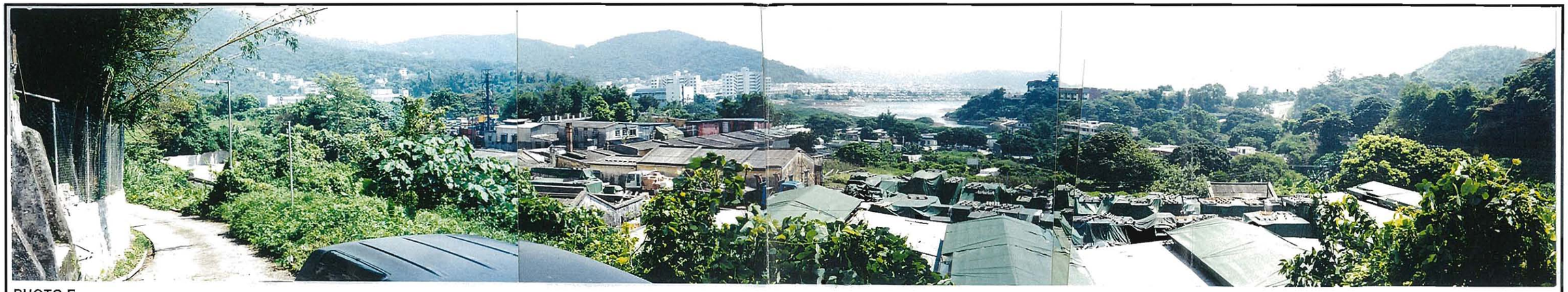


PHOTO E
VIEW OF STUDY AREA FROM SINGLE STOREY HOUSES AT UPPER PART OF WO MEI VILLAGE

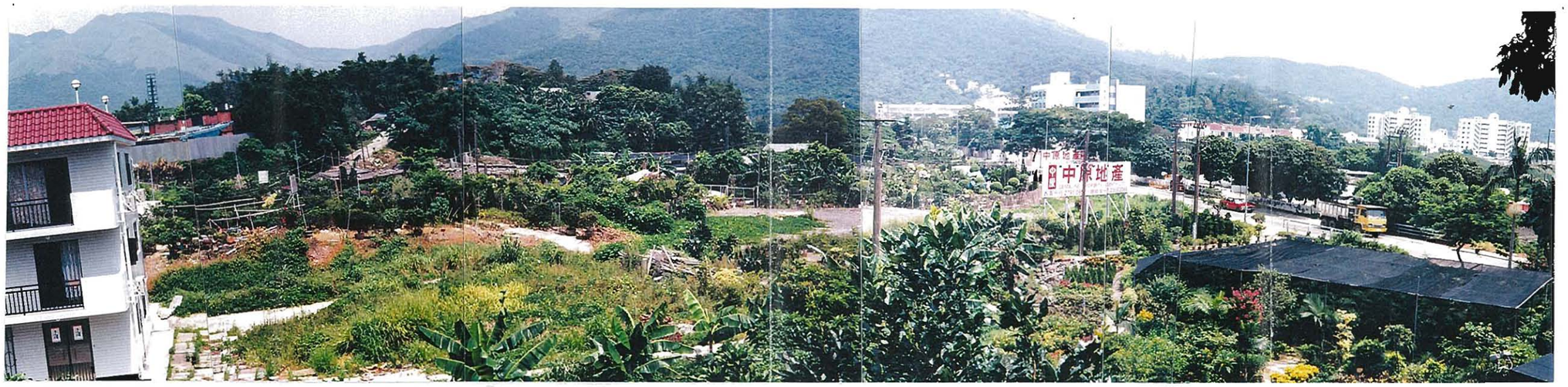


PHOTO F
VIEW NORTH FROM WO MEI VILLAGE TO PRIMARY SCHOOL

PHOTO G
VIEW SOUTH FROM WO MEI KAPOK ROAD TOWARD WO MEI VILLAGE

Hiram's Highway Improvements between Nam Wai and Ho Chung
Existing Site Photographs

FIGURE 3.6

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers

PHOTO H
VIEW SOUTH ALONG HIRAM'S HIGHWAY FROM FRONT ENTRANCE OF SAI KUNG CENTRAL PRIMARY SCHOOL

PHOTO I
VIEW OF NEW RESIDENTIAL DEVELOPMENT ON NAM PIN WAI ROAD FROM PRIMARY SCHOOL

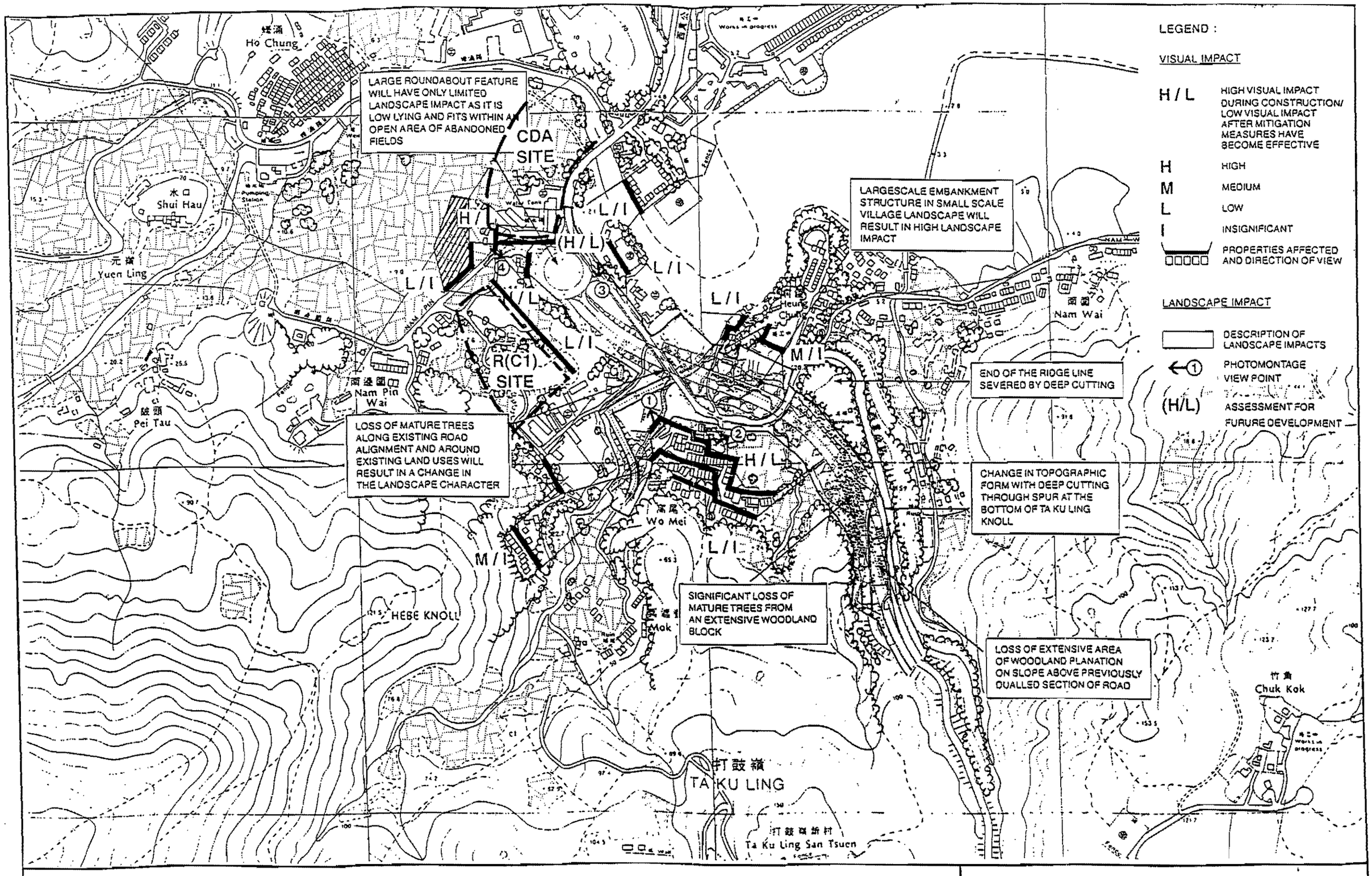
PHOTO J
VIEW OF SAI KUNG CENTRAL PRIMARY SCHOOL FROM NAM PIN WAI ROAD

PHOTO K
VIEW OF STUDY AREA FROM CAR PARK AT MARINA COVE

Hiram's Highway Improvements between Nam Wai and Ho Chung
Existing Site Photographs

FIGURE 3.7

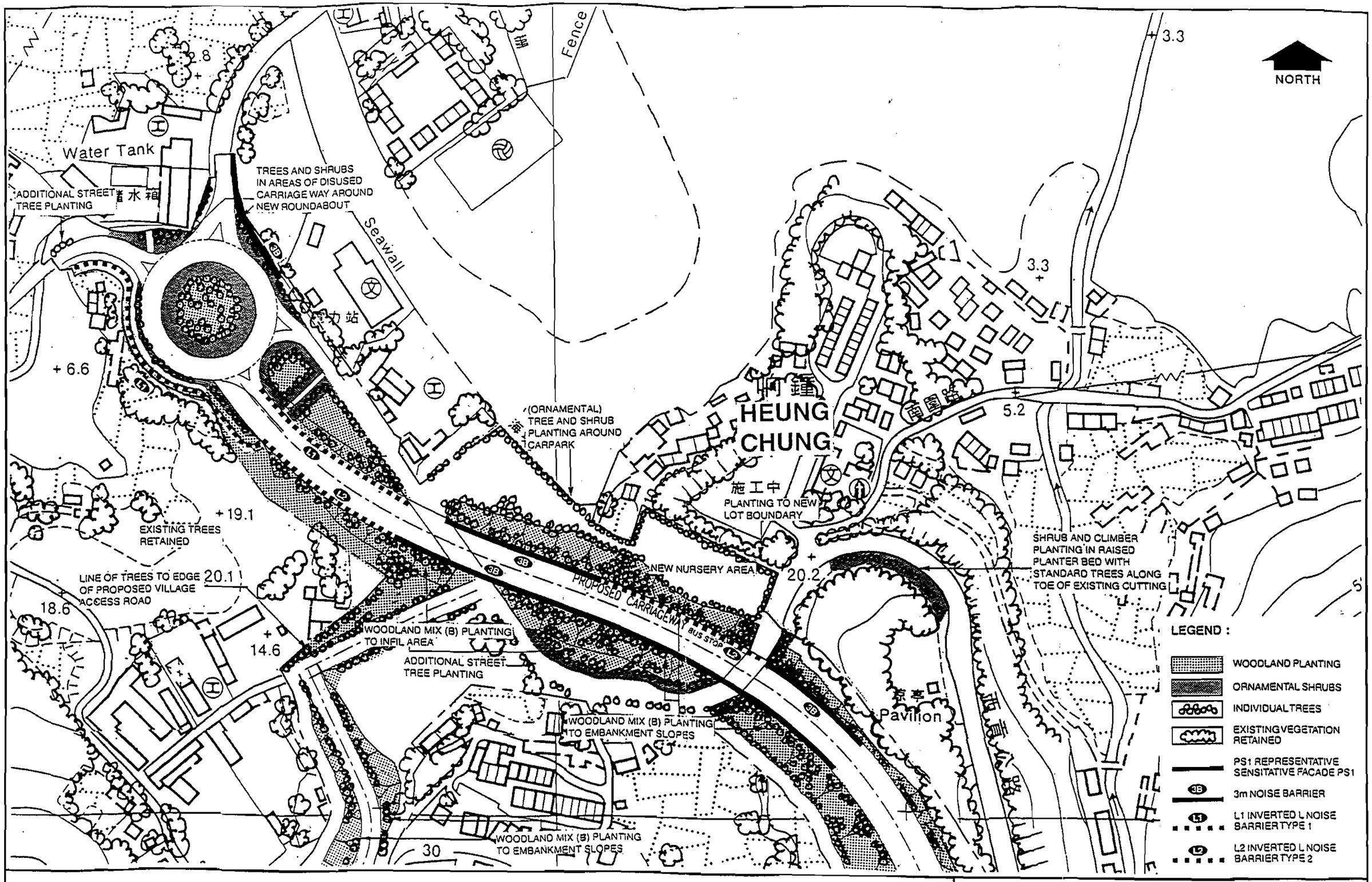
Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



Hiram's Highway Improvements between Nam Wai and Ho Chung
Landscape and Visual Impact Plan

FIGURE 3.8

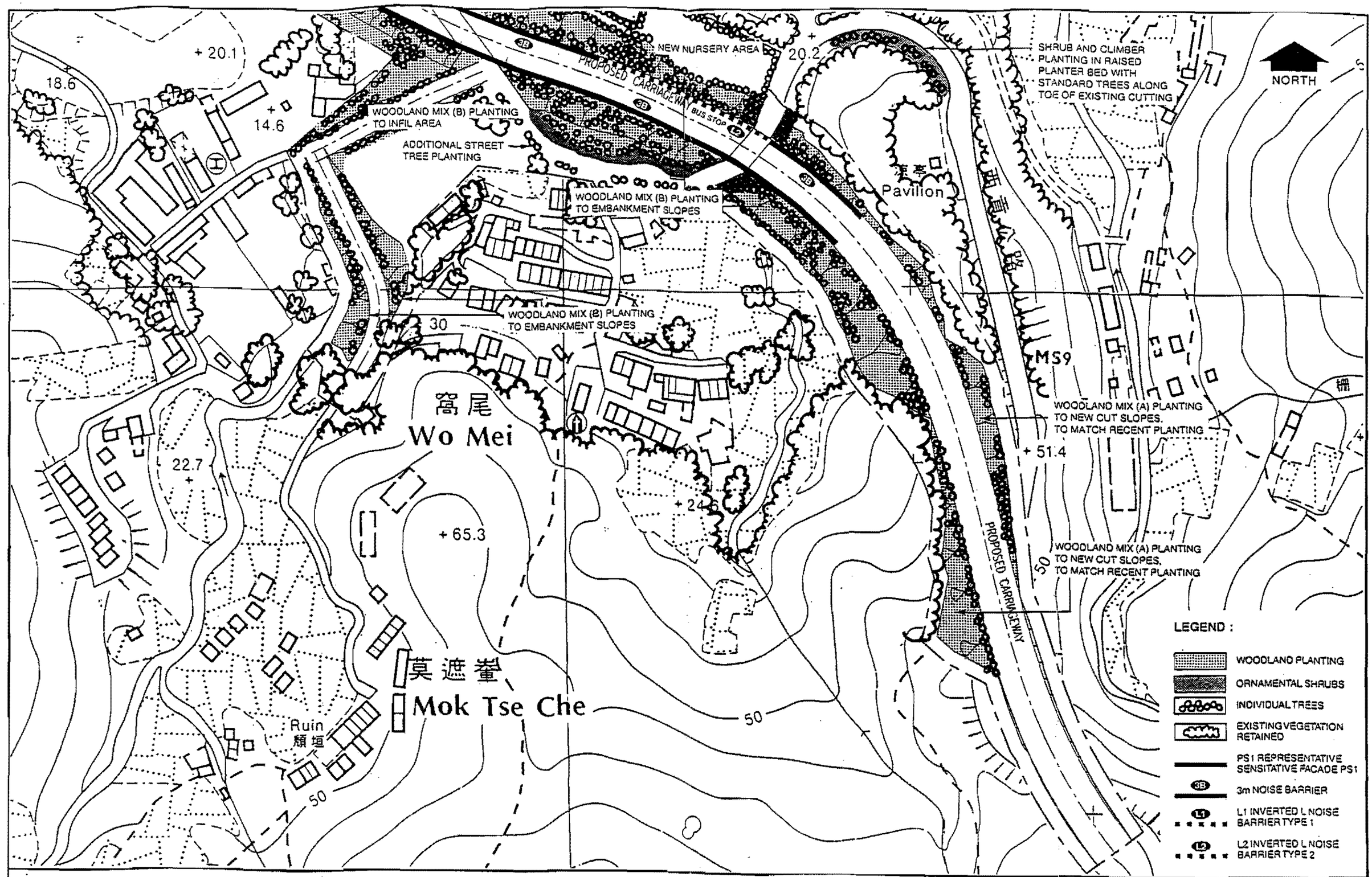
Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



Hiram's Highway Improvements between Nam Wai and Ho Chung
Landscape Mitigation Measures Plan (1 of 2)

FIGURE 3.9

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers



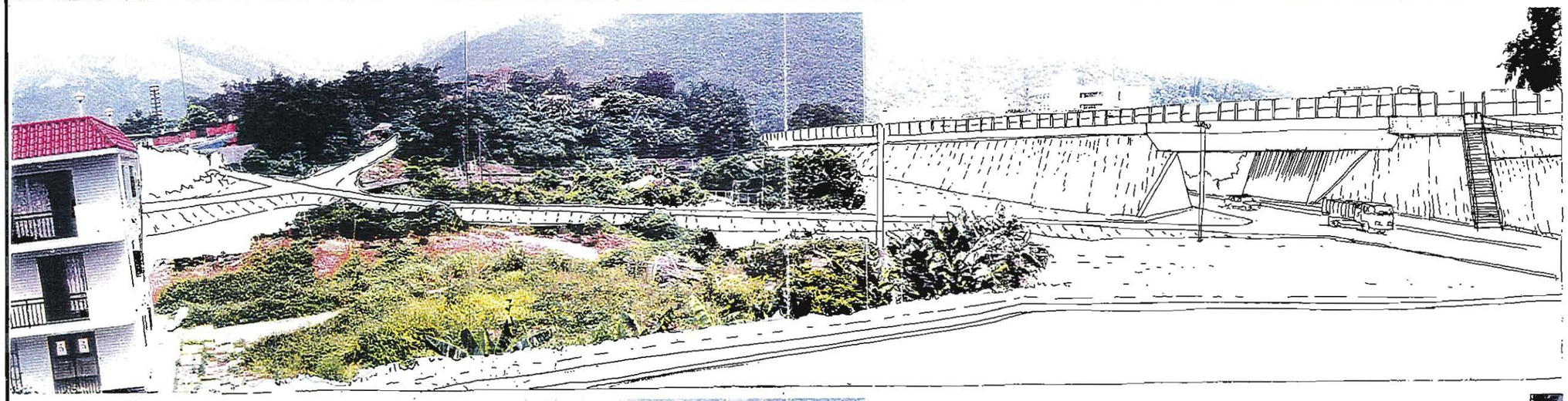
Hiram's Highway Improvements between Nam Wai and Ho Chung
Landscape Mitigation Measures Plan (2 of 2)

FIGURE 3.10

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers

VIEW NORTH FROM WO MEI VILLAGE TO PRIMARY SCHOOL

EXISTING CONDITION



UPON COMPLETION OF CONSTRUCTION WORKS

AFTER LANDSCAPE MEASURES BECOME EFFECTIVE

Hiram's Highway Improvements between Nam Wai and Ho Chung
Existing Site Photographs

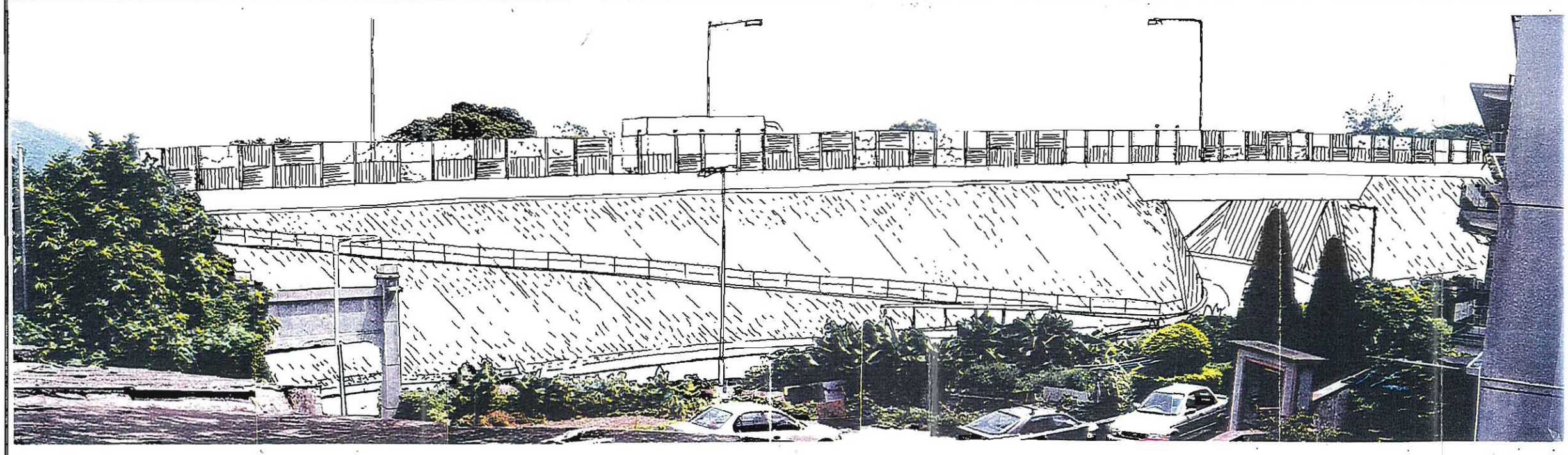
FIGURE 3.11

PHOTOMONTAGES (1 OF 4)

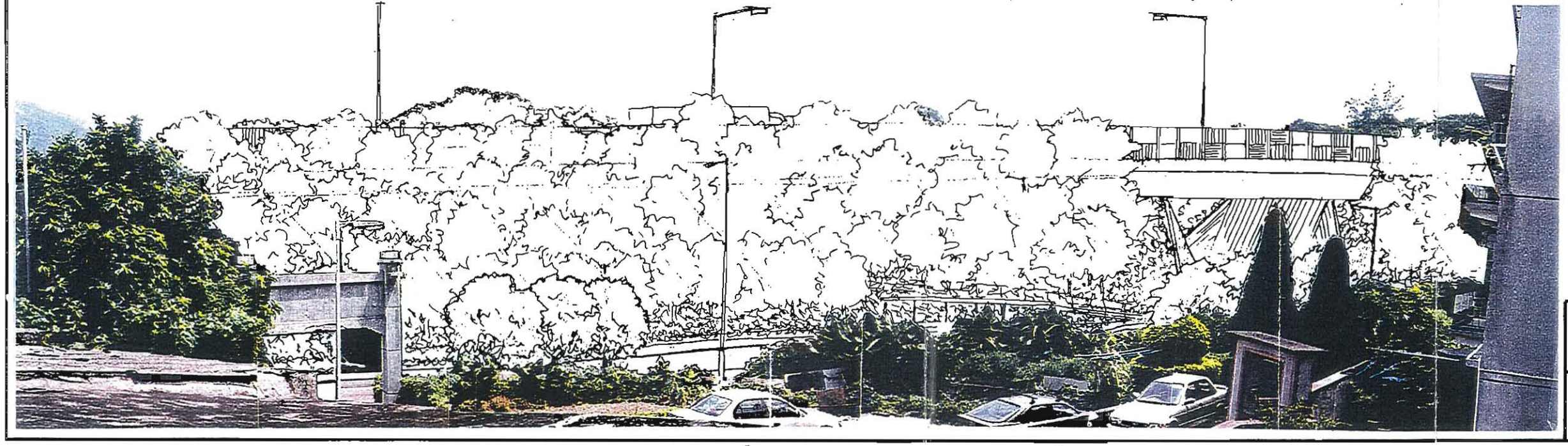
Babtie BMT (Hong Kong) Ltd.
Consulting Engineers

VIEW OF EXISTING HIRAM'S HIGHWAY AND YUE SUN AND GREENFIELDS NUSERIES, FROM LOWER TERRACE OF WO MEI VILLAGE

EXISTING CONDITION



UPON COMPLETION OF CONSTRUCTION WORKS



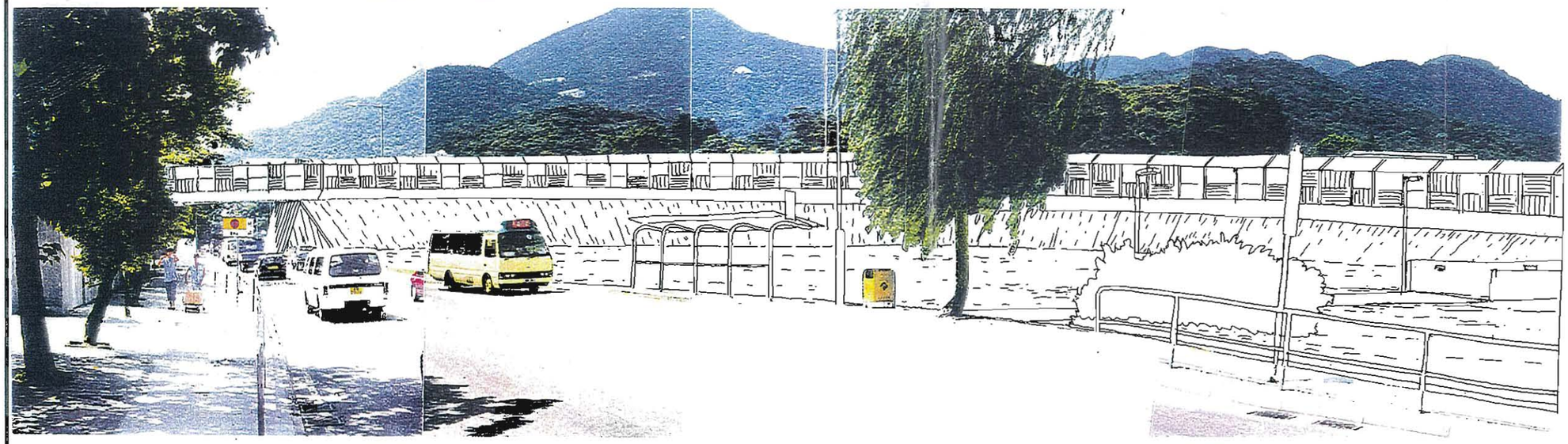
AFTER LANDSCAPE MEASURES BECOME EFFECTIVE

FIGURE 3.12

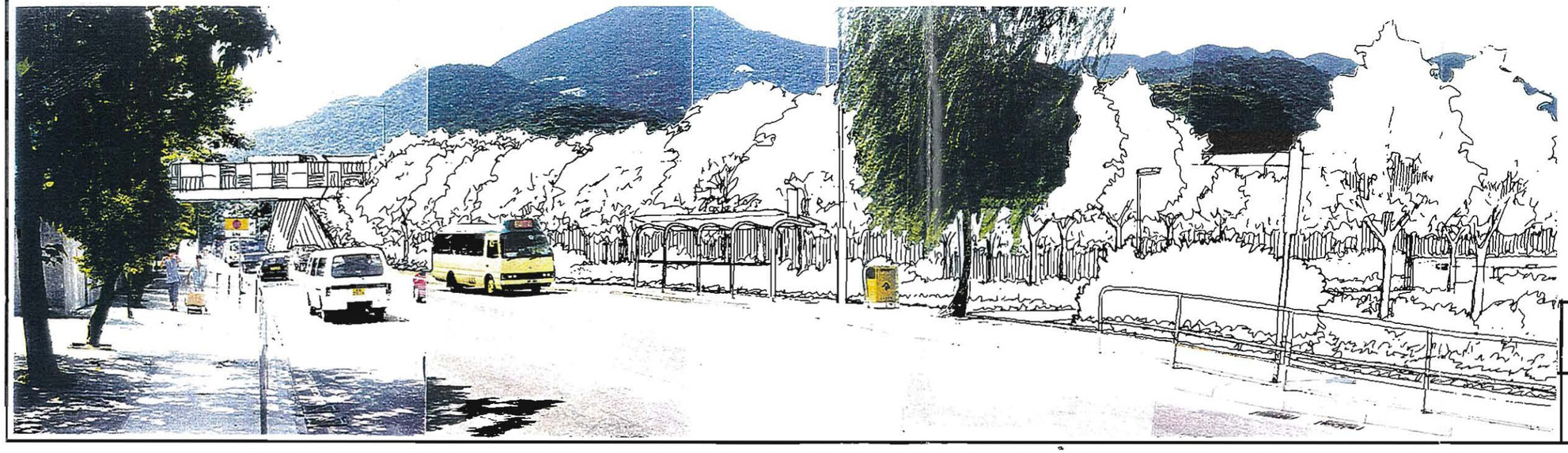
PHOTOMONTAGES
(2 OF 4)

VIEW SOUTH ALONG HIRAM'S HIGHWAY FROM FRONT ENTRANCE OF SAI KUNG CENTRAL PRIMARY SCHOOL

EXISTING CONDITION



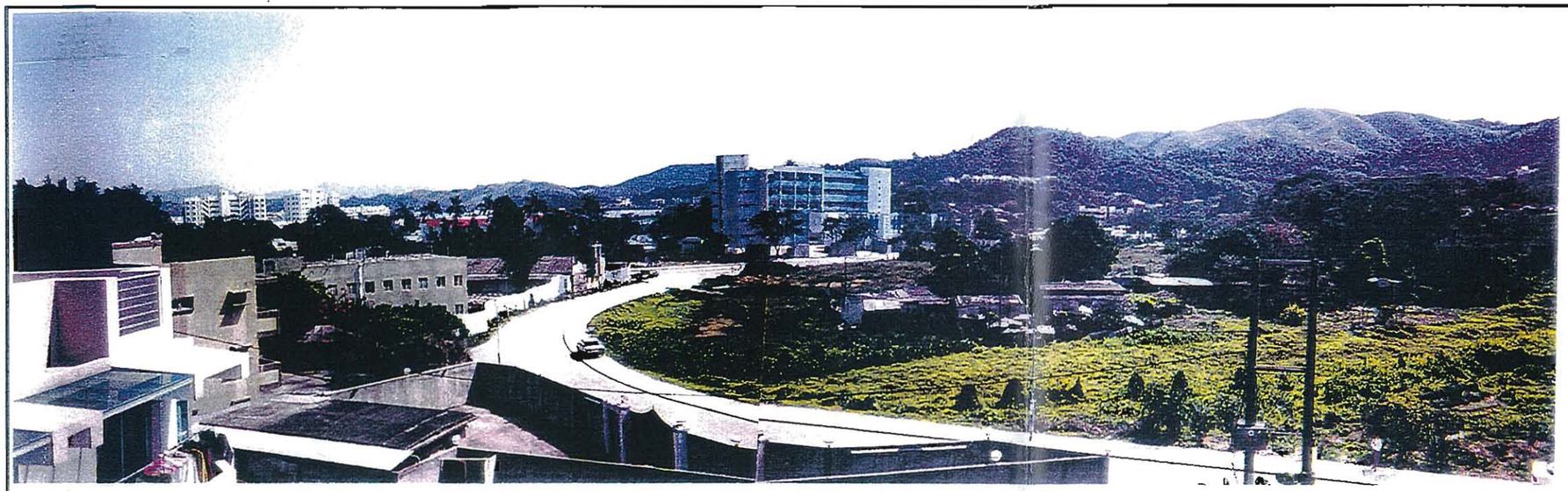
UPON COMPLETION OF CONSTRUCTION WORKS



AFTER LANDSCAPE MEASURES BECOME EFFECTIVE

FIGURE 3.13

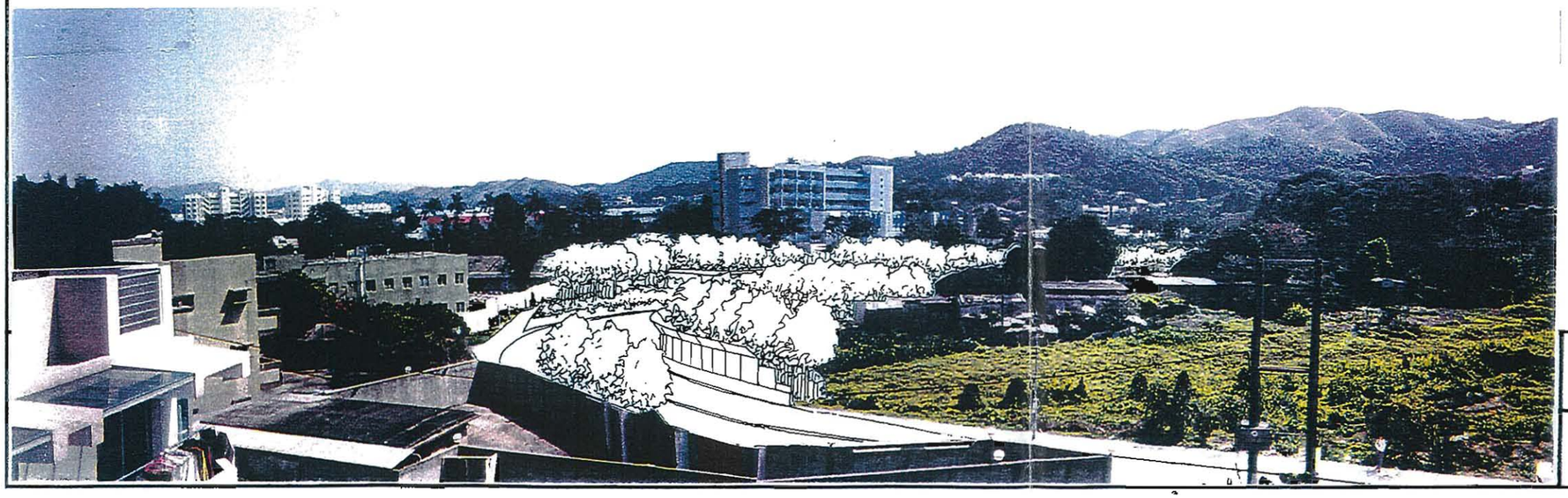
PHOTOMONTAGES
(3 OF 4)



VIEW FROM NEW VILLAGE HOUSES ON NAM PIN WAI ROAD, LOOKING TOWARDS THE SCHOOL

EXISTING CONDITION

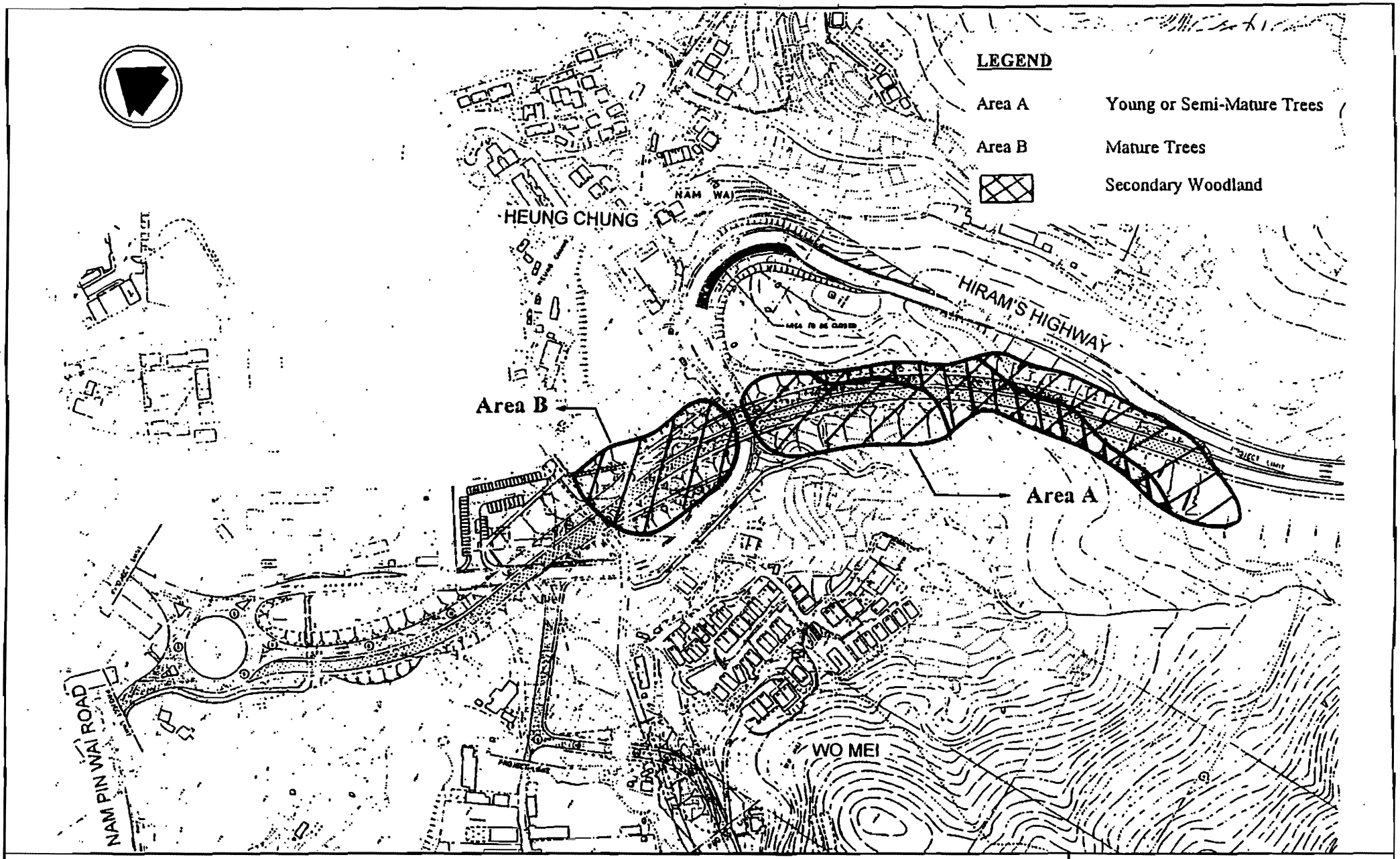
UPON COMPLETION OF CONSTRUCTION WORKS



AFTER LANDSCAPE MEASURES BECOME EFFECTIVE

FIGURE 3.14

PHOTOMONTAGES
(4 OF 4)



LOCATIONS OF TREES AFFECTED

Figure 4.1

Babtie BMT (Hong Kong) Ltd.
Consulting Engineers

APPENDIX A

RECOMMENDED POLLUTION CONTROL CLAUSES

APPENDIX A

RECOMMENDED POLLUTION CONTROL CLAUSES

1. AVOIDANCE OF NUISANCE

(a) All works are to be carried out in such a manner as to cause as little inconvenience as possible to nearby residents, property and to the public in general, and the Contractor shall be held responsible for any claims which may arise from such inconvenience.

(b) The Contractor shall be responsible for the adequate maintenance and clearance of channels, gullies, etc., and shall also provide and maintain such pedestrian and vehicular access as shall be directed within the works site.

(c) Water shall be used to prevent dust rising and the Contractor shall take every precaution to prevent the excavated materials from entering into the public drainage system.

(d) The Contractor shall carry out the Works in such a manner as to minimise adverse impacts on the environment during execution of the Works.

2. NOISE POLLUTION CONTROL

(a) The Contractor shall comply with and observe the Noise Control Ordinance and its subsidiary regulations in force in Hong Kong.

(b) The Contractor shall provide an approved integrating sound level meter to IEC 651:1979 (Type 1) and 804:1985 (Type 1) and THE manufacturer's recommended sound level calibrator for the exclusive use of the Engineer at all times. The Contractor shall maintain the equipment in proper working order and provide a substitute when the equipment are out of order or otherwise not available.

The sound level meter including the sound level calibrator shall be verified by the manufactures every two years to ensure they perform the same levels of accuracy as stated in the manufacturer's specifications. That is to say at the times of measurements, the equipment shall have been verified within the last two years.

(c) In addition to the requirements imposed by the Noise Control Ordinance, to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 07:00 to 19:00 hours on any day not being a general holiday (including Sundays), the following requirements shall also be complied with:

(i) The noise level measured at 1 m from the most affected external facade of the nearby noise sensitive receivers from the construction work alone during any 30 minute period shall not exceed an equivalent sound level (L_{eq}) of 75 dB(A).

(ii) The noise level measured at 1 m from the most affected external facade of the nearby schools from the construction work alone during any 30 minute period shall not exceed an equivalent sound level (L_{eq}) of 70 dB(A) [65 dB(A) during school examination periods].

The Contractor shall liaise with the schools and the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the contract.

(iii) Should the limits stated in the above sub-clauses (i) and (ii) be exceeded, the construction shall stop and shall not recommence until appropriate measures acceptable to the Engineer that are necessary for compliance have been implemented.

Any stoppage or reduction in output resulting from compliance with this clause shall not entitle the Contractor to any extension of time for completion or to any additional costs whatsoever.

(d) Before the commencement of any work, the Engineer may require the methods of working, equipment and sound-reducing intended to be used on the Site to be made available for inspection and approval to ensure that they are suitable for the project.

(e) The Contractor shall devise, arrange methods of working and carry out the Works in such a manner so as to minimise noise impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

The noise reduction methods shall include, but not be limited to, scheduling of works; siting of facilities; selection of quiet equipment; and use of purpose-built acoustic panels and enclosures.

(f) The Contractor shall ensure that all plant and equipment to be used on site are properly maintained in good operating condition and noisy construction activities shall be effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means to avoid disturbance to any nearby noise sensitive receivers.

(g) Notwithstanding the requirements and limitations set out in clause (c) above and subject to compliance with clauses (e) and (f) above, the Engineer may, upon application in writing by the Contractor, allow the use of any equipment and the carrying out of any construction activities for any duration provided that he is satisfied with the application which, in his opinion, to be of absolute necessity and adequate noise insulation has been provided to the educational institutions to be affected, or of emergency nature, and not in contravention with the Noise Control Ordinance in any respect.

(h) No excavator mounted breaker shall be used within 125 m from any nearby noise sensitive receivers. The Contractor shall use hydraulic concrete crusher wherever applicable.

(i) The only equipment that shall be allowed on the Site for rock drilling works will be quiet drilling rigs with a sound power level not exceeding 110 dB(A). Conventional pneumatically driven drilling rigs are specifically prohibited.

(j) Do not operate the percussive piling equipment during the period as prohibited by the Noise Control Ordinance at the elevated structures.

(k) For the purposes of the above clauses, any domestic premises, hotel, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, or performing arts centre or office building shall be considered a noise sensitive receiver.

(l) The Contractor shall, when necessary, apply as soon as possible for a construction noise permit in accordance with the Noise Control (General) Regulations, display the permit as required and copy to the Engineer.

(m) The Contractor shall, when necessary, apply as soon as possible for a construction noise permit in accordance with the Noise Control (General) Regulations, display the permit as required and copy to the Engineer.

3. DUST SUPPRESSION MEASURES

(a) The Contractor shall undertake at all times to prevent dust nuisance as a result of his activities. The air pollution control system installed shall be operated whenever the plant is in operation.

(b) The Contractor shall at his own cost, and to the satisfaction of the Engineer, install effective dust suppression equipment and take such other measures as may be necessary to ensure that at the Site boundary and any nearby sensitive receiver the concentration of air-borne dust shall not exceed 0.5 milligrams per cubic meter, at standard temperature (25°C) and pressure (1.0 bar) averaged over one hour, and 0.26 milligrams per cubic metre, at standard temperature (25°C) and pressure (1.0 bar) averaged over 24 hours.

(c) In the process of material handling other than cement and the like, any material which has the potential to create dust shall be treated with water or spraying with wetting agent.

(d) Where dusty materials are being discharged to a vehicle from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry shall be provided. Exhaust should be provided for this enclosure and vented to a fabric filter system.

(e) Any vehicle with an open load carrying area used for moving materials which have the potential to create dust shall have properly fitting side and tail boards. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be covered by a clean tarpaulin. The tarpaulin shall be properly secured and shall extend at least 300 mm over the edges of the side and tail boards.

(f) Stockpiles of sand and aggregate greater than 20 m^3 shall be enclosed on three sides, with walls extending above the pile and 2 metres beyond the front of the pile. In addition, water sprays shall be provided and used, both to dampen stored materials and when receiving raw material.

(g) The Contractor shall frequently clean and water the site to minimise the fugitive dust emissions.

(h) The Contractor shall restrict all motorised vehicles to a maximum speed of 8 km per hour and confine haulage and delivery vehicles to designated roadways inside the site. Areas of roadway longer than 100 m where movement of motorised vehicles exceeds 100 vehicular movements per day, or as directed by the Engineer, shall be furnished with a flexible pavement surfacing.

(i) Wheel washing facilities shall be installed and used by all vehicles leaving the site. No earth, mud, debris, dust and the like shall be deposited on public roads. Water in the wheel cleaning facility shall be changed at frequent intervals and sediments shall be removed regularly. The Contractor shall submit details of proposals for the wheel cleaning facilities to the Engineer

prior to construction of the facility. Such wheel washing facility shall be usable prior to the commencement of any earthworks excavation activity on the Site. The Contractor shall also provide a hard-surfaced road between the washing facility and the public road.

(j) Conveyor belts shall be fitted with windboards, and conveyor transfer points and hopper discharge areas shall be enclosed to minimise emission of dust. All conveyors carrying materials which have the potential to create dust shall be totally enclosed and fitted with belt cleaners.

4. CONSENT TO EQUIPMENT AND PROCESSES

(a) The Contractor shall not install any furnace, boiler or other plant or equipment or use any fuel that might in any circumstance produce smoke or any other air pollution without the prior consent of the Engineer. Unless specifically instructed by the Engineer, the Contractor shall not light fires on site for the burning of debris or any other matter.

(b) The Contractor's attention is drawn to the Air Pollution Control Ordinance and its subsidiary legislation, particularly the Air Pollution (Furnaces, Ovens and Chimneys) (Installation and Alteration) Regulations and the Air Pollution Control (Smoke) Regulations.

5. REMOVAL OF WASTE MATERIAL

(a) The Contractor shall not permit any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the site onto any adjoining land or allow any waste matter or refuse to be deposited anywhere within the Site or onto any adjoining land and shall have all such matter removed from the Site.

(b) The Contractor shall be liable for any damages caused to adjoining land through his failure to comply with clause 5(a).

(c) The Contractor shall be responsible for temporary training, diverting or conducting of open streams or drains intercepted by any works and for reinstating these to their original courses on completion of the Works.

(d) The Contractor shall be responsible for adequately maintaining any existing site drainage system at all times, including removal of solids in sand traps, manholes and stream beds.

(e) Any proposed stream course and nullah temporary diversions shall be submitted to the Engineer for agreement one month prior to such diversion works being commenced. Diversions shall be constructed to allow the water flow to discharge without overflow, erosion or washout. The area through which the temporary diversion runs is to be reinstated to its original condition or as agreed by the Engineer after the permanent drainage system has been completed.

(f) The Contractor shall furnish, for the Engineer's information, particulars of the Contractor's arrangements for ensuring that material from any earthworks does not wash into the drainage system. If at any time such arrangements prove to be ineffective the Contractor shall take such additional measures as the Engineer shall deem necessary and shall remove all silt which may have accumulated in the drainage system whether within the Site or not.

(g) The Contractor shall segregate all inert construction waste material suitable for reclamation or land formation and shall dispose of such material at such public dumping area(s) as may be specified from time to time by the Director of Civil Engineering Services.

(h) All non-inert construction waste material deemed unsuitable for reclamation or land formation and all other waste material shall be disposed of at a public landfill.

(i) The Contractor's attention is drawn to the Waste Disposal Ordinance, the Public Health and Municipal Services Ordinance, and the Water Pollution Control Ordinance.

6. DISCHARGE INTO SEWERS AND DRAINS

(a) The Contractor shall not discharge directly or indirectly (by runoff) or cause or permit or suffer to be discharged into any public sewer, storm-water drain, channel, stream-course or sea any effluent or foul or contaminated water or cooling or hot water without the prior consent of the Engineer who may require the Contractor to provide, operate and maintain at the Contractor's own expense, within the premises or otherwise, suitable works for the treatment and disposal of such effluent or foul or contaminated or cooling or hot water. The design of such treatment works shall be submitted to the Engineer for approval not less than one month prior to the commencement of construction or as agreed by the Engineer.

(b) If any office, site canteen or toilet facilities are erected, foul water effluent shall be directed to a foul sewer or to a sewage treatment facility either directly or indirectly by means of pumping or other means approved by the Engineer.

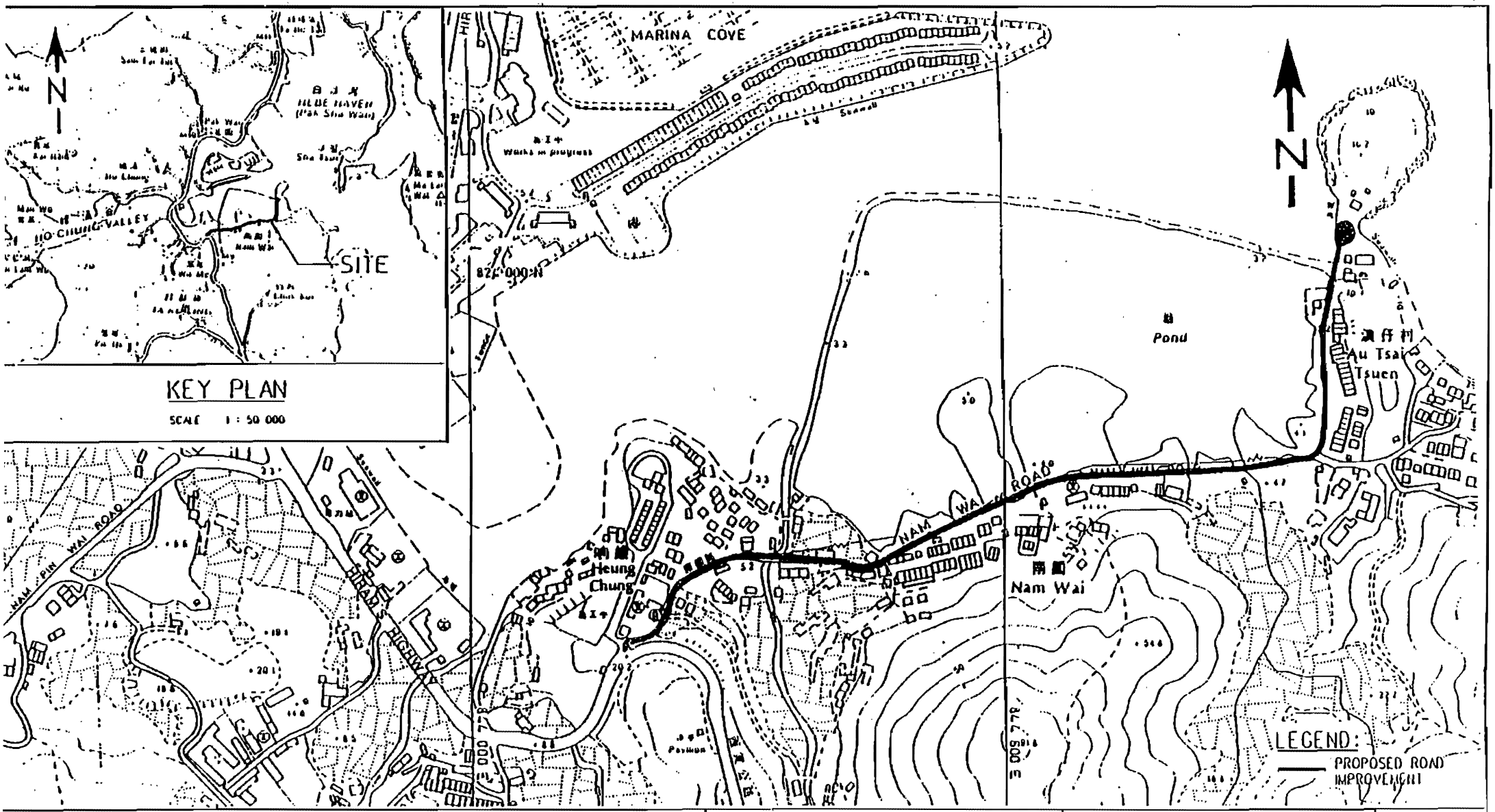
(c) The Contractor's attention is drawn to the Buildings Ordinance and to the Water Pollution Control Ordinance.

APPENDIX B

CONCURRENT PROJECTS

APPENDIX B

CONCURRENT PROJECTS



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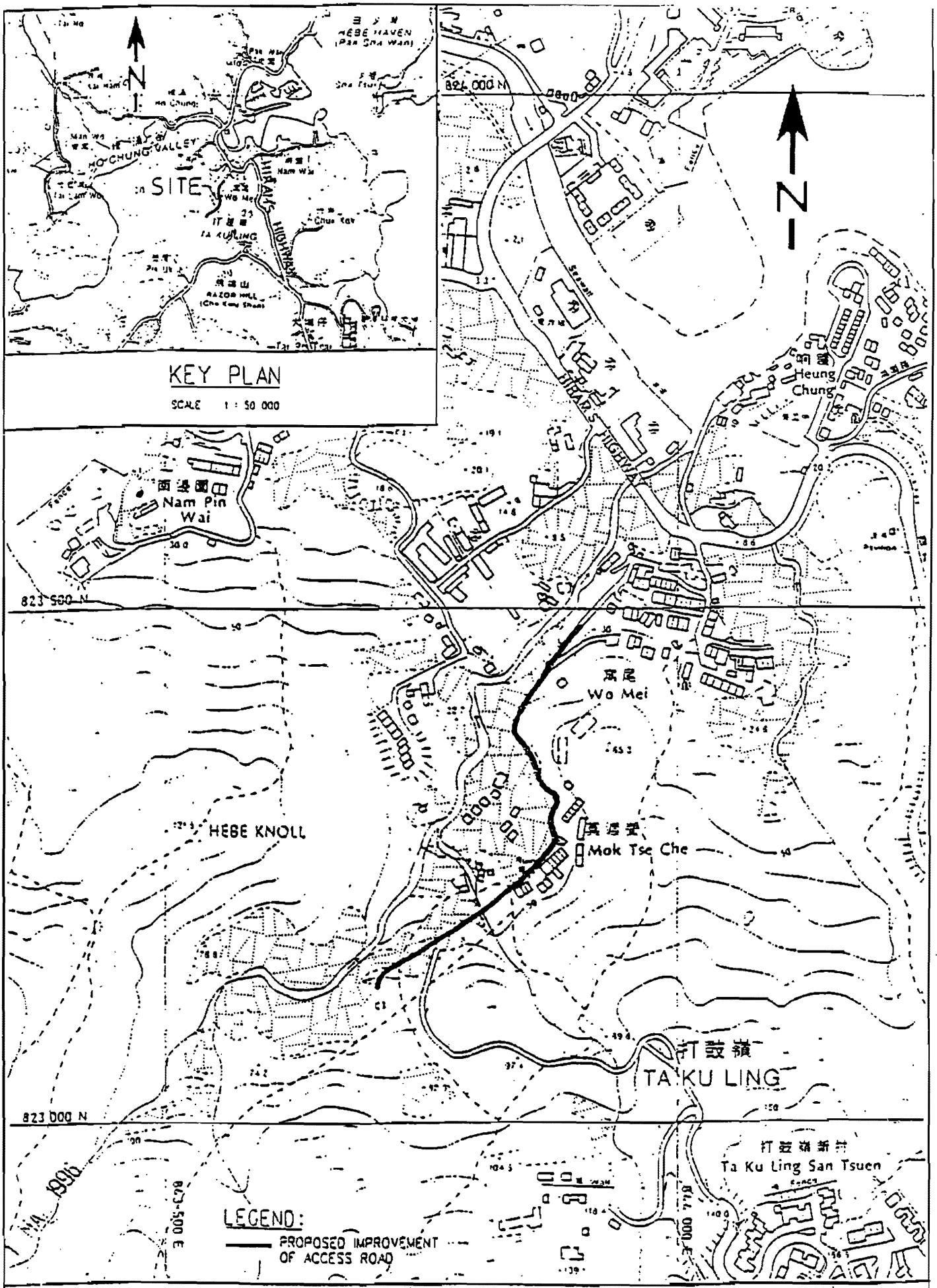


SAI KUNG DISTRICT	SK-025		1 : 5 000
IMPROVEMENT OF ACCESS ROAD AT MOK TSE CHE, SAI KUNG	RURAL PLANNING & IMPROVEMENT STRATEGY	HIGHWAYS / N.T. REGION	HIGHWAYS DEPARTMENT HONG KONG

APPENDIX C

FIRST SURVEY TREE SPECIES
(Excluding Secondary Woodland)

APPENDIX C

FIRST SURVEY TREE SPECIES (Excluding Secondary Woodland)

A vegetation survey was carried out on 18 May 1996 to identify the tree species within the Study Area. Altogether 32 tree species, which are common or widespread in Hong Kong, were recorded.

Listed below are the trees recorded during the survey:

Acacia auriculiformis	*Acacia confusa*	*Acacia mangium*
Alangium chinense	*Albizia lebbek*	*Aleurites moluccana*
*Bauhinia variegata**	*Bombax malabaricum*	*Callistemon viminalis*
Caryota ochlandra	*Castanopsis fissa**	*Chrysalidocarpus lutescens*
Cinnamomum camphora	*Delonix regia*	*Eucalyptus citriodora*
*Ficus hispida**	*Ficus microcarpa**	*Ficus virens**
Glyptostrobus pensilis	*Ilex rotunda*	*Litsea glutinosa**
Livistona chinensis	*Macaranga tanarius*	*Mallotus paniculatus**
Melaleuca leucadendron	*Michelia alba*	*Musa paradiculatus*
Podocarpus macrophyllus	*Schefflera octophylla**	*Sterculia lanceolata*
Syzgium jambos	*Tristania conferta*	

* Native Species

APPENDIX D

SUMMARY OF VEGETATION SURVEY
(Secondary Woodland)

APPENDIX D

SUMMARY OF VEGETATION SURVEY (SECONDARY WOODLAND)

1 METHODS

A flora survey of the secondary woodland along the western face of the ridge east of Wo Mei Village was conducted on 31 January 1997. Figure D1 shows the approximate extent of this woodland within the study area, as determined by inspection of aerial photographs.

The woodland was surveyed on foot qualitatively, near its northern and southern extremities within the study area. The purpose of the surveys was to develop a species list for the woodland, with a non-quantitative estimate of relative abundance for each species within the woodland (common, occasional, rare). Special effort was made to locate species protected under Hong Kong law, and species considered of conservation interest, e.g. due to local or regional rarity (see for example Zhuang and Corlett 1966).

Signs of mammals using the woodland were recorded incidental to the flora survey, as indications of the utility of the site to terrestrial wildlife.

2 RESULTS

2.1 *Flora*

A total of 52 species were recorded during the course of the survey, including 20 tree and 17 shrub species. A species list is attached at Appendix D1. Readers should also refer to results of tree surveys for height, dbh and conditions of trees recorded.

The woodland at the southern extremity of the study area appeared more mature than that at the northern end. The woodland at the southern end had a higher degree of canopy closure, less ground cover and higher richness of plant species. Large stands of bamboo and a number of exotic species were recorded in the northern end of the woodland.

Canopy height throughout the woodland ranged from 5-6m near the ridge top to 8-10m (upto 12m in some locations) farther downslope.

Tree species including *Cratoxylum cochinchinensis, Sterculia lanceolata, Mallotus paniculatus, Garcinia oblongifolia, Aporusa dioica, Cinnamomum camphora* and *Schefflera octophylla* dominated the canopy of the woodland. Seedlings and whips of these trees were also commonly found in the understorey, indicating a high degree of woodland regeneration. In addition, shrub species including *Psychotria, Ardisia quinquegona, Sarcandra glabra* and *Litsea rotundifolia* also dominated the understorey. Large patches of the fern *Cibotium barometz* dominated in areas with more open canopy where light intensity was higher.

No species protected under the Forestry Regulation were found during the survey. Most of the species recorded are common species in the Territiory, but are also known forage sources for frugivorous birds. However, one uncommon tree species, *Endospermum chinense*, was recorded during the survey. The presence of both seedlings and mature individuals of this species indicated that it is regenerating in this woodland. This species has a restricted distribution locally and can regenerate only in fairly good soils. It is included in a list of rare, threatened or extinct species in Hong Kong by Zhuang and Corlett (1996), who accord it "vulnerable" status. Based on the present survey and previous field observations, it appears that Sai Kung is one of the areas where *Endospermum chinensis* is regenerating in Hone Kong.

2.2 *Fauna*

No direct observations of mammals were made, but mammal burrows and traps were recorded.

Five burrows were recorded in the course of a three-hour survey of the southern end of the woodland. All were in the range of 25cm wide and 17cm high at the mouth. Three of the burrow mouths were within 2m of each other and appeared to be multiple entrances to a single burrow; one of these was freshly dug and clearly active. The size of the burrows suggests that they belong to Ferret Badgers *Melogale moschata.*

Boar tracks and scrapes were observed in the dry bottom of the Wo Mei stream, below the study area. Traps were observed near the northern end of the woodland, within or near the study area. These included a noose trap, presumably for boar or deer, just inside the woodland east of Wo Mei Village, and a box trap of a size suitable for porcupine or ferret badger slightly upslope from the Yue Sun Nursery.

3 IMPACTS TO WOODLAND AND MITIGATION MEASURES

The extensive cut works on the ridge top and fill works in the Wo Mei valley will affect approximately 0.52 ha of the native woodland.

Loss of this woodland, especially on the southern part, is moderately significant because of its quality, age, structure, as well as presence of an uncommon tree species and wildlife use. However, as the affected area is fairly small in size and is located on the edge of the woodland close to an existing cut slope and path, the impact of its loss would be considered moderate.

Loss of woodland could be mitigated by replanting of species recorded from the woodland. Replanting has been proposed on cut and fill slopes along the new alignment (EIA, Section4.4). An area of 3.75 ha would be available for tree planting on these slopes.

Species used in replanting should be selected from among those recorded in the existing woodland, particularly in areas where replanting will be contiguous with existing woodland.

Care should be taken during the construction phase of the project in order to avoid disturbance to woodland outside the site boundary. The temporary works areas, access road, and other related facilities should be kept away from the woodland as far as possible.

4 REFERENCE CITED

Zhuang, X. and R. T. Corlett. 1996. The conservation status of Hong Kong's tree flora. Chinese Biodiversity 4 (suppl.):36-43. [In English]

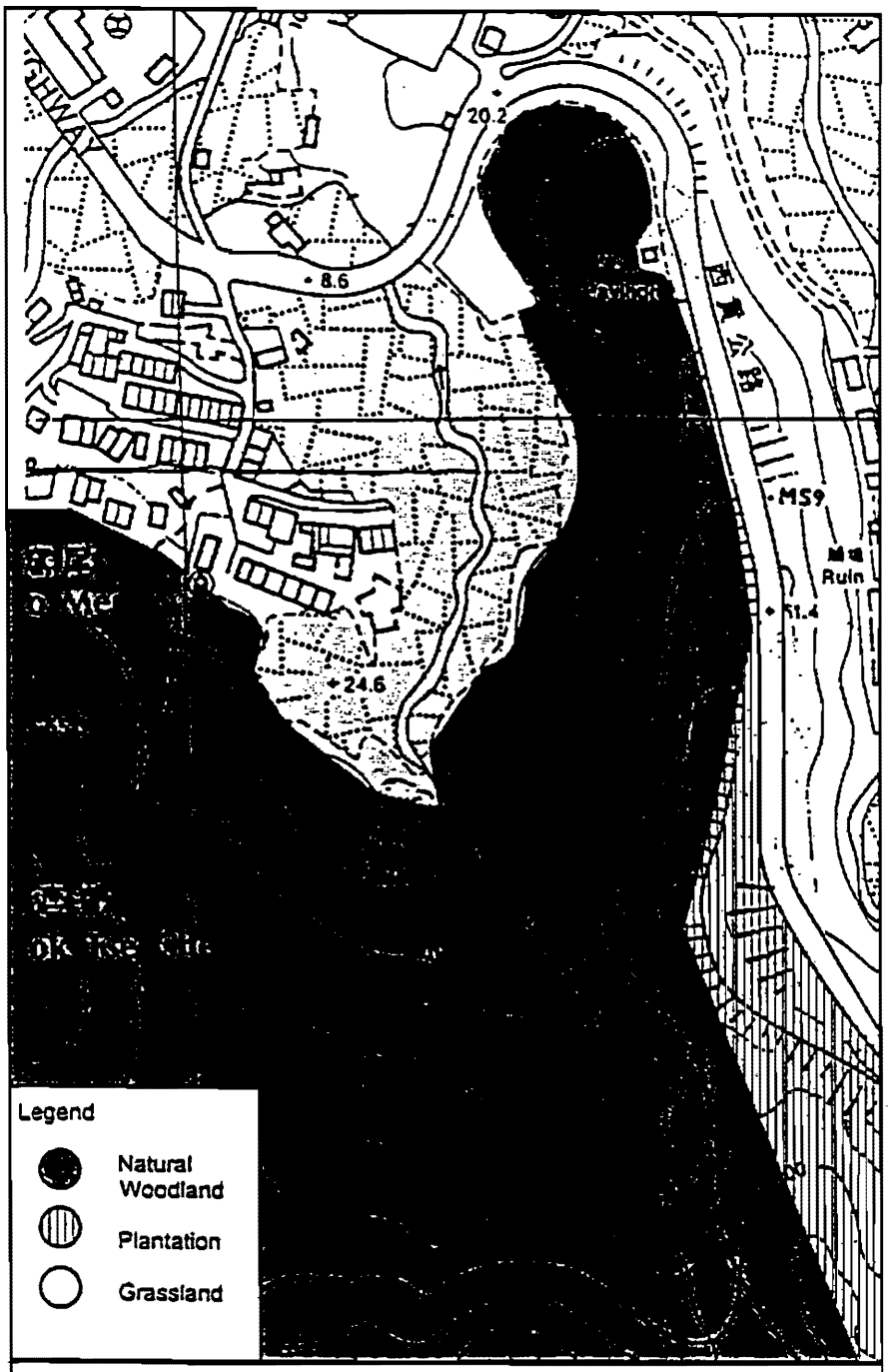


Figure D1 Habitat Map showing the secondary woodland in the study area at Hiram's Highway, January 1997.

Appendix D1 Plant species list for the natural secondary woodland east of Hiram's Highway, January 1997.

Species	Habit	Relative Abundance	Species	Habit	Relative Abundance
Embelia laeta	C	+	*Rhaphiolepis indica*	S	+
Psychotria serpens	C	+	*Rhodomyrtus tomentosa*	S	+
Rubus reflexus	C	+	*Sarcandra glabra*	S	+++
Smilax glabra	C	+	*Tricalysia dubia*	S	++
Tetracera asiatica	C	++	*Uvaria microcarpa*	S	+
Adiantum flabellatum	F	+	*Scleria* sp.	SE	+
Blechnum orientale	F	++	*Aporusa dioica*	T	++
Cibotium barometz	F	+++	*Aquilaria sinensis*	T	+
Dicranopteris linearis	F	++	*Archidendron clypearia*	T	+
Pronephrium simplex	F	+++	*Cinnamomum camphora*	T	++
Pteris semipinnata	F	++	*Cratoxylum cochinchinensis*	T	+++
Alocasia macrorhizza	H	+	*Dimocarpus longan*	T	+
Alpinia spp.	H	+++	*Diospyros eriantha*	T	++
Liriope spicata	H	++	*Endospermum chinense*	T	+
Alchornea trewioides	S	+	*Evodia lepta*	T	+
Ardisia quinquegona	S	+++	*Garcinia oblongifolia*	T	+
Desmos chinensis	S	+	*Machilus* sp.	T	+
Elephantopus sp.	S	+	*Machilus velutina*	T	+
Ficus sp.	S	+	*Mallotus paniculatus*	T	+++
Ficus variolosa	S	+	*Pinus massoniana*	T	+
Glochidion eriocarpum	S	+	*Quercus* sp.	T	++
Ilex asprella	S	+	*Rhus chinensis*	T	++
Ilex pubescens	S	++	*Schefflera octophylla*	T	++
Litsea rotundifolia	S	+++	*Sterculia lanceolata*	T	+
Pandanus urophylla	S	+	*Symplocos glauca*	T	++
Psychotria rubra	S	+++	*Ternstroemia gymnanthera*	T	+

C = climber, F = fern, H = herb, S = shrub, SE = sedge, T = tree
+++ = common, ++ = occasional, + = rare

APPENDIX E

SUMMARY OF TREE SURVEY REPORT

APPENDIX E

SUMMARY OF TREE SURVEY REPORT

1. DESCRIPTION OF THE TREES

(a) A total of 777 no trees, meeting the standard size definition, were recorded within the area of the project limit of works, of which 7 no. were found to be dead (to be removed). A description of the trees is given in the Tree Survey Schedule, and their location is shown on the Tree Survey Plan drawings accompanied by a photographic record of the trees.

(b) The trees comprise some 63 no. ornamental, and secondary woodland species, all commonly found in Hong Kong. There were no irreplaceably rare species found, and none of them have any special ecological value. A list of the tree species found is given in Table E1.

(c) The vertical and horizontal alignment of the new road sections, the design of supporting structures, and the contractors working areas and construction methods will be refined as far as possible to minimise the potential loss of existing trees, and achieve the least environmental impact possible.

(d) Based on the preliminary alignment drawings, a total of 556 no. trees will be affected by the proposed works, lying either within the area of the new carriageways, directly under elevated bridge structures, or would have the majority of their root systems disturbed by the excavation works to build the highway and retaining structures.

(e) As most of the trees affected are situated on steep slopes their rooting patterns would not be possible for them to be successfully transplanted. It is considered that only some 108 no. Trees which currently lie in the low lying areas near Wo Mei Village are suitable for transplanting. The remaining 448 no. trees will need to be felled. However, these numbers may vary slightly due to any refinement during detailed design stage.

(f) It may be possible to retained some of the trees affected through crown or root pruning, or accepting overfilling with rock and soil material to make up the necessary ground levels. Any crown or root pruning works would need to be undertaken by specialist tree surgeons, with the extent of works required minimised through on site in consultation with the Contractor,

2. COMPENSATION TREE PLANTING PROPOSALS

(a) Compensation planting proposals have been prepared as part of the Landscape Mitigation Measures Plans prepared as part of the EIA for the scheme.

(b) The design proposes extensive planting of secondary woodland tree and large shrub species to promote the long term development of a mature woodland structure and to screen the new highway structures, and to tie the scheme into the surrounding landscape pattern. Some fast growing exotic species will be included within woodland mixes to act as nurse species, and more ornamental species will be used in pedestrian areas along the local access roads.

(c) It is suggested that the trees to be transplanted be temporarily relocated to the area of the Yue Sun Nursery east of the road, before being replanted within the final landscape scheme for the project.

(d) In addition to trees to be transplanted back into the final layout, some 870 no. new Standard and Light Standard size tree and some 12,000 no. seedling and whip size trees and tall shrubs can be planted within the scope of the works in compensation for those lost and to help screen the road and re-establish the existing woodland landscape pattern.

Table E1 - Existing Tree - Species List

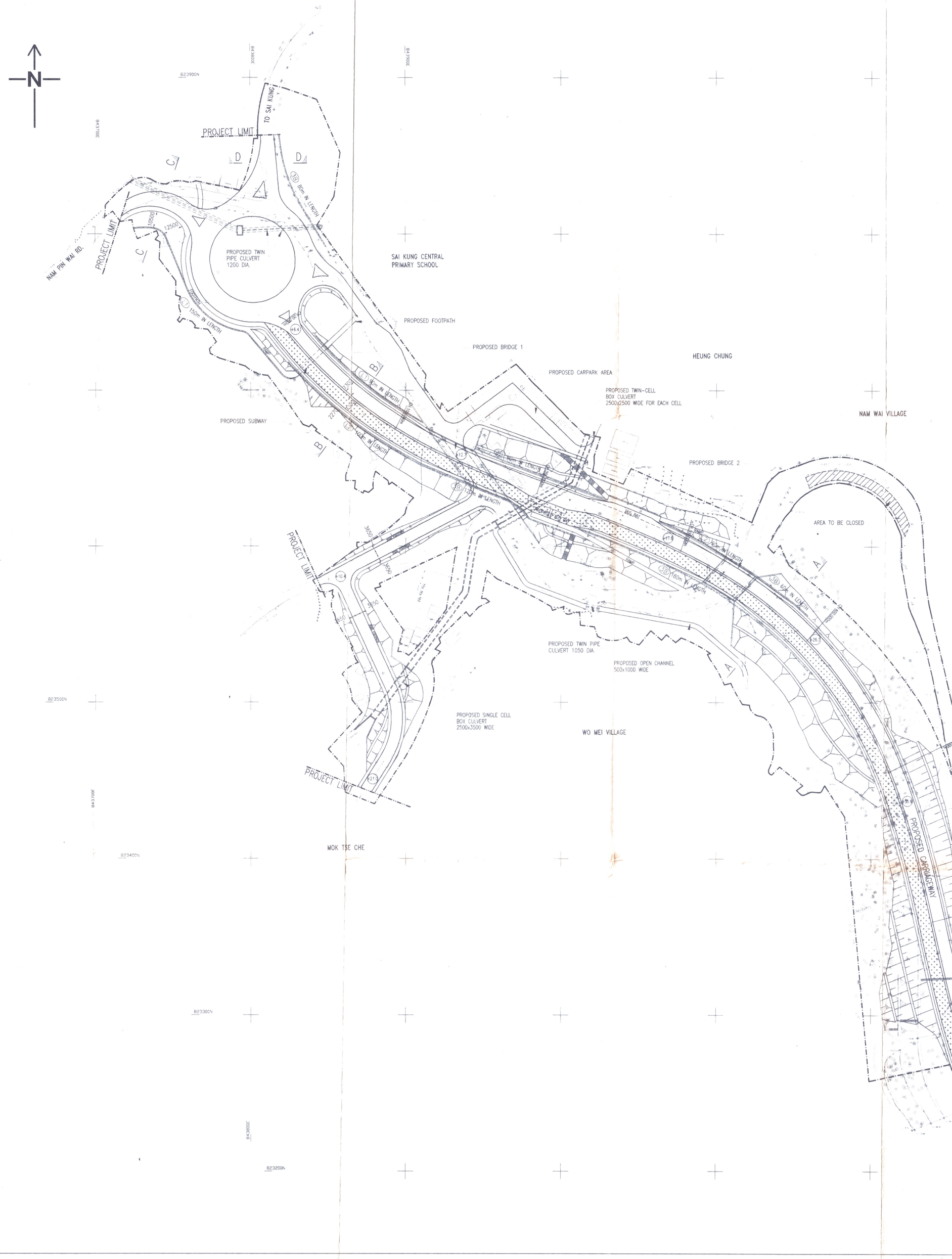
Acacia auriculaeformis	Cinnamonum camphora *	Macaranga tanarius *
Acacia confusa	Citrus grandis	Mallotus paniculatus *
Acacia dealdata	Delonix regia	Mangifera indica
Acacia mangium	Dracaena marginata	Melaleuca leucadendron
Alangium chinense *	Eucalyptus robusta	Melia azedarach
Albizia lebbek *	Eucalyptus salignus	Michelia alba
Aleurites fordii	Eucalyptus tereticornis	Podocarpus macrophyllus
Aleurites moluccana	Euphoria longan	Pterocarpus indicus
Archontophoenix alexandrae	Ficus auriclata	Quercus spp. *
Ardisia crenata *	Ficus benjamina	Salix babylonica
Artocarpus heterophyllus	Ficus lyrata	Sapium sebiferum
Averrhoa carambola	Ficus variegata *	Sapium spp *
Bauhinia spp. *	Ficus virens *	Schefflera octophylla *
Bischofia trifoliata *	Glyptostrobus pensilis	Scolopia chinensis *
Bombax malabaricum	Grevillea robusta	Sterculia lanceolata *
Bridelia monoica *	Hibiscus tiliaceus *	Sterculia nobilis
Callistemon viminalis	Ilex rotunda *	Taxodium distichum
Cassia spp.	Litchi chinensis	Terminalia catappa
Cassia surattensis	Litsea glutinosa *	Ternstroemia gymnanthera *
Castanopsis fissa *	Litsea spp. *	Thevetia peruviana
Celtis sinensis *	Livistona chinensis	Toona sinensis

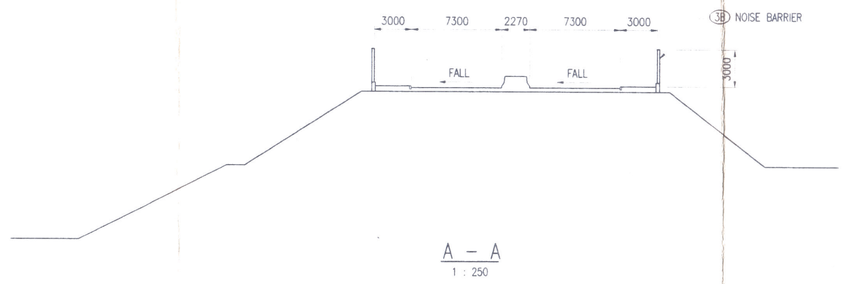
* Native Species

Note: Only trees with the Government standard size (95mm dbh) is included in the list.

APPENDIX F

PRELIMINARY GENERAL LAYOUT PLAN





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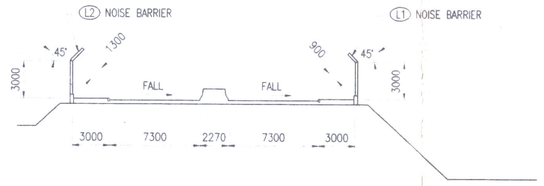

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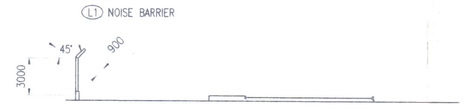

C – C
1 : 250

D – D
1 : 250

NOTES:–

1. ALL DIMENSIONS ARE IN MILLIMETRES, UNLESS OTHERWISE STATED.
2. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM OF HONG KONG.

LEGEND:–

- 55.9 — PROPOSED SPOT LEVEL
- PROPOSED FILL SLOPE
- PROPOSED CUT SLOPE
- EXISTING SLOPE
- PROPOSED RETAINING WALL
- PROPOSED FORMATION
- 38 — 3m HIGH PLAIN NOISE BARRIER
- L1 — 3m HIGH INVERTED–L BARRIER WITH INCLINED PANEL OF 0.8m IN LENGTH
- L2 — 3m HIGH INVERTED–L BARRIER WITH INCLINED PANEL OF 1.3m IN LENGTH
- PROPOSED LAND RESUMPTION LIMIT

PRELIMINARY

Rev.	Date	Description	Approved
A	JAN. 97	NOISE BARRIER LOCATION	

Client

HIGHWAYS DEPARTMENT
HONG KONG

Project

HIRAM'S HIGHWAY IMPROVEMENT IMPROVEMENT BETWEEN NAM WAI AND HO CHUNG AND UPGRADING LOCAL ACCESS ROADS

Title

GENERAL LAYOUT PLAN

Drawn	TMH	Scale	1 : 1000
Checked			
Approved		Date	AUGUST, 96

Drg. No. BBHK/96044/G1/P/001 Rev. A

Babtie BMT (Hong Kong) Ltd.
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