香港地下鐵路公司
Mass Transit Railway Corporation

Feasibility Study and Preliminary Design for

Tseung Kwan O Extension
Quarry Bay Congestion Relief Works

Quarry Bay Congestion Relief Works
Detailed Environmental
Impact Assessment Report R9Q

Volume IV : Supplementary Working Paper

March 1997

Maunsell

in association with

MVA
Parsons Brinckerhoff
Urbis
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Design Research Unit
ERM
Widnell

CONTENTS:

1 INTRODUCTION

1.1 BACKGROUND TO THE DETAILED ENVIRONMENTAL IMPACT ASSESSMENT

1.1.1 Maunsell Consultants Asia Ltd, in association with MVA, Parsons Brinckerhoff, Urbis, Dennis Lau & Ng Chun Man, Design Research Unit and ERM Hong Kong, were commissioned by the Mass Transit Railway Corporation (MTRC) to undertake the Feasibility Study and Preliminary Design for the Quarry Bay Relief Works (QBR). During the initial stages of the Study, ERM Hong Kong produced the Quarry Bay Extension Environmental Feasibility Study Report (R8Q), Maunsell Consultants (Asia) Ltd, February 1996 (EFS) to determine the environmental constraints which could affect the feasibility of the railway.

1.1.2 The EFS showed that, with appropriate mitigation, identified potentially adverse impacts could generally be controlled to within the established standards and guidelines. The findings of the EFS were used by the Study Team during the preliminary design stage of the QBR to develop effective construction and operational measures to limit the effects of those potential adverse environmental impacts identified in the EFS.

1.1.3 Subsequently, ERM has developed the findings of the EFS, using the more developed output of the QBR Preliminary Design, to produce a Detailed Environmental Impact Assessment (DEIA). The DEIA will be used to establish the environmental performance criteria to be applied during the construction and operation of the QBR and for inclusion in the Tender requirements for the Design and Construct Contracts.

1.1.4 Following the completion of the original DEIA Report (*Volume II*) in July 1996, a number of changes were made to the plans for the QBR construction works at North Point. A series of supplementary Working Papers were produced to deal with these aspects, notably noise impacts at the revised construction site locations. The findings of the Working Papers supersede those of the QBR DEIA Main Report (*Volume II*). This *Volume*, containing the supplementary Working Papers, should be read in conjunction with the other *Volumes* of this Report.

1.2 THE MTRC QUARRY BAY RELIEF WORKS

1.2.1 To relieve the pressure on the Kwun Tong/Island Line Interchange at Quarry Bay Station, identified in the MTRC commissioned *ISL Stations Capacity Enhancement Report, February 1995*, MTRC propose to continue the Kwun Tong Line (KTL) which currently terminates at Quarry Bay, through to either North Point Station or Fortress Hill Stations to provide an alternative interchange. The need for such action was also identified in the Government's *Railway Development Strategy Report* of December 1994. It was also envisaged that the line may be extended later to connect to the Lantau and Airport Railway (LAR) via a new North Hong Kong Island Line.

1.2.2 Following the completion of the *Quarry Bay Extension Feasibility Study, Maunsell et al, January 1996*, the MTRC identified the North Point option as the most suitable. The Quarry Bay extension will, therefore, run west, from the existing KTL overrun tunnels through Braemar Hill to North Point Station, running into a new North Point Station adjacent to the existing MTR station and emerging from rock tunnel south of King's Road near Fortress Hill Station.

1.2.3 In the *Quarry Bay Extension: Proposal To Government, MTRC, February 1996*, North Point was identified as the preferred option for the new station as it:

- provides good interchange for passengers;
- has the lowest construction costs of all options;
- has a much shorter construction period than the Fortress Hill Station option;
- is better suited for further extension as part of the North Island Line; and
- has fewer complex construction interfaces with the operating MTR.

1.2.4 Subject to Government approval, it is proposed that construction of the QBR will commence in September 1997 and is projected to open in December 2000.

1.2.5 Construction works for the QBR will occur near Quarry Bay Station, North Point Station and Fortress Hill Stations (see *Figure 2.1a*). At Quarry Bay, construction site QB1 will be on the site of the petrol filling station between Quarry Bay Station and North Point Government School. The site will be used to drive an access adit to the rear of the existing station and then two rail tunnels through to the site of the new North Point Station. Spoil from the tunnelling and station excavation will be removed via QB1.

1.2.6 Four potential construction sites have now been identified in the North Point area.

- Site NP1, to the west of the existing station is located adjacent to the south-west corner of Tzat Tze Mui Road and will be used for the construction of an access shaft to the new station. The site will subsequently be used for the construction of a three-storey ancillary building.

- Site NP2 is adjacent to Tanner Road, to the north of Tanner Hill Estate, it will be used for the construction of a ventilation shaft and associated vent building. The location of this site has been moved from the southern side of Tanner Road to the northern side.

- Site NP4 which was to cover the eastern end of Tzat Tsz Mui street, much of Kam Hong Street, a section of Tanner Road and the adjacent sitting out area has been removed from the construction plans. No new station entrances will now be created.

- A new work site, Site NP5, is located to the south of NP1, at the end of Kam Ping Street. The site will provide an additional access adit to the North Point Station and tunnel works.

- A further site at Pak Fuk Road has also been identified, utilising land currently used for a car park. The site is above tunnel workings from the original Island Line construction and this will reduce the volume of excavated material which would need to be removed when compared to other sites.

1.2.7 The Fortress Hill construction site, FH3, will be sited on the corner of King's Road and Comfort Terrace and will fulfil the same role as the QB1 site driving an access adit to the end of the new overrun tunnels and through to the new North Point Station from the west.

1.2.8 Other than the new above ground structures, including site NP1 in its entirety, and the removal of the petrol filling station at QB1, all sites will be returned to their existing uses upon completion of the construction works.

1.2.9 The construction sites referred to above, and the construction methodology used for the impact assessments in the following Working Papers, were developed for the DEIA in association with Maunsell and the MTRC, based on the Quarry Bay Extension Preliminary Design. The successful Tenderer will be required to demonstrate that his preferred construction methodology will meet the performance criteria established in this Report regardless of the similarities or differences between the two methodologies.

1.3 OBJECTIVES OF THE DETAILED ENVIRONMENTAL IMPACT ASSESSMENT

1.3.1 The specific objectives for the DEIA are to complete the investigations undertaken in the EFS and thus fulfil the requirements of the EPD Environmental Impact Assessment Study Brief, which are:

i) to describe the proposed railway and associated facilities including railway stations and the requirements for their development;

ii) to identify and describe the elements of the existing and planned community and environment likely to be affected by the proposed railway;

iii) to identity and quantify environmental polluting sources and determine the significance of impacts on sensitive receivers and potential affected uses;

iv) to minimize potential pollution and environmental disturbance arising from the development and its operation and during construction of the railway;

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

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

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

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

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

x) to identify any additional studies necessary to fulfil the objectives to the requirements of this Environmental Impact Assessment Study.

1.4 *STRUCTURE OF THE DETAILED ENVIRONMENTAL IMPACT ASSESSMENT REPORT*

1.4.1 The DEIA comprises four volumes:

- *Volume I*, the Executive Summary, briefly explains how the DEIA was carried out and describes the findings of the Main Report, concentrating on the potential adverse impacts and proposed mitigation measures;
- *Volume II*, the Main Report, provides the findings of the DEIA: identifying the environmental performance criteria applicable to the QBR; focusing on the likely impacts of the construction and operation of QBR; and developing appropriate mitigation measures to control any adverse impacts.
- *Volume III*, the Technical Annexes which contain the detailed technical data and methodologies used in the air quality and noise impact assessments of the DEIA.
- *Volume IV*, the supplementary Working Papers which deal with the changes to the original construction methodology which were developed after the submission of the DEIA.

1.4.2 After this introductory section, the remainder of Volume IV of the DEIA comprises the six supplementary Working Papers as follows.

- Work Site NP1 Construction Noise Impact Assessment
- Work Site NP5 Construction Noise Impact Assessment
- Work Site NP2 Construction Noise Impact Assessment
- Additional Construction Dust Impact Assessment
- Additional Dust Impact Assessment at Quarry Bay and North Point
- Detailed EIA for Additional Work Site at Pak Fuk Road

WORKING PAPER

CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

Mass Transit Railway Corporation

Quarry Bay Relief Works DEIA - Work Site NP1 : *Construction Noise Impact Assessment*

3 September 1996

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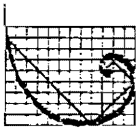


ERM

WORKING PAPER

Mass Transit Railway Corporation

Quarry Bay Relief Works DEIA - Work Site NP1 : *Construction Noise Impact Assessment*

3 September 1996

Reference C1365/39343

For and on behalf of ERM-Hong Kong, Ltd

Approved by: _____

Position: Principal Consultant

Date: 3 September 1996

EXECUTIVE SUMMARY

This Paper is a revision of the noise impact assessment for the construction works at the NP1 work site (North Point Station Access Shaft) contained in the draft Detailed Environmental Impact Assessment (DEIA) for the Quarry Bay Relief Works (QBR) presented to the Study Management Group meeting on 11 July 1996.

The purpose of this Paper is to give further consideration to the details of the construction programme and methodology for the QBR such that the level and duration of the predicted exceedances of the recommended voluntary daytime noise target are more clearly understood.

The revised assessment has considered all practicable mitigation measures that can realistically be imposed upon the Contractor without preventing him from fulfilling his contractual responsibilities.

The highest noise levels will only occur for: about three weeks during the three to four month site preparation period; and one to two weeks of the final three or four months of structures work; during the 36 month construction programme. This represents about four or five out of 156 weeks, some 2-3 % of the total construction period.

For about half the construction programme, while work is underground, noise levels at the nearest residential properties will be close to the daytime target level and during the majority of the above ground works the noise levels are expected to cause only limited exceedances of the target level.

CONTENTS:

1 INTRODUCTION

The Detailed Environmental Impact Assessment (DEIA) for the Quarry Bay Relief Works (QBR) identified a number of exceedances of the EPD's recommended voluntary daytime noise target levels for construction works. This Paper reassesses the noisiest predicted impacts associated with the construction of the Access Shaft Site (NP1) based on the original works and receiver locations. This assessment has been refined using revised plant inventories and more detailed information on construction methodologies and programmes. The revision to the construction works requiring the removal of part of the rock face to the rear of the site has also been addressed. Mitigation measures including the construction of an acoustic enclosure, use of silenced plant, movable noise barriers and limiting the numbers of operational plant, have been recommended to reduce the noise impacts to the NSRs during the construction period.

2 ASSESSMENT METHODOLOGY

2.1 NOISE SENSITIVE RECEIVERS

At North Point, the region surrounding the proposed work site currently consists of highly populated residential buildings and other developments. The NSRs have been identified for this assessment based on the NSRs selected previously in the Draft Detailed Environmental Impact Assessment Report R9Q. The NSRs affected by the work site NP1 are listed as below and shown in *Figure 2.1a:*

- NNP1a - Tung Fat Building
- NNP2 - Kam Ping Building
- NNP3a - Pine Tree House
- NNP9b - Cheong Yuen Building
- NNP9c - Ming Wai Kindergarten at Cheong Yuen Building
- NNP10 - Roca Centre
- NNP11 - Maylun Apartment

The NSRs have no central air conditioning system and are in direct line of sight to the proposed works.

2.2 POTENTIAL SOURCE OF IMPACTS

Potential sources of impact from NP1 will include the following construction activities:

- Site preparation will include clearance of the site, cutting back the rock face at the rear of the site and construction of the noise enclosure. During this phase the only opportunities available for mitigation are the use of quiet plant, moveable noise barriers and a reduction in the number of plant operating at any one time. At the initial stage, excavator mounted breakers will be involved for cutting rock and this activity will last for 2-3 weeks. Standard types of construction plant will be used for a period which is expected to last for 2-3 months.

- Site excavations within the noise enclosure will take approximately 12 months to complete. This phase has been split into two elements; initial and final excavations. During the initial excavations, hand-held rock drills and breakers will be used. The final excavations will involve standard construction plant and this stage is expected to be quieter during the final six months as the noisiest plant, including rock drills and breakers will not be used.

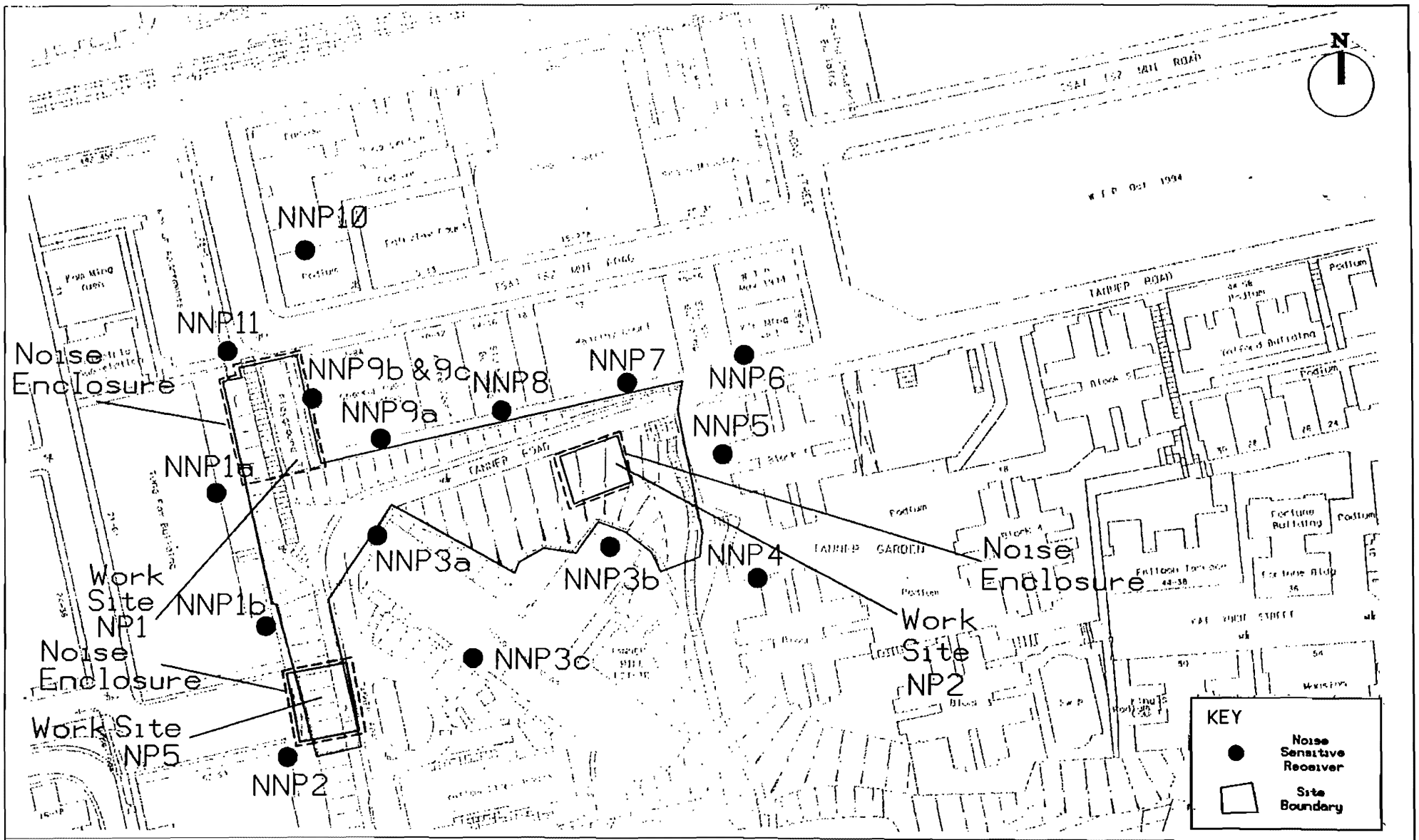
- Construction of the structure of the access shaft will commence within the noise enclosure up to the first storey height; this will take approximately six months. However, for works to proceed above this height, the roof of the noise enclosure will have to be removed. During these stages, it may be possible to erect additional noise barriers to provide some screening to the closest NSR during the three to four months required for completion of the structure.

Following completion of the structure, the remaining sections of the enclosure will be dismantled and removed. This will take approximately one month.

- The noisiest operations associated with the dismantling of the enclosure will be the removal of the foundations. This will involve breakers, loaders and lorries and the only available methods of noise mitigation are the use of quiet plant, moveable barriers and limiting the number of plant operating. This phase is expected to take approximately two months.

- Following completion of the above works (29 months), E&M installation works will take approximately a further 7 months, during which time most of the construction activities will be inside the building.

A methodology for assessing noise from the construction of the proposed alignment has been developed based on the *Technical Memorandum on Noise from Construction Work other than Percussive Piling* (TM). The revised plant inventories for the different phases of construction activities are given in *Annex A*.



NSR Locations in North Point

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FIGURE No. 2.1a

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Adverse noise impacts are predicted during all the construction phases, especially at Tung Fat Building (NNP1a), Cheong Yuen Building (NNP9b), Ming Wai Kindergarten (NNP9c) and Maylun Apartment (NNP11). The predicted noise levels with and without mitigation measures are shown in *Table 3.1a* below. The 'unmitigated' noise level for excavation and structures assumes the use of a noise enclosure.

Table 3.1a ***Predicted Noise Levels at NP1 ($L_{Aeq\ 30min.}$ dB)***

NSRs	Construction Activities	Unmitigated Noise Level with noise enclosure	Quiet Plant	Quiet Plant, Moveable Barriers	Quiet Plant, Moveable Barrier & Reduced Plant	Construction Duration (month)
NNP1a	Initial site preparation[1]	97	91	87	87	1
	Site preparation[1]	92	87	83	83	2
	Initial Excavation[2]	77	75	-	72	6
	Final Excavation[2]	73	70	-	68	6
	Structures[2] (up to 1/F)	74	72	-	67	6
	Structures[3] (2/F)	84	82	-	77	4
	Structures[1] (3/F)	94	92	90	84	1
	Enclosure[1] Removal	90	81	80	80	2
	Foundation removal[1]	91	86	82	82	1
NNP2	Initial site preparation[1]	81	75	71	71	1
	Site preparation[1]	76	71	67	67	2
	Initial Excavation[2]	61	59	-	56	6
	Final Excavation[2]	57	54	-	52	6
	Structures[2] (up to 1/F)	58	56	-	51	6
	Structures[3] (2/F)	68	66	-	61	4
	Structures[1] (3/F)	78	76	74	69	1
	Enclosure Removal[1]	74	66	64	64	2
	Foundation removal[1]	75	70	66	66	1

NSRs	Construction Activities	Unmitigated Noise Level with noise enclosure	Quiet Plant	Quiet Plant, Moveable Barriers	Quiet Plant, Moveable Barrier & Reduced Plant	Construction Duration (month)
NNP3a	Initial site preparation[1]	87	82	77	77	1
	Site preparation[1]	82	77	73	73	2
	Initial Excavation[2]	68	66	-	63	6
	Final Excavation[2]	64	60	-	59	6
	Structures[2] (up to 1/F)	64	62	-	58	6
	Structures[3] (2/F)	74	72	-	68	4
	Structures[1] (3/F)	84	82	80	75	1
	Enclosure Removal[1]	81	72	70	70	2
	Enclosure foundation removal[1]	82	77	73	73	1
NNP9b	Initial site preparation[1]	103	97	93	93	1
	Site preparation[1]	98	93	89	89	2
	Initial Excavation[2]	83	81	-	78	6
	Final Excavation[2]	79	76	-	74	6
	Structures[2] (up to 1/F)	80	78	-	73	6
	Structures[3] (2/F)	90	88	-	83	4
	Structures[1] (3/F)	100	98	96	90	1
	Enclosure Removal[1]	96	87	86	86	2
	Foundation removal[1]	97	92	88	88	1

NSRs	Construction Activities	Unmitigated Noise Level with noise enclosure	Quiet Plant	Quiet Plant, Moveable Barriers	Quiet Plant, Moveable Barrier & Reduced Plant	Construction Duration (month)
NNP9c school	Initial site preparation[1]	103	97	93	93	1
	Site preparation[1]	98	93	89	89	2
	Initial Excavation[2]	83	81	-	78	6
	Final Excavation[2]	79	76	-	74	6
	Structures[2] (up to 1/F)	80	78	-	73	6
	Structures[3] (2/F)	90	88	-	83	4
	Structures[1] (3/F)	100	98	96	90	1
	Enclosure Removal[1]	96	87	86	86	2
	Foundation removal[1]	97	92	88	88	1
NNP10	Initial site preparation[1]	89	83	79	79	1
	Site preparation[1]	84	79	75	75	2
	Initial Excavation[2]	69	67	-	64	6
	Final Excavation[2]	65	62	-	60	6
	Structures[2] (up to 1/F)	66	64	-	59	6
	Structures[3] (2/F)	76	74	-	69	4
	Structures[1] (3/F)	86	84	82	77	1
	Enclosure Removal[1]	82	73	72	72	2
	Foundation removal[1]	83	78	74	74	1

NSRs	Construction Activities	Unmitigated Noise Level with noise enclosure	Quiet Plant	Quiet Plant, Moveable Barriers	Quiet Plant, Moveable Barrier & Reduced Plant	Construction Duration (month)
NNP11	Initial site preparation[1]	**98**	**93**	**88**	**88**	1
	Site preparation[1]	**93**	**88**	**84**	**84**	2
	Initial Excavation[2]	**78**	**77**	-	74	6
	Final Excavation[2]	75	71	-	70	6
	Structures[2] (up to 1/F)	75	73	-	69	6
	Structures[3] (2/F)	**85**	**83**	-	**79**	4
	Structures[1] (3/F)	**95**	**93**	**91**	**86**	1
	Enclosure Removal[1]	**92**	**83**	**81**	**81**	2
	Foundation removal[1]	**93**	**87**	**84**	**84**	1

Note : (1) A 5 dB(A) or 10 dB(A) attenuation from the moveable barrier has been incorporated for mobile and stationary plant without acoustic enclosure.
(2) A 20 dB(A) attenuation from the acoustic enclosure has been incorporated.
(3) A 10 dB(A) attenuation from the remaining 10 m high side-wall of the enclosure has been incorporated.
Noise levels exceeding the EPD's recommended noise criteria of 75 dB(A) for residential premises and 70 dB(A) for schools are shown in bold and underlined.

Adverse construction noise impacts have been predicted based on the TM methodology during all the construction phases at one or more NSRs. A package of practical mitigation measures have been included in the calculations reported in the preceding *Tables* and are described below.

Site Preparation

During the site preparation stage, mitigation measures including the use of quiet plant, movable barriers for mobile and stationary plant and reducing the number of plant operating at any one time have been proposed. During the early stages of the site preparation work, an excavator mounted breaker will be used for 2-3 weeks and a 10 dB(A) reduction could be obtained with the above noise control measures. Following completion of the initial site preparation works, a further 4 dB(A) reduction could be obtained if the excavator mounted breaker is not required.

Excavation

Since the noise enclosure will be erected during the site excavation, only the use of quiet plant and reducing the number of operational plant could further reduce noise levels. In addition to the 20 dB(A) reduction attributable to the noise enclosure, mitigation measures would give 4 dB(A) and 5 dB(A) reductions during the initial and final excavation stages respectively.

Structures

As the access shaft will be built floor by floor, it is considered that the site will remain enclosed up to the completion of the first floor during the building structures phase. The 10 m high side-walls of the enclosure will be retained during the remaining building structures work for the second and third floors. A package of mitigation measures including the use of quiet plant and reducing the number of plant operating at any one time will need to be adopted for the construction activities within or partially screened by the noise enclosure. A noise reduction of up to 6 dB could be obtained using these mitigation measures. During the final stage of building structure work involving construction above the enclosure side-wall, a package of mitigation measures including the use of quiet plant, movable barriers and reducing the number of operational plant has been proposed. A reduction of up to 9 dB(A) could be obtained during this stage.

Enclosure Removal

A package of mitigation measures including the use of quiet plant, movable barriers and reducing the number of operational plant, has been proposed during this stage. Up to 11 dB(A) and 9 dB(A) reductions in noise levels could be obtained during the enclosure and foundation removal stages respectively.

E&M Installation

The completion of the building construction works will be followed by the electrical and mechanical (E&M) installation works which will take up the remaining seven months of the construction programme. Most of the E&M installation works will be undertaken inside the plant building and will involve the limited use of noisy equipment. During these activities, noise from the operation of hand held power tools is expected to be effectively contained within the building structure and no exceedances of the target levels are anticipated.

The noisiest activity during this stage will be the installation of chillers at the top of the building which will require the use of an hydraulic breaker, a tower crane and various hand tools. These works are only expected to last for a few days and a construction noise level of 77 dB(A) at the nearest NSRs, NNP9b and NNP9c, has been predicted resulting in 2 dB(A) and 7 dB(A) exceedances of the target criteria respectively.

The previous Section has identified a number of exceedances of the recommended voluntary daytime noise limit. In the worst case, an exceedance of 23 dB(A) at Ming Wai Kindergarten (NNP9c) has been predicted. The prediction methodology based on the requirements of the TM uses the worst case conditions and assumes that these occur for the entire period of the works. In most cases, however, many items of plant are only operated for a limited proportion of the working day. If this is taken into account, the actual durations and levels of the exceedances can be reduced.

Site preparation at work site NP1 is scheduled to take three months, the noisiest works, breaking out the rock face at the rear of the site, will take about two to three weeks. During this period, the excavator mounted breaker will operate for about 50 % of the time, about 4-6 hours each day on average. The noise enclosure footings will take about one month to prepare, during which time rock breaking will take place for about 25 % of the time, producing levels of up to 90 dB(A). When the use of the excavator mounted breaker is completed, a further 4 dB attenuation could be achieved during the rest of the site preparation work. The preparation and erection of the acoustic enclosure and it's subsequent dismantling and removal are necessary to provide a reduction in noise levels of some 20 dB(A) during the 18-24 months of the main construction period.

As the initial excavation stage proceeds below ground level, there will be some further reductions in noise levels due to additional screening and distance attenuation not previously taken into account.

During the structures phase, there are two major factors which will reduce the duration and levels of the predicted exceedances. After the removal of the roof of the acoustic enclosure, the concrete pours, involving the use of the noisiest plant during this phase, will probably occur about 20 times over a three month period (1-2 times each week for about 4-5 hours) some 15 % of the work period. E&M installation works are anticipated to result in minor exceedancees, on occasion, over a period of a few days but will generally remain below the established criteria.

The distances and positions of various pieces of noisy plant in relation to the worst affected NSRs are also likely to be better that those assumed in the TM methodology. An indication of the overall noise trend during the construction period is shown in *Figure 4.1a*.

NSR NNP2 will not be exposed to noise levels above the recommended voluntary target level of 75 dB(A). NNP3a is a non-sensitive facade (stairwell) and noise impacts reaching dwellings via the central corridor are not expected to exceed the target level.

At NNP10, the Roca Centre, a total of 127 flats have a line of sight to work site NP1 and of these 75 are located on the south face which is predicted to experience exceedances of up to 4 dB(A) during the equivalent of 4-5 weeks of the 156 week construction programme. The remaining 52 flats on the west face are not expected to experience exceedances due to the very acute angle of view to the work site.

Both NNP1a, Tung Fat Building, with 192 flats and NNP11, Maylun Apartments, with a total of 84 flats, could be exposed to levels, during the noisiest 4-5 weeks of the construction programme, of up to 87-88 dB(A) for site preparation and 84-86 dB(A) during the latter stages of the building construction works. However, most of the 70 flats along the east face of Maylun Apartments will actually experience lower levels than those predicted for this NSR due to their acute angle of view and greater distance from the site (further than NNP10). These additional attenuation factors mean that it is likely that at least 50% of the flats (at least 35 dwellings) on this face should not experience levels above the 75 dB(A) target at any time.

Noise levels at NNP1a, NNP10 and NNP11 are predicted to remain below the target level of 75 dB(A) for at least 65% of the construction programme during excavation and initial above ground construction works.

The 42 flats on the west face of NNP9b, Cheong Yuen Building, and NNP9c, Ming Wai Kindergarten, will be affected by noise levels of 86-93 dB(A) during the noisiest 4-5 weeks of construction works. Noise levels at NNP9b are predicted to be below the target level for at least 50% of the works period However, as the target level for the kindergarten is 5 dB(A) less than that for residential properties, NNP9c may be exposed to noise exceedances throughout the works programme.

These details are set out in *Table 4.1a* below.

Table 4.1a *Work Site NP1 - Affected Dwellings*

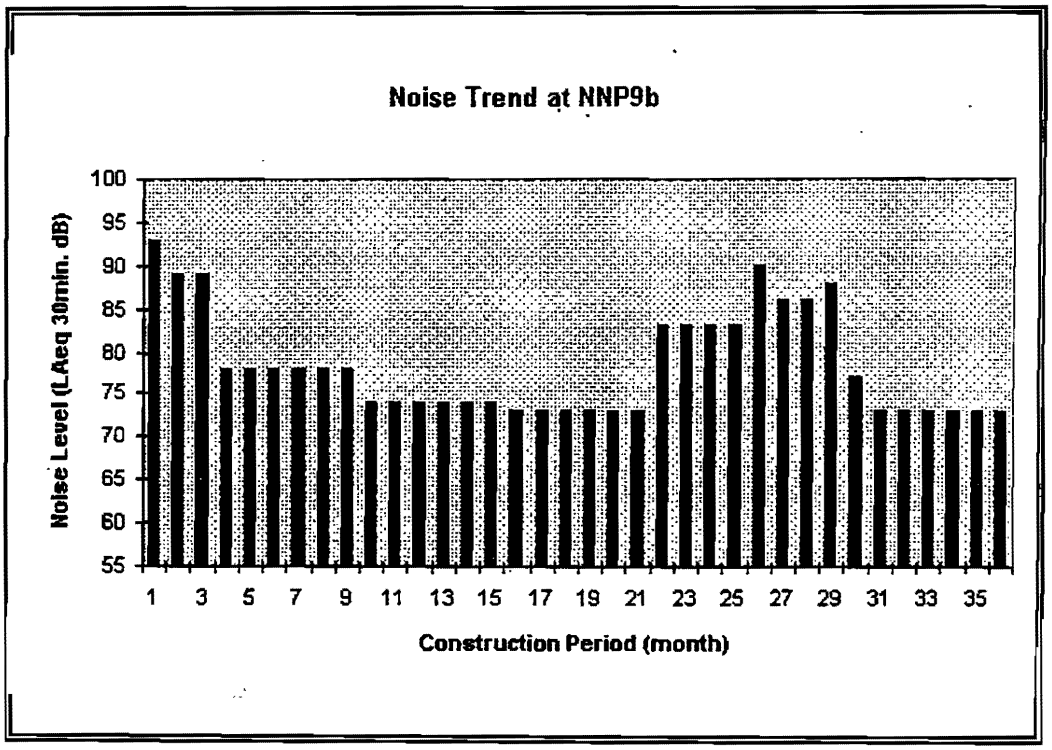
NSR	No. of Flats	Target Level (dB(A))	Period Within Target (months)	Maximum Noise Level (dB(A))	Exposure to Max Noise Level (weeks)
NNP2	112	75	Entire Period (36)	N/a	N/a
NNP3a	111	75	Entire Period (36)	N/a	N/a
NNP10 (S)	75	75	35	79	4-5
NNP10 (W)	52	75	Entire Period (36)	N/a	N/a
NNP1a	192	75	>24	87	4-5
NNP11 (S)	14	75	>24	88	4-5
NNP11 (E)[1]	35	75	Entire Period (36)	N/a	N/a
NNP11 (E)[2]	35	75	>24	<88	4-5
NNP9b	45	75	>18	93	4-5
NNP9c	1	70	0[3]	93	4-5

Notes: 1) 50% of receivers are further from NP1 than NSR NNP10 and have an acute angle of view.
2) 50% of receivers will be impacted by levels between those predicted for NNP10 and NNP11 but with a restricted angle of view.
3) Noise levels will be below 75 dB(A) for at least 50% of the construction period.

Although the scale and duration of the predicted impacts will be reduced when compared with results obtained using the standard TM methodology, the predicted levels are still expected to occur. It is, therefore, recommended

that Ming Wai Kindergarten (NNP9c) should be relocated before construction works commence. If this is not possible, double glazed windows with Type III insulation should be provided for the duration of the construction works.

Figure 4.1a *Indicative Noise Trend During the Construction Period*



5 CONCLUSIONS

This revised assessment has predicted that construction noise associated with work site NP1, will cause adverse impacts at nearby NSRs. Due to the proximity of the NSRs, the use of standard mitigation measures would not be fully effective in controlling the high levels of construction noise impacts. Even the use of an acoustic enclosure to cover the sites cannot completely prevent exceedances of the recommended voluntary daytime noise levels.

Noise levels have been investigated in great detail for each construction phase and it is clear that the noisiest construction activities will not last for the entire construction phase, unlike the results produced by the standard TM methodology which identifies the worst case only. The highest noise levels will only occur for: about three weeks during the three to four month site preparation period; and one to two weeks of the final three or four months of structures work; during the 36 month construction programme. This represents about four or five out of the 156 week programme, some 2-3 % of the total construction period.

During the below ground stages, for about 50 % of the time, noise levels at NNP9b will be close to the 75 dB(A) target level. During the majority of the above ground works, the noise levels are expected to be around 80 dB(A).

Some 45 dwellings are predicted to be exposed to noise levels in excess of 90 dB(A) for about 4-5 weeks of the three year construction period (2-3% of the whole works programme) and 241 dwellings are predicted to be exposed to levels in excesss of 80 dB(A) for a similar period. A total of some 361 dwellings, including those already described, will experience levels of between 75-80 dB(A) for periods ranging from up to 18 months at NNP9b (45 dwellings) down to 4-5 weeks for NNP10 (75 dwellings).

This reassessment of the potential noise impacts from work site NP1 shows that, whilst the predictions of major exceedances in the DEIA are accurate, their duration will be brief in terms of the overall construction programme. Mitigation measures, including changes to the construction methodology, have been proposed which bring the overall construction noise levels as close as possible to the recommended voluntary daytime level without imposing unrealistic constraints on the Contractor which would prevent his fulfilling his contractual responsibilities.

Annex A

Construction Plant Lists

Table C1.3b(i) North Point - No Mitigation					
Assess shaft (NP1)					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	mounted breaker	CNP028	1	122	122
of noise enclosure)	lorry	CNP141	1	112	112
	compressor	CNP001	1	104	104
	excavator	CNP081	1	112	112
	loader	CNP081	1	112	112
	generator	CNP101	1	108	108
				PHASE TOTAL SWL	**123**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	2	110	113
	lorry	CNP141	2	112	115
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	112	112
	compressor	CNP001	1	104	104
	excavator	CNP081	1	112	112
	loader	CNP081	1	112	112
	generator	CNP101	1	108	108
	vent fan	CNP241	1	108	108
	rock drill	CNP183	2	116	119
	hoist	CNP121	1	108	108
	water pump	CNP282	1	103	103
				PHASE TOTAL SWL	**123**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	112	115
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	112	112
	loader	CNP081	1	112	112
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP282	1	103	103
				PHASE TOTAL SWL	**120**
Structures	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	4	109	115
	mobile crane	CNP048	1	112	112
	vibrator	CNP170	2	113	116
	circular saw	CNP201	2	108	111
	water pump	CNP282	1	103	103
				PHASE TOTAL SWL	**120**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	112	115
	mobile crane	CNP048	1	112	112
				PHASE TOTAL SWL	**117**
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor	CNP001	1	104	104
	loader	CNP081	1	112	112
	lorry	CNP141	2	112	115
	breaker	CNP024	1	110	110
				PHASE TOTAL SWL	**118**
Finishing	Noise Source	TM ref	Unit	SWL	Total - SWL
	hand tools		1	85	85
	breaker	CNP024	1	90	90
	tower crane	CNP049	1	95	95
				PHASE TOTAL SWL	**97**

Table C1.4c(i) North Point - Use of Quiet Plant					
Assess shaft (NP1)					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	mounted breaker	CNP028	1	117	117
of noise enclosure)	lorry	CNP141	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
				PHASE TOTAL SWL	**118**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	2	110	113
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
	vent fan	CNP241	1	108	108
	rock drill	CNP183	2	116	119
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**122**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	loader	CNP081	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**116**
Structures	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	4	109	115
	mobile crane	CNP048	1	105	105
	vibrator	CNP170	2	110	113
	circular saw	CNP201	2	108	111
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**118**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	mobile crane	CNP048	1	105	105
				PHASE TOTAL SWL	**108**
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor	CNP002	1	100	100
	lorry	CNP141	1	105	105
	loader	CNP081	1	105	105
	breaker	CNP024	1	110	110
				PHASE TOTAL SWL	**112**

Table C1.4c(ii) North Point - Use of Quiet Plant + Movable Barriers					
Assess shaft (NP1)					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	mounted breaker	CNP028	1	112	112
of noise enclosure)	lorry	CNP141	1	105	105
	compressor	CNP001	1	90	90
	excavator	CNP081	1	100	100
	loader	CNP081	1	100	100
	generator	CNP101	1	90	90
				PHASE TOTAL SWL	**113**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	2	110	113
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
	vent fan	CNP241	1	108	108
	rock drill	CNP182	2	116	119
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**122**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	loader	CNP081	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**116**
Structures	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	4	109	115
	mobile crane	CNP048	1	100	100
	vibrator	CNP170	2	105	108
	circular saw	CNP201	2	98	101
	water pump	CNP281	1	78	78
				PHASE TOTAL SWL	**116**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	mobile crane	CNP048	1	100	100
				PHASE TOTAL SWL	**106**
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor	CNP002	1	90	90
	lorry	CNP141	1	105	105
	loader	CNP081	1	100	100
	breaker	CNP024	1	105	105
				PHASE TOTAL SWL	**109**

Table C1.4c(iii) North Point - Use of Quiet Plant + Barriers + Limiting No. of Plant Type ot One					
Assess shaft (NP1)					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	mounted breaker	CNP028	1	112	112
of noise enclosure)	lorry	CNP141	1	105	105
	compressor	CNP001	1	90	90
	excavator	CNP081	1	100	100
	loader	CNP081	1	100	100
	generator	CNP101	1	90	90
				PHASE TOTAL SWL	**113**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	1	110	110
	lorry	CNP141	1	105	105
	concrete lorry	CNP044	1	109	109
	mobile crane	CNP048	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
	vent fan	CNP241	1	108	108
	rock drill	CNP183	1	116	116
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**119**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	concrete lorry	CNP044	1	109	109
	mobile crane	CNP048	1	105	105
	loader	CNP081	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**115**
Structures	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	1	109	109
	mobile crane	CNP048	1	100	100
	vibrator	CNP170	1	105	105
	circular saw	CNP201	1	98	98
	water pump	CNP281	1	78	78
				PHASE TOTAL SWL	**111**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	mobile crane	CNP048	1	100	100
				PHASE TOTAL SWL	**106**
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor	CNP002	1	90	90
	lorry	CNP141	1	105	105
	loader	CNP081	1	100	100
	breaker	CNP024	1	105	105
				PHASE TOTAL SWL	**109**

Annex B

Responses to Comments

Responses to Comments
Quarry Bay Relief Works
Work Site NP1 Supplementary Working Paper

No.	Department/Date	Reference	Comments	Consultants' Response
10	EPD/Alan Au 31 August 1996	Table 3.1a	<u>QBR Works DEIA - Work Site NP1: Construction Noise Impact Assessment</u> It is indicated in Fig. 4.1a and Section 5 that the construction programme would last for about 156 weeks (3 years). However, the total construction period from site preparation to enclosure foundation removal given in the table is 29 months. Please clarify.	The programme has been revised in the Work Site Working Papers, the additional seven months is for the E&M installation and fitting out of the building.
11		Section 4	<u>Evaluation of Impacts</u> The report recommends that NNP9c (Ming Wai Kindergarten) should be relocated or be provided with window insulation. Would MTRC consider providing window insulation (with air conditioning if necessary) to NN9b which is on top of NN9c and other NSRs, such as NNP1a and NNP11, in the proximity to the site?	MTRC will provide window insulation to schools during construction works but not to residential properties, primarily because of the implications to the construction programme. The detailed reasons were set out in our fax to you dated 12 September (ref C1365/42970/CONSULT).
12		Table 1 WS NP1 Affected Dwellings	<u>Additional Information on Work Site NP1 (ERM's Letter of 22/8/96)</u> The periods given under "Period Within Target (months)" during which the recommended criteria would not be exceeded do not agree with those in Table 3.1a of the DEIA Report. Please clarify.	Revisions to the construction programme in the Working Papers will be incorporated into the revised DEIA.

CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

WORKING PAPER

Mass Transit Railway Corporation

Quarry Bay Relief Works DEIA - Work Site NP5 : *Construction Noise Impact Assessment*

4 September 1996

ERM-Hong Kong, Ltd
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ERM

WORKING PAPER

Mass Transit Railway Corporation

Quarry Bay Relief Works DEIA - Work Site NP5 : *Construction Noise Impact Assessment*

4 September 1996

Reference C1365/41559

For and on behalf of ERM-Hong Kong, Ltd

Approved by: _____

Position: Principal Consultant

Date: 4 September 1996

EXECUTIVE SUMMARY

This Paper is a noise impact assessment for the construction works at the NP5 work site (Kam Ping Street Access Adit) for the Quarry Bay Relief Works (QBR).

The purpose of this Paper is to review the potential noise impacts from this additional construction site for the QBR to identify exceedances of the recommended voluntary daytime noise target level and to provide appropriate mitigation measures where practicable.

The assessment has considered all practicable mitigation measures that can realistically be imposed upon the Contractor without preventing him from fulfilling his contractual responsibilities.

The highest noise levels will only occur for: about three weeks during the three to four month site preparation period; and one to two weeks of the three or four months of enclosure removal and finishing work; during the 36 month construction programme. This represents about four or five out of 156 weeks, some 2-3 % of the total construction period.

For about two-thirds of the construction programme, while work is underground, noise levels at the nearest residential properties will be within the daytime target level and during the majority of the above ground works the noise levels are expected to cause only limited exceedances of the target level.

CONTENTS:

1 INTRODUCTION

This Paper assesses the predicted impacts associated with the construction of the Kam Ping Street Access Adit (NP5) based on the construction works and receiver locations. This additional worksite has been assessed based on detailed information on plant inventories, construction methodologies and programmes. Mitigation measures including the construction of an acoustic enclosure, use of silenced plant, movable noise barriers and limiting the number of operational plant, have been recommended to reduce the noise impacts to the NSRs during the construction period.

2 ASSESSMENT METHODOLOGY

2.1 NOISE SENSITIVE RECEIVERS

At North Point, the region surrounding the proposed work site currently consists of highly populated residential buildings and other developments. The NSRs have been identified for this assessment based on the NSRs selected previously in the Draft Detailed Environmental Impact Assessment Report R9Q and some additional NSRs in the vicinity of the site. A selection of representative NSRs likely to be affected by the work site NP5 are listed as below and shown in *Figure 2.1a:*

- NNP1b - Tung Fat Building
- NNP2 - Kam Ping Building
- NNP3c - Pine Tree House
- NNP9a - Cheong Yuen Building (south)
- NNP9b - Cheong Yuen Building (west)
- NNP9c - Ming Wai Kindergarten at Cheong Yuen Building (west)

Impacts on the southern facade of Tung Fat Building are considered to be the same as those on NNP2. The NSRs have no central air conditioning system and are in direct line of sight to the proposed works.

2.2 POTENTIAL SOURCE OF IMPACTS

Potential sources of impact from NP5 will include the following construction activities:

- Site preparation will include clearance of the site and construction of the noise enclosure. During this phase the only opportunities available for mitigation are the use of quiet plant, moveable noise barriers and a reduction in the number of plant operating at any one time. Standard types of construction plant will be used for the assessment of the works, which is expected to last for six months.

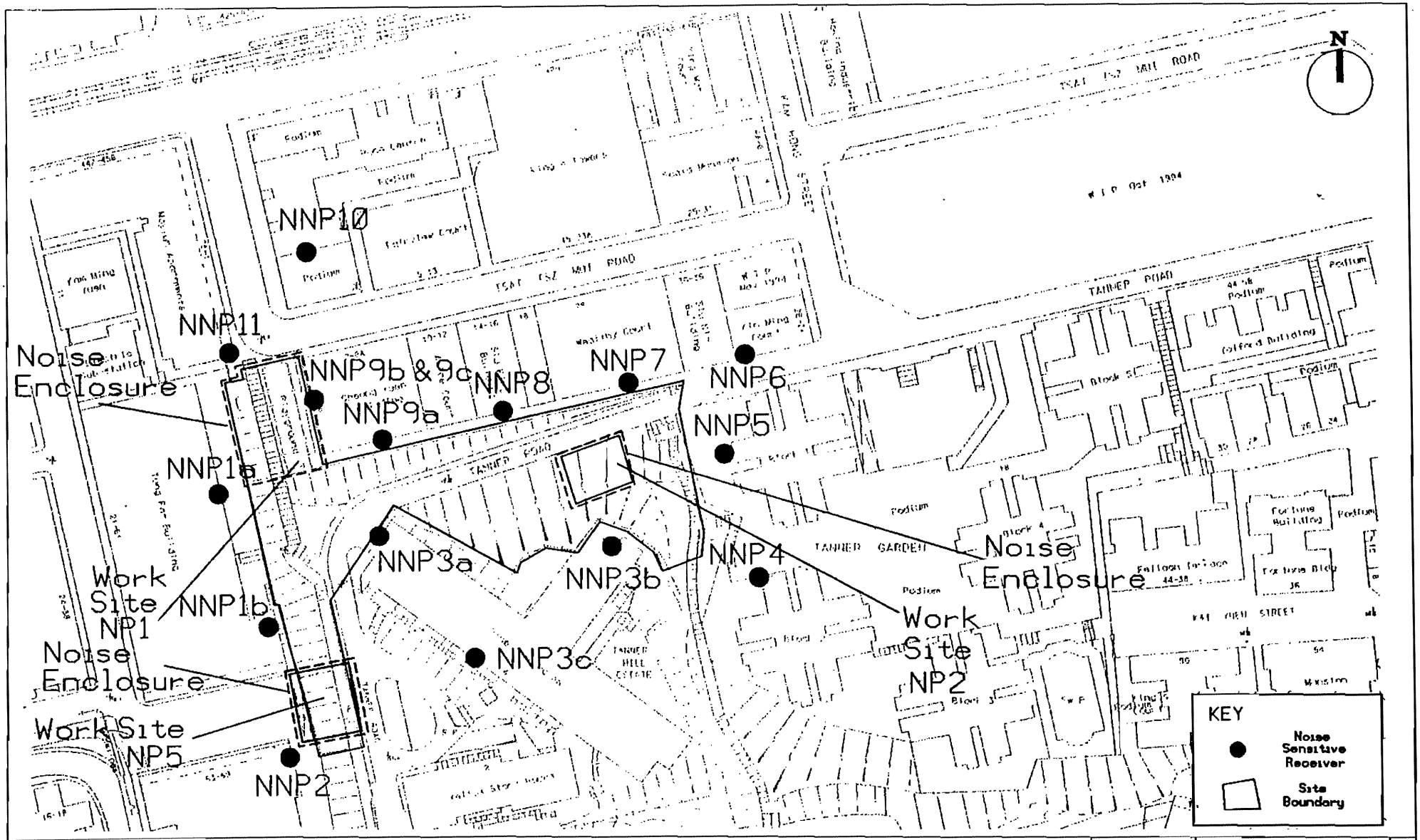
- Excavation works within the noise enclosure will take about 26 months to complete. This phase has been split into two elements; initial surface works and NOP Station excavation. During the six months of the initial excavations, hand-held rock drills and breakers will be used. The NOP Station excavation will involve standard construction plant and this is expected to be quieter than the initial surface works as the noisiest plant, including rock drills and breakers, will be operated inside the tunnel.

- The noisiest operations associated with the dismantling of the enclosure will be the removal of the foundations. This will involve breakers, loaders and lorries and the only available methods of noise mitigation are in the use of quiet plant, moveable barriers and limiting the number of plant operating. This phase is expected to take approximately one month.

- Finishing work for the emergency entrance will include installation of lighting and other Electrical and Mechanical (E&M) works. No continuous

noisy construction activities are expected. Various hand tools and a hand-held breaker will be used during this three month phase.

A methodology for assessing noise from the construction of the access adit has been developed based on the *Technical Memorandum on Noise from Construction Work other than Percussive Piling* (TM). The plant inventories for the different phases of construction activities are given in *Annex A*.



NSR Locations in North Point

MAUNSELL CONSULTANTS ASIA LTD 茂盛工程顧問有限公司

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APR 96	2.1a
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Maunsell

Adverse noise impacts are predicted during all the construction phases, especially at Tung Fat Building (NNP1b) and Kam Ping Building (NNP2). The predicted noise levels with and without mitigation measures are shown in *Table 3.1a* below. "Unmitigated" noise levels include the attenuation effect of the noise enclosure.

Table 3.1a ***Predicted Noise Levels at NP5 ($L_{Aeq\ 30min.}$ dB)***

NSRs	Construction Activities	Unmitigated Noise Level	Quiet Plant	Quiet Plant, Moveable Barriers	Quiet Plant, Moveable Barrier & Reduced Plant	Construction Duration (month)
NNP1b	Site preparation[1]	90	85	81	81	6
	Excavation[2] (initial)	75	73	-	70	6
	Excavation[2] (station)	71	68	-	66	20
	Enclosure Removal[1]	88	79	78	78	1
	Finishing[1]	63	-	-	-	3
NNP2	Site preparation[1]	93	88	84	84	6
	Excavation[2] (initial)	78	77	-	74	6
	Excavation[2] (station)	75	71	-	70	20
	Enclosure Removal[1]	92	83	81	81	1
	Finishing[1]	66	-	-	-	3
NNP3c	Site preparation[1]	81	76	72	72	6
	Excavation[2] (initial)	66	65	-	62	6
	Excavation[2] (station)	63	59	-	58	20
	Enclosure Removal[1]	80	71	69	69	1
	Finishing[1]	54	-	-	-	3
NNP9a	Site preparation[1]	76	73	69	69	6
	Excavation[2] (initial)	63	61	-	58	6
	Excavation[2] (station)	59	56	-	54	20
	Enclosure Removal[1]	76	67	66	66	1
	Finishing[1]	51	-	-	-	3

NSRs	Construction Activities	Unmitigated Noise Level	Quiet Plant	Quiet Plant, Moveable Barriers	Quiet Plant, Moveable Barrier & Reduced Plant	Construction Duration (month)
NNP9b & 9c	Site preparation[1]	<u>76</u>	71	67	67	6
	Excavation[2] (initial)	61	60	-	57	6
	Excavation[2] (station)	58	54	-	53	20
	Enclosure Removal[1]	75	66	64	64	1
	Finishing[1]	49	-	-	-	3

Note : (1) A 5 dB(A) and 10 dB(A) attenuation from the moveable barrier for mobile and stationary plant have been incorporated.
(2) A 20 dB(A) attenuation from the acoustic enclosure has been incorporated.
Noise levels exceeding the EPD's recommended noise criteria of 75 dB(A) for residential premises and 70 dB(A) for schools, are shown in bold and underlined.

Adverse construction noise impacts have been predicted, based on the TM methodology, during some construction phases at one or more NSRs. A package of practical mitigation measures have been included in the calculations reported in the *Table 3.1a* above and are described below.

<u>Site Preparation</u>

During the site preparation stage, mitigation measures including the use of quiet plant, movable barriers for mobile and stationary plant and reducing the number of plant operating at any one time have been proposed. During the early stages of the site preparation work, a breaker will be used for 2-3 weeks and a 9 dB(A) reduction could be obtained using the above noise control measures. Following completion of the initial site preparation works, a further 2 dB(A) reduction could be obtained if the breaker is not required.

<u>Excavation</u>

Since the noise enclosure will be erected during the site excavation, only the use of quiet plant and reducing the number of operational plant could further reduce noise levels. In addition to the 20 dB(A) reduction attributable to the noise enclosure, these mitigation measures would give a further 4 - 5 dB(A) reduction for the initial and station excavation stages respectively.

<u>Enclosure Removal</u>

A package of mitigation measures including the use of quiet plant, movable barriers and reducing the number of operational plant, has been proposed during this stage. Reductions in noise levels of up to 11 dB(A) and 9 dB(A) respectively could be obtained during the enclosure and foundation removal stages. These construction activities would last for one month.

<u>Finishing</u>

Finishing work for this site will last for three months. Various hand tools and a hand held breaker will be operated inside the portal during this stage. No adverse noise impacts have been predicted.

The previous Section has identified a number of exceedances of the recommended voluntary daytime noise limit. In the worst case, an exceedance of 9 dB(A) at Kam Ping Building (NNP2) has been predicted even with a package of mitigation measures. The prediction methodology based on the requirements of the TM uses the worst case conditions and assumes that these occur for the entire period of the works. In most cases, however, many items of plant are only operated for a limited proportion of the working day. If this is taken into account, the actual durations and levels of the exceedances will be reduced.

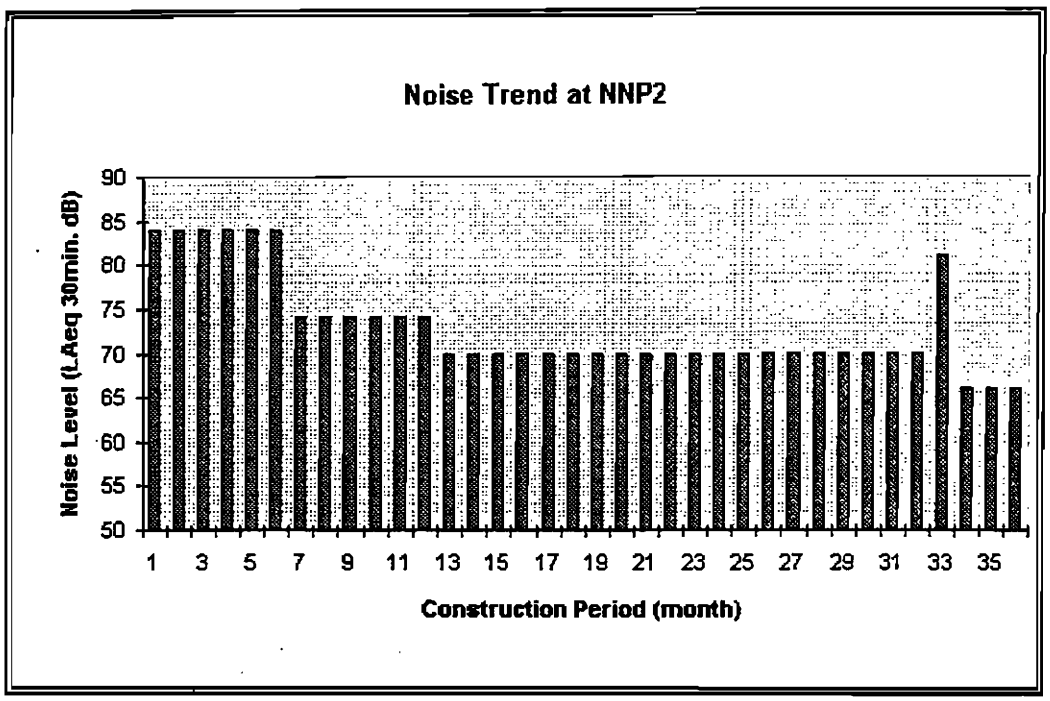
Site preparation at work site NP5 is scheduled to take three months: the noisiest works, the noise enclosure footings will take about one month to prepare, during which time rock breaking will take place for about 25 % of the time, producing levels of up to 84 dB(A). The preparation and erection of the acoustic enclosure and it's subsequent dismantling and removal are necessary to provide a reduction in noise levels of some 20 dB(A) during the 26 months of the main construction period.

No adverse construction noise impacts have been predicted during the station excavation stage as the noise enclosure will provide sufficient attenuation to control noise levels to within the established criteria.

An indication of the overall noise trend during the construction period is shown in *Figure 4.1a* overleaf.

It should be noted that the cumulative noise impacts from NP1 and NP2 have also been considered. The predicted noise levels at NNP2 will be dominated by worksite NP5 and NNP9b & 9c by NP1 respectively. The maximum predicted level for NP5 at NNP9b & 9c is only 76 dB(A) which will not increase the impact from NP1 predicted in the previous Working Paper on worksite NP1 (93 dB(A)). Similarly, the noise level predicted at NNP2 from NP1 is 71 dB(A), more than 10 dB(A) below the impact predicted from NP5 and will not, therefore, further increase the predicted construction noise level for NP1.

Figure 4.1a Indicative Noise Trend During the Construction Period



This assessment has predicted that construction noise associated with work site NP5, will cause adverse impacts at nearby NSRs. Due to the proximity of the NSRs, the use of standard mitigation measures would not be fully effective in controlling the high levels of noise impacts for the construction activities not carried out within the enclosure.

Construction noise levels have been investigated in detail for each construction phase and it is clear that the noisiest construction activities will not last for the entire construction period, unlike the results produced by the standard TM methodology which identifies the worst case only. The highest noise levels will only occur for: about two to three weeks during the six months site preparation period; and one to two weeks during the enclosure removal stage. This represents only about 2 - 3% of the total construction programme.

A total of 224 dwellings in Kam Ping House and Tung Fat Building have been identified which may be exposed to these noise exceedances. However, the facades along Kam Ping Street have a limited angle of view to site NP5 which will lessen the noise impact and whilst exceedances will be experienced, they are expected to be below the predicted levels.

This assessment of the potential noise impacts from work site NP5 shows that, whilst the predictions of major exceedances in the DEIA are accurate, their duration will be brief in terms of the overall construction programme. Mitigation measures, including changes to the construction methodology, have been proposed which bring the overall construction noise levels as close as possible to the recommended voluntary daytime level without imposing unrealistic constraints on the Contractor which would prevent his fulfilling his contractual responsibilities.

Annex A

Construction Plant Lists

Table C1.3b(iii) (NP5)					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	breaker	CNP024	1	110	110
of noise enclosure)	lorry	CNP141	1	112	112
	compressor	CNP001	1	104	104
	excavator	CNP081	1	112	112
	loader	CNP081	1	112	112
	generator	CNP101	1	108	108
				PHASE TOTAL SWL	**118**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	2	110	113
	lorry	CNP141	2	112	115
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	112	112
	compressor	CNP001	1	104	104
	excavator	CNP081	1	112	112
	loader	CNP081	1	112	112
	generator	CNP101	1	108	108
	vent fan	CNP241	1	108	108
	rock drill	CNP183	2	116	119
	hoist	CNP121	1	108	108
	water pump	CNP282	1	103	103
				PHASE TOTAL SWL	**123**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	112	115
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	112	112
	loader	CNP081	1	112	112
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP282	1	103	103
				PHASE TOTAL SWL	**120**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	112	115
	mobile crane	CNP048	1	112	112
				PHASE TOTAL SWL	**117**
Finishing	Noise Source	TM ref	Unit	SWL	Total - SWL
	hand tools		1	85	85
	breaker	CNP024	1	90	90
				PHASE TOTAL SWL	**91**

Table C1.4e(i) (NP5) - Quiet Plant					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	breaker	CNP024	1	110	110
of noise enclosure)	lorry	CNP141	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
				PHASE TOTAL SWL	**113**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	2	110	113
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
	vent fan	CNP241	1	108	108
	rock drill	CNP183	2	116	119
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**122**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	loader	CNP081	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**116**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	mobile crane	CNP048	1	105	105
				PHASE TOTAL SWL	**108**

Table C1.4e(ii) (NP 5) - Quiet Plant + Barrier					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	breaker	CNP024	1	105	105
of noise enclosure)	lorry	CNP141	1	105	105
	compressor	CNP001	1	90	90
	excavator	CNP081	1	100	100
	loader	CNP081	1	100	100
	generator	CNP101	1	90	90
				PHASE TOTAL SWL	**109**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	2	110	113
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
	vent fan	CNP241	1	108	108
	rock drill	CNP182	2	116	119
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**122**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	loader	CNP081	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**116**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	mobile crane	CNP048	1	100	100
				PHASE TOTAL SWL	**106**

Table C1.4e(iii) (NP5)- Quiet Plant + Barrier + Limiting No. of Plant Type to One					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	breaker	CNP024	1	105	105
of noise enclosure)	lorry	CNP141	1	105	105
	compressor	CNP001	1	90	90
	excavator	CNP081	1	100	100
	loader	CNP081	1	100	100
	generator	CNP101	1	90	90
				PHASE TOTAL SWL	**109**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	1	110	110
	lorry	CNP141	1	105	105
	concrete lorry	CNP044	1	109	109
	mobile crane	CNP048	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
	vent fan	CNP241	1	108	108
	rock drill	CNP183	1	116	116
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**119**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	concrete lorry	CNP044	1	109	109
	mobile crane	CNP048	1	105	105
	loader	CNP081	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**115**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	mobile crane	CNP048	1	100	100
				PHASE TOTAL SWL	**106**

WORKING PAPER

CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

Mass Transit Railway Corporation

Quarry Bay Relief Works DEIA - Work Site NP2 : *Construction Noise Impact Assessment*

11 September 1996

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ERM

WORKING PAPER

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11 September 1996

Reference C1365/42287

For and on behalf of ERM-Hong Kong, Ltd

Approved by: [signature]

Position: Deputy Managing Director

Date: 11th September 1996

EXECUTIVE SUMMARY

This Paper is the noise impact assessment for the construction works at the relocated NP2 work site (North Point Station Vent Shaft) for the Quarry Bay Relief Works (QBR).

The purpose of this Paper is to assess the potential noise impacts from this relocated NP2 worksite for the QBR and to identify exceedances of the recommended voluntary daytime noise target level and to provide appropriate mitigation measures where practicable.

The assessment has considered all practicable mitigation measures that can realistically be required of the Contractor without preventing him from fulfilling his contractual responsibilities.

The highest noise levels will only occur for: about two weeks during the one month site preparation period; four weeks of the six months of structures work and two to three weeks of the two months of enclosure foundation removal; during the 156 week construction programme. This represents about nine out of 156 weeks, some 6 % of the total construction period. No cumulative impacts from the three North Point worksites have been predicted at any of the sensitive receivers.

For about half of the construction programme, while work is underground, noise levels at the nearest residential properties will be within the daytime target level and during the majority of the above ground works the noise levels are expected to cause only limited exceedances of the target level.

CONTENTS:

1 INTRODUCTION

This Paper assesses the potential noise impacts associated with the construction of the relocated Vent Shaft Site (NP2) for the Quarry Bay Relief Works (QBR) based on the original works and receiver locations in the vicinity of the worksite. This worksite has been assessed based on detailed information on plant inventories, construction methodologies and programmes. Mitigation measures including the construction of an acoustic enclosure, use of silenced plant, movable noise barriers and limiting the number of operational plant, have been recommended to reduce the noise impacts to the NSRs during the construction period.

2 ASSESSMENT METHODOLOGY

2.1 NOISE SENSITIVE RECEIVERS

At North Point, the region surrounding the proposed work site currently consists of highly populated residential buildings and other developments. The NSRs have been identified for this assessment based on the NSRs selected previously in the draft QBR DEIA. The NSRs affected by the work site NP2 are listed as below and shown in *Figure 2.1a:*

- NNP1a - Tung Fat Building
- NNP3b - Pine Tree House
- NNP4 - Tanner Garden Block 1
- NNP5 - Siu Nin Building
- NNP6 - Wealthy Court
- NNP7 - Siu King Building
- NNP8 - Alice Court
- NNP9a - Cheong Yuen Building (south)

The NSRs have no central air conditioning system and are in direct line of sight to the proposed works.

2.2 POTENTIAL SOURCE OF IMPACTS

Potential sources of impact from NP2 will include the following construction activities:

- Site preparation will include clearance of the site and construction of the noise enclosure. During this phase the only opportunities available for mitigation are the use of quiet plant, moveable noise barriers and a reduction in the number of plant operating at any one time. Standard construction plant will be used for this period which is expected to last for one month.

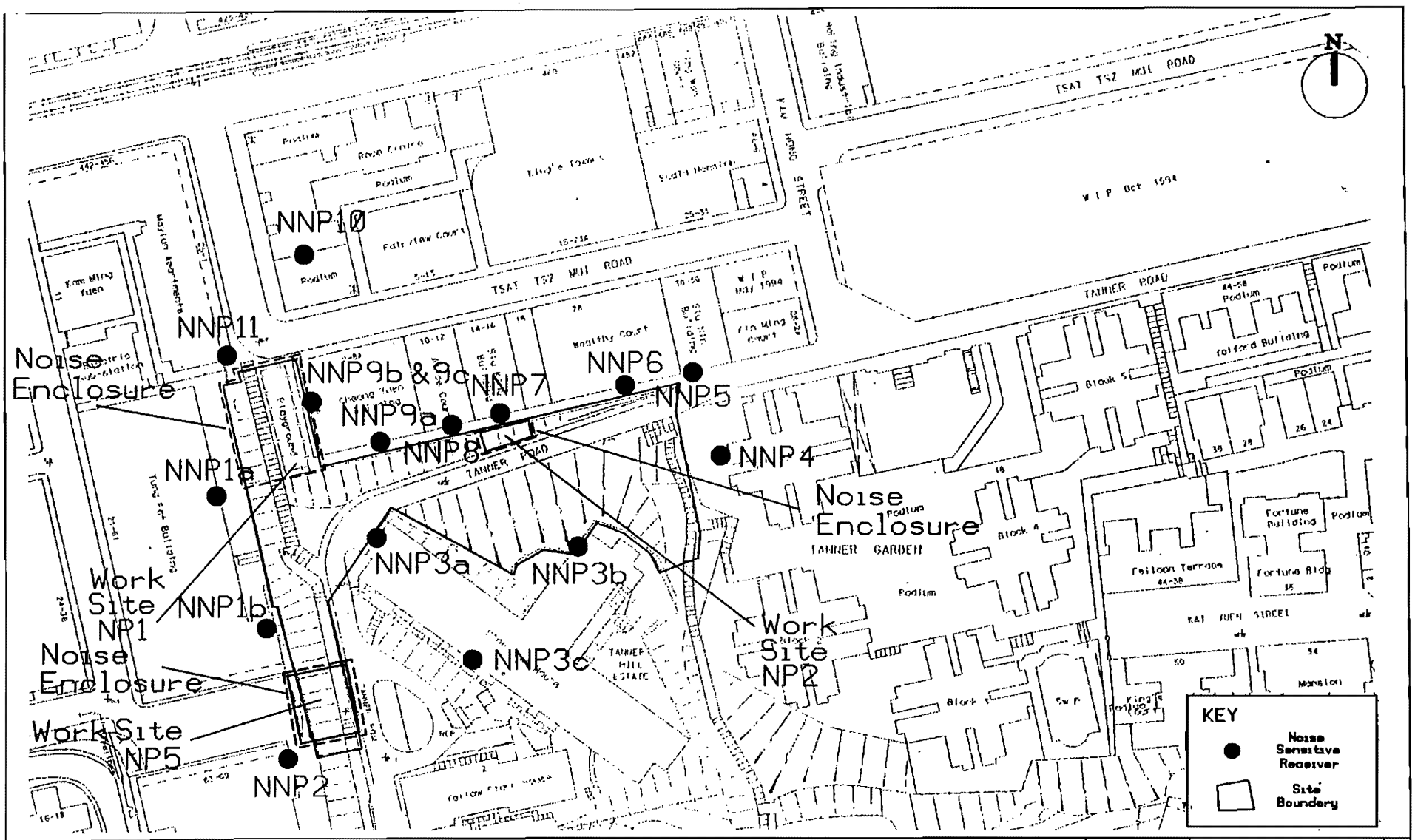
- Site excavation within the noise enclosure will take approximately eight months to complete. This phase has been split into two elements; above ground and under ground excavations. During the above ground excavations, hand-held rock drills and breakers will be used. The under ground excavations will involve standard construction plant and this stage is expected to be quieter during the final six months as the noisiest plant, including rock drills and breakers will be used beneath ground level. Following completion of these two stages, excavation works will continue for another 18 months within the station cavern and thus noise is expected to be fully screened until the final breakthrough.

- Construction of the vent shaft will take approximately five to six months. The works will commence within the noise enclosure during the initial three months, however, for works to proceed above this height, the roof of the noise enclosure will have to be removed and for the next two months, construction will only be partially screened by the side wall of the enclosure. During the final stage, when works are above the side walls of

the enclosure, it may be possible to erect additional noise barriers to provide some screening to the closest NSR; this final phase is expected to last for one month.

- Following completion of the structure, the side walls of the enclosure will be dismantled and removed. This will take approximately two months. The noisiest operations associated with the dismantling of the enclosure will be the removal of the foundations. This will involve breakers, loaders and lorries and the only available methods of noise mitigation are the use of quiet plant, moveable barriers and limiting the number of plant operating, and this final phase is expected to take approximately one month.

A methodology for assessing noise from the construction of the vent shaft has been developed based on the *Technical Memorandum on Noise from Construction Work other than Percussive Piling* (TM). The plant inventories for the different phases of construction activities are given in *Annex A*.



NSR Locations in North Point

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DATE:	FIGURE No.
APR 96	2.1a
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Unmitigated adverse noise impacts are predicted during the noisiest construction phases, especially at Wealthy Court (NNP6), Siu King Building (NNP7), Alice Court (NNP8) and Cheong Yuen Building (NNP9a). The predicted noise levels with and without mitigation measures are shown in *Table 3.1a* below. The 'unmitigated' noise level for excavation and structures assumes the use of a noise enclosure.

Table 3.1a ***Predicted Noise Levels at NP2 ($L_{Aeq\ 30min.}$ dB)***

NSRs	Construction Activities	Unmitigated Noise Level with noise enclosure	Quiet Plant	Quiet Plant, Moveable Barriers	Quiet Plant, Moveable Barrier & Reduced Plant	Construction Duration (month)
NNP1a	Site Preparation[1]	77	72	68	68	1
	Surface Excavation [2]	63	61	-	58	2
	Underground Excavation[2]	58	55	-	54	6
	Structures[2] (enclosure)	59	57	-	53	3
	Structures[3] (enclosure side wall)	69	67	-	63	2
	Structures[1] (without enclosure)	79	77	75	70	1
	Enclosure[1] Removal	76	67	65	65	1
	Enclosure Foundation Removal[1]	77	71	67	67	2
NNP3b	Site Preparation[1]	82	77	73	73	1
	Surface Excavation[2]	68	67	-	63	2
	Underground Excavation[2]	64	60	-	59	6
	Structures[2] (enclosure)	64	62	-	58	3
	Structures[3] (enclosure side wall)	74	72	-	68	2
	Structures[1] (without enclosure)	84	82	80	75	1
	Enclosure Removal[1]	81	72	70	70	1
	Enclosure Foundation Removal[1]	82	76	73	73	2

NSRs	Construction Activities	Unmitigated Noise Level with noise enclosure	Quiet Plant	Quiet Plant, Moveable Barriers	Quiet Plant, Moveable Barrier & Reduced Plant	Construction Duration (month)
NNP4	Site Preparation[1]	79	74	70	70	1
	Surface Excavation[2]	65	64	-	60	2
	Underground Excavation[2]	61	57	-	56	6
	Structures[2] (enclosure)	61	59	-	55	3
	Structures[3] (enclosure side wall)	71	69	-	65	2
	Structures[1] (without enclosure)	81	79	77	72	1
	Enclosure Removal[1]	78	69	67	67	1
	Enclosure Foundation Removal[1]	79	73	70	70	2
NNP5	Site Preparation[1]	80	75	71	71	1
	Surface Excavation[2]	66	65	-	61	2
	Underground Excavation[2]	62	58	-	57	6
	Structures[2] (enclosure)	62	60	-	56	3
	Structures[3] (enclosure side wall)	72	70	-	66	2
	Structures[1] (without enclosure)	82	80	78	73	1
	Enclosure Removal[1]	79	70	68	68	1
	Enclosure Foundation Removal[1]	80	84	71	71	2

NSRs	Construction Activities	Unmitigated Noise Level with noise enclosure	Quiet Plant	Quiet Plant, Moveable Barriers	Quiet Plant, Moveable Barrier & Reduced Plant	Construction Duration (month)
NNP6	Site Preparation[1]	90	85	81	81	1
	Surface Excavation[2]	76	74	-	70	2
	Underground Excavation[2]	71	68	-	66	6
	Structures[2] (enclosure)	72	70	-	65	3
	Structures[3] (enclosure side wall)	82	80	-	75	2
	Structures[1] (without enclosure)	92	90	88	83	1
	Enclosure Removal[1]	88	79	78	78	1
	Enclosure Foundation Removal[1]	89	84	80	80	2
NNP7	Site Preparation[1]	93	88	84	84	1
	Surface Excavation[2]	79	78	-	74	2
	Underground Excavation[2]	75	71	-	70	6
	Structures[2] (enclosure)	75	73	-	67	3
	Structures[3] (enclosure side wall)	85	83	-	77	2
	Structures[1] (without enclosure)	95	93	91	86	1
	Enclosure Removal[1]	92	83	81	81	1
	Enclosure Foundation Removal[1]	93	87	84	84	2

NSRs	Construction Activities	Unmitigated Noise Level with noise enclosure	Quiet Plant	Quiet Plant, Moveable Barriers	Quiet Plant, Moveable Barrier & Reduced Plant	Construction Duration (month)
NNP8	Site Preparation[1]	**92**	**87**	**83**	**83**	1
	Surface Excavation[2]	**78**	**76**	-	72	2
	Underground Excavation[2]	73	70	-	68	6
	Structures[2] (enclosure)	74	72	-	67	3
	Structures[3] (enclosure side wall)	**84**	**82**	-	**77**	2
	Structures[1] (without enclosure)	**94**	**92**	**89**	**84**	1
	Enclosure Removal[1]	**90**	**81**	**80**	**80**	1
	Enclosure Foundation Removal[1]	**91**	**86**	**82**	**82**	2
NNP9a	Site Preparation[1]	**88**	**83**	**79**	**79**	1
	Surface Excavation[2]	74	73	-	69	2
	Underground Excavation[2]	70	66	-	65	6
	Structures[2] (enclosure)	70	68	-	64	3
	Structures[3] (enclosure side wall)	**80**	**78**	-	74	2
	Structures[1] (without enclosure)	**90**	**88**	**86**	**81**	1
	Enclosure Removal[1]	**87**	**78**	**76**	**76**	1
	Enclosure Foundation Removal[1]	**88**	**82**	**79**	**79**	2

Note : (1) A 5 dB(A) or 10 dB(A) attenuation from moveable barriers has been incorporated for mobile and stationary plant, respectively, without the acoustic enclosure.
(2) A 20 dB(A) attenuation from the acoustic enclosure has been incorporated.
(3) A 10 dB(A) attenuation from the remaining 10 m high side-wall of the enclosure has been incorporated.
Noise levels exceeding the EPD's recommended noise criteria of 75 dB(A) for residential premises are shown in bold and underlined.

Adverse construction noise impacts have been predicted based on the TM methodology during some of the construction phases at one or more NSRs. A package of practical mitigation measures have been included in the calculations reported in the preceding *Tables* and are described below.

Site Preparation

During the site preparation stage, mitigation measures including the use of quiet plant, movable barriers for mobile and stationary plant and reducing the number of plant operating at any one time have been proposed. With a package of mitigation measures, a noise reduction of 9 dB(A) could be obtained for this one month construction period.

Excavation

Since the noise enclosure will be erected during the site excavation, only the use of quiet plant and reducing the number of operational plant could further reduce noise levels. In addition to the 20 dB(A) reduction attributable to the noise enclosure, mitigation measures would give 5-6 dB(A) reductions for the above ground and underground excavation stages.

Structures

A package of mitigation measures including the use of quiet plant and reducing the number of plant operating at any one time will need to be adopted for the construction activities after the first three months when the roof of the noise enclosure is removed. A noise reduction of up to 7 dB could be obtained using these mitigation measures. During the final stage of building structure works, involving construction without the enclosure, a package of mitigation measures including the use of quiet plant, movable barriers and reducing the number of operational plant has been proposed. A reduction of up to 9 dB(A) could be obtained during this stage which is expected to last for one month.

Enclosure Removal

A package of mitigation measures including the use of quiet plant, movable barriers and reducing the number of operational plant, has been proposed during this stage. Up to 11 dB(A) and 9 dB(A) reductions in noise levels could be obtained during the enclosure and foundation removal stages respectively.

The previous Section has identified a number of exceedances of the recommended voluntary daytime noise limit. In the worst case, an exceedance of 11 dB(A) at Siu King Building (NNP7) has been predicted. The prediction methodology based on the requirements of the TM uses the worst case conditions and assumes that these occur for the entire period of the works. In most cases, however, many items of plant are only operated for a limited proportion of the working day. If this is taken into account, the actual durations and levels of the exceedances will be reduced.

Site preparation at work site NP2 is scheduled to take one month, including the erection of noise enclosure. The preparation and erection of the acoustic enclosure and it's subsequent dismantling and removal are necessary to provide a reduction in noise levels of some 20 dB(A) during the 30 months of the main construction period. It is expected that the highest noise levels will occur for about two weeks of one month site preparation period.

No adverse construction noise impacts have been predicted during the excavation stages as the noise enclosure will provide sufficient attenuation to control noise levels to within the established criteria. The excavation works within the enclosure will last for eight months, then the excavation works will continue inside the station cavern for another eighteen months.

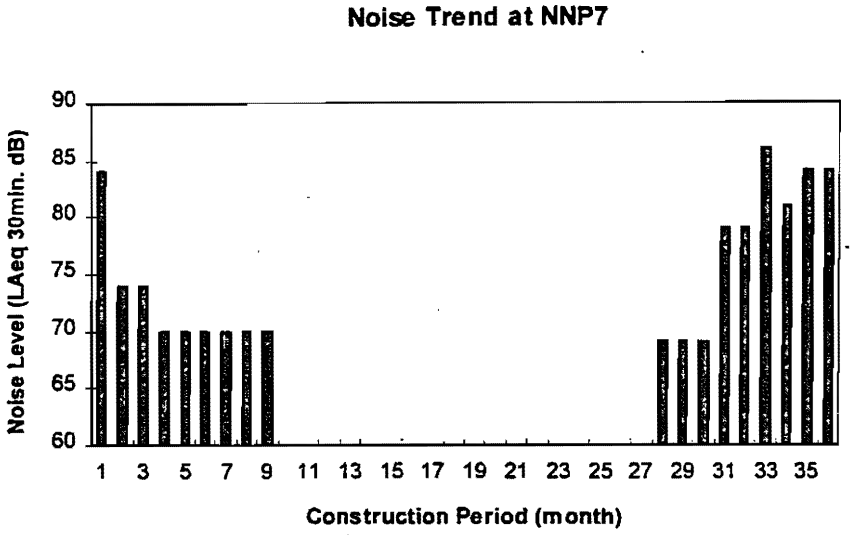
During the structures phase, the building works will proceed within the enclosure for three months. The enclosure will then be partially removed for another two months. A 10 dB(A) noise attenuation will be obtained from the remaining enclosure side wall during this two month period. After the enclosure has been removed, it may be possible to erect additional noise barriers to provide some screening to the NSR during the last one month required for completion of the building structure. It is expected that the highest noise levels will occur for four weeks of the three to four months of structures work.

Following the completion of structures works, enclosure will be removed and the highest noise levels will be occur for two to three weeks during the enclosure removal stage.

It should be noted that the cumulative noise impacts from NP1 (access shaft worksite) and NP5 (Kam Ping Street worksite) have been considered and no NSR will suffer increased noise impacts as a result of simultaneous working. The predicted noise levels at NNP1a will be dominated by worksite NP1. The maximum predicted level for noise from NP2 at NNP1a is only 70 dB(A) which will not increase the impact from NP1 predicted in the previous Working Paper on worksite NP1 (87 dB(A)). As any direct line of sight between sites NP2 and NP5 and their associated NSRs is blocked by Tanner Hill, a 10 dB(A) difference in impacts from the two sites can be assumed at all NSRs and therefore no cumulative impacts are possible.

An indication of the overall noise trend at NNP7 during the construction period is shown in *Figure 4.1a.*

Figure 4.1a *Indicative Noise Trend During the Construction Period*



No adverse noise emissions exceeding the recommended noise criterion are expected between month 10 and month 27 (totally 18 months) as the excavation works will be take place inside the station cavern and the noise will be totally screened.

5 CONCLUSIONS

This revised assessment has predicted that unmitigated construction noise associated with work site NP2, will cause adverse impacts at nearby NSRs. Due to the proximity of the NSRs, the use of standard mitigation measures would not be fully effective in controlling the high levels of construction noise impacts.

Noise levels have been investigated in detail for each construction phase and it is clear that the noisiest activities will not last for the entire construction phase, unlike the results produced by the standard TM methodology which identifies the worst case only. The highest noise levels will only occur for: about two weeks of the one month site preparation period; four weeks of the final three or four months of structures work and two to three weeks of the two month enclosure foundation removal stage; during the 36 month construction programme. A total of 150 dwellings (NNP6, NNP7 & NNP8) are predited to be exposed to the highest noise levels for a period of about 9 weeks out of the 156 weeks of the construction programme, some 6 % of the total construction period.

For about 80 % of the construction programme noise levels at NNP7, the worst affected NSR, will be within the 75 dB(A) target level. During the majority of the above ground works, the noise levels are expected to be around 80 dB(A). No cumulative impacts from the three sites are predicted at any of the NSRs.

This assessment of the potential noise impacts from work site NP2 shows that, mitigation measures, including changes to the construction methodology, have been proposed which bring the overall construction noise levels as close as possible to the recommended voluntary daytime level without imposing unrealistic constraints on the Contractor which would prevent his fulfilling his contractual responsibilities.

Annex A

Construction Plant Lists

Table C1.3b(ii) Ventilation Shaft (NP2)					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	breaker	CNP024	1	110	110
of noise enclosure)	lorry	CNP141	1	112	112
	compressor	CNP001	1	104	104
	excavator	CNP081	1	112	112
	loader	CNP081	1	112	112
	generator	CNP101	1	108	108
				PHASE TOTAL SWL	118
Excavation (above ground)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	2	110	113
	lorry	CNP141	2	112	115
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	112	112
	compressor	CNP001	1	104	104
	excavator	CNP081	1	112	112
	loader	CNP081	1	112	112
	generator	CNP101	1	108	108
	vent fan	CNP241	1	108	108
	rock drill - hand held	CNP183	3	116	121
	hoist	CNP121	1	108	108
	water pump	CNP282	1	103	103
				PHASE TOTAL SWL	124
Excavation (under ground)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	112	115
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	112	112
	loader	CNP081	1	112	112
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP282	1	103	103
				PHASE TOTAL SWL	120
Structures	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	4	109	115
	mobile crane	CNP048	1	112	112
	vibrator	CNP170	2	113	116
	circular saw	CNP201	2	108	111
	water pump	CNP282	1	103	103
				PHASE TOTAL SWL	120
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	112	115
	mobile crane	CNP048	1	112	112
				PHASE TOTAL SWL	117
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor	CNP001	1	104	104
	loader	CNP081	1	112	112
	lorry	CNP141	2	112	115
	breaker	CNP024	1	110	110
				PHASE TOTAL SWL	118

Table C1.4d(i) Ventilation Shaft (NP 2) - Use of Quiet Plant					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	breaker	CNP024	1	110	110
of noise enclosure)	lorry	CNP141	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
				PHASE TOTAL SWL	113
Excavation (above ground)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	2	110	113
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
	vent fan	CNP241	1	108	108
	rock drill hand-held	CNP183	3	116	121
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	123
Excavation (under ground)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	loader	CNP081	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	116
Structures	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	4	109	115
	mobile crane	CNP048	1	105	105
	vibrator	CNP170	2	110	113
	circular saw	CNP201	2	108	111
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	118
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	mobile crane	CNP048	1	105	105
				PHASE TOTAL SWL	108
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor	CNP002	1	100	100
	lorry	CNP141	1	105	105
	loader	CNP081	1	105	105
	breaker	CNP024	1	110	110
				PHASE TOTAL SWL	112

Table C1.4d(iii) Ventilation Shaft (NP 2) - Quiet Plant + Barrier + Limiting of No. of Plant Type to One					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	breaker	CNP024	1	105	105
of noise enclosure)	lorry	CNP141	1	105	105
	compressor	CNP001	1	90	90
	excavator	CNP081	1	100	100
	loader	CNP081	1	100	100
	generator	CNP101	1	90	90
				PHASE TOTAL SWL	**109**
Excavation (above ground)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	1	110	110
	lorry	CNP141	1	105	105
	concrete lorry	CNP044	1	109	109
	mobile crane	CNP048	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
	vent fan	CNP241	1	108	108
	rock drill hand-held	CNP183	1	116	116
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**119**
Excavation (under ground)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	concrete lorry	CNP044	1	109	109
	mobile crane	CNP048	1	105	105
	loader	CNP081	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**115**
Structures	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	1	109	109
	mobile crane	CNP048	1	100	100
	vibrator	CNP170	1	105	105
	circular saw	CNP201	1	98	98
	water pump	CNP281	1	78	78
				PHASE TOTAL SWL	**111**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	mobile crane	CNP048	1	100	100
				PHASE TOTAL SWL	**106**
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor	CNP002	1	90	90
	lorry	CNP141	1	105	105
	loader	CNP081	1	100	100
	breaker	CNP024	1	105	105
				PHASE TOTAL SWL	**109**

Table C1.4d(ii) Ventilation Shaft (NP 2) - Quiet Plant + Barrier					
Site Preparation	Noise Source	TM ref	Unit	SWL	Total - SWL
(including construction	breaker	CNP024	1	105	105
of noise enclosure)	lorry	CNP141	1	105	105
	compressor	CNP001	1	90	90
	excavator	CNP081	1	100	100
	loader	CNP081	1	100	100
	generator	CNP101	1	90	90
				PHASE TOTAL SWL	**109**
Excavation (above ground)	Noise Source	TM ref	Unit	SWL	Total - SWL
	breaker	CNP024	2	110	113
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	compressor	CNP001	1	100	100
	excavator	CNP081	1	105	105
	loader	CNP081	1	105	105
	generator	CNP101	1	100	100
	vent fan	CNP241	1	108	108
	rock drill hand-held	CNP183	3	116	121
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**123**
Excavation (under ground)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	105	108
	concrete lorry	CNP044	2	109	112
	mobile crane	CNP048	1	105	105
	loader	CNP081	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP281	1	88	88
				PHASE TOTAL SWL	**116**
Structures	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	4	109	115
	mobile crane	CNP048	1	100	100
	vibrator	CNP170	2	105	108
	circular saw	CNP201	2	98	101
	water pump	CNP281	1	78	78
				PHASE TOTAL SWL	**116**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	1	105	105
	mobile crane	CNP048	1	100	100
				PHASE TOTAL SWL	**106**
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor	CNP002	1	90	90
	lorry	CNP141	1	105	105
	loader	CNP081	1	100	100
	breaker	CNP024	1	105	105
				PHASE TOTAL SWL	**109**

WORKING PAPER

CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

Mass Transit Railway Corporation

Quarry Bay Relief Works DEIA : *Additional Construction Dust Impact Assessment*

21 March 1997

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ERM

WORKING PAPER

Mass Transit Railway Corporation

Quarry Bay Relief Works DEIA : *Additional Construction Dust Impact Assessment*

21 March 1997

Reference C1365/42193

For and on behalf of ERM-Hong Kong, Ltd

Approved by: _____

Position: Dep. Managing Director

Date: 20th March 1997

CONTENTS:

1 INTRODUCTION

The review of the draft Quarry Bay Relief Works Detailed Environmental Impact Assessment (QBR DEIA) identified the need for further air quality studies to quantify the impacts from blasting and to present the construction dust impacts in the form of contour maps. This Working Paper presents the findings of the required additional air quality assessment studies.

2 BLASTING

2.1 ASSESSMENT METHODOLOGY

This assessment focuses on the potential dust impacts from the blasting activity involved in the construction of stations and tunnels for the QBR. The 1-hour averaged Total Suspended Particulate (TSP) concentrations have been predicted at downwind distances of 5-200 m from the blasting site.

2.1.1 *Dispersion Model*

The Fugitive Dust Model (FDM) was used to model the extent of impacts from the QBR construction works with parameters taken from the *Compilation of Air Pollutant Emission Factors, 5th Edition, US Environmental Protection Agency, 1996, (US EPA - AP-42)* for various fugitive dust sources.

2.1.2 *Meteorological Input*

It is anticipated that blasting will take place during the daytime and the stability class D is assumed. Strong winds may give rise to fugitive dust, however, high wind speed will also enhance dispersion and reduce the extent of dust impact. Wind speeds of 1 m s^{-1}, 2 m s^{-1} and 3 m s^{-1} were used in the model to assess the worst case impacts from blasting.

2.1.3 *TSP Emission Rates*

Estimations of emission factors have been made in accordance with the *US EPA - AP-42*. A dust emission rate is established for blasting activity in *Table 11.9-1* of *Section 11.9-5* of AP-42. The emission factors used in the modelling assessment are presented in *Table 2.1a*. Blasting dust impacts can be expected during the initial excavation stage when blasting takes place at the access adit portal, dust impacts will diminish as works move inside the tunnel. Blasting dust impacts can be further reduced by the adoption of current best practice for blasting works including the erection of blasting nets and coverage of the blasting opening by canvas covers.

Table 2.1a ***Emission Factors for Construction Activities at Station Worksites***

Activities	Emission Factor	Remarks
Blasting	27.5 g blast^{-1}	• Based on USEPA AP-42 Vol. 1, 5th Edition, Section 11.9-5. • Assume blast area with dimension of 5 m x 5 m

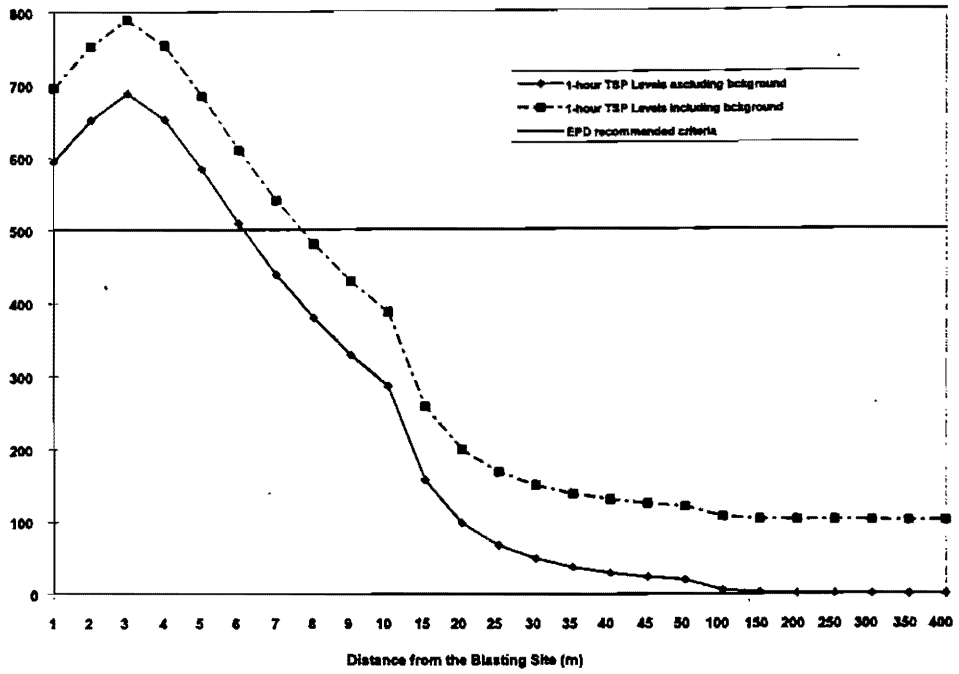
2.1.4 *Prediction of Impacts*

Dust impacts arising from blasting operations are considered as discreet events, as during blasting, construction works in the vicinity of the blast area will be halted for safety reasons. It has, therefore, been assumed that only one blast will occur at any site during a one hour period. The 1-hour TSP levels have been predicted at downwind distances of 5-200 m from the blasting site under wind speeds of 1 m s^{-1}, 2 m s^{-1} and 3 m s^{-1}. The worst case condition has been identified to be 1 m s^{-1} and the predicted 1-hour TSP levels for this wind speed are presented in *Table 2.1b*.

Table 2.1b ***Predicted 1-hour averaged TSP Concentrations (μg m^{-3}) arising from blasting (excluded background)***

Down Wind Distance from Blasting site (m)	1-hour TSP levels μg m^{-3}
1	595
2	652
3	688
4	652
5	583
10	286
15	157
20	98
25	67
30	49
35	37
40	29
45	24
50	19
100	6
200	2

Figure 2.1a *Predicted 1-hour averaged TSP Concentrations (μg m^{-3}) arising from blasting*



2.1.5 *Evaluation of Impacts*

The nearest sensitive uses to the blasting site for the access shaft (NP1) include Maylun Apartments (AN1), Tung Fat Building (AN2), Roca Centre (AN4), Fairview Court (AN5), Cheong Yuen Building (AN6) and Pine Tree House (AN7). As indicated in *Figure 2.1a*, 1-hour TSP levels decrease rapidly away from the worksite, the predicted 1-hour TSP level is within the EPD's recommended hourly criteria of 500 μg m^{-3} at 8 m. All ASRs except Cheong Yuen Building are located at least 8 m from NP1. The predicted 1-hour TSP levels are below the EPD criterion.

Cheong Yuen Building is 3 m from the site boundary of NP1. The predicted 1-hour level at Cheong Yuen Building is 688 μg m^{-3} (+101 μg m^{-3} background = 789 μg m^{-3}). A noise enclosure will be constructed at worksite NP1 and dust generated within worksite will be largely contained by the noise enclosure, with dust emissions at the entrance and exit of the worksite. The modelling results have excluded the positive effect of the noise enclosure and, therefore, the dust levels at Cheong Yuen Building should be lower than the prediction.

The dust levels have been predicted based on blasting site dimensions of 5 m wide by 5 m long. It should be noted that the extent of dust impacts will depend on the actual size and nature of the blasting area and blasting techniques that are used. Best practice for blasting works, as required by Mines and Quarries (M&Q) Division including the erection of blasting nets and coverage of the blasting opening by canvas covers, will be implemented at the blasting site. The dust impact from blasting will be mitigated by such mitigation measures although the specific effects cannot be quantified.

3 *GENERAL CONSTRUCTION ACTIVITIES*

In addition to the TSP concentrations predicted at discrete ASRs in the draft QBR DEIA, the predicted 1-hour and 24-hour TSP concentrations during the different construction stages, including the background level of 101 $\mu g\ m^{-3}$, are presented in the form of contour maps. The contour maps are presented in *Annex A* as *Figures 2.4a to 2.4j* for the Quarry Bay work site (QB1); *Figures 2.4o to 2.4p* for the North Point work sites (NP1, NP2 & NP5 - cumulative impact of worst case for each site) and *Figures 2.4t to 2.4bb* for the Fortress Hill work site (FH3). Both 1-hour and 24-hour TSP levels show similar levels to those predicted for individual identified ASRs. 1-hour TSP levels are above the criteria at areas close to the QBR work sites during construction of the main tunnels and North Point Station. Unmitigated construction work is likely to cause dust impacts exceeding the established criteria and therefore, mitigation measures have been recommended. Predicted dust levels with mitigation measures are presented in *Figures 2.4k to 2.4n* for QB1; *Figures 2.4q to 2.4r* for NP1, NP2 & NP5; and *Figures 2.4cc to 2.4ff* for FH3.

4 *CONCLUSIONS*

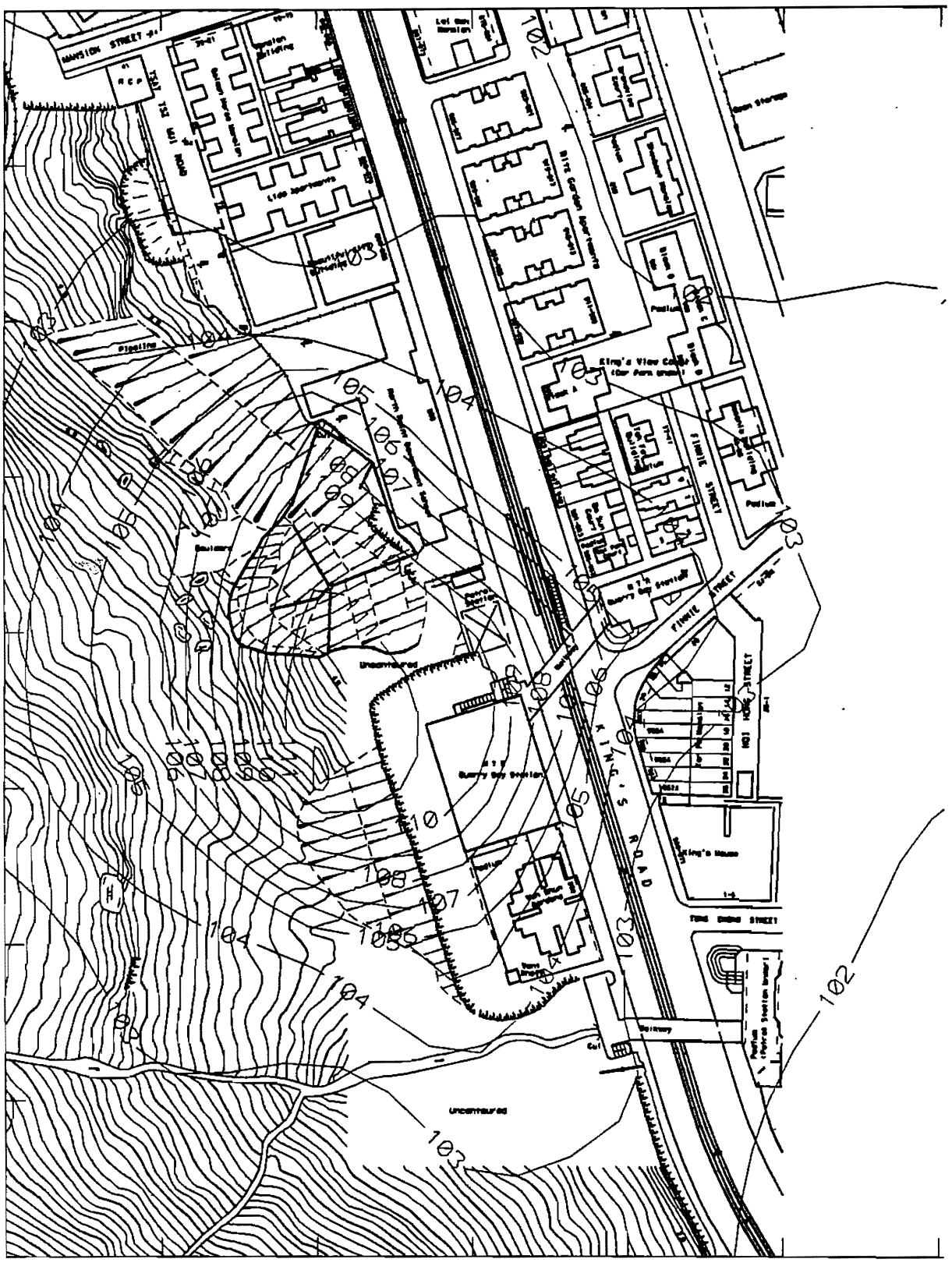
The TSP levels predicted from blasting, set out in *Table 1.1b*, are well within the recommended 1-hour average level even without mitigation measures. The standard control techniques of blast nets and canvas covers will further reduce the predicted levels and it can be expected that the presence of the noise enclosure will also help to reduce any impacts.

The use of standard construction dust control measures will be effective in controlling the predicted 1-hour TSP exceedances to within the established criteria. Once again, the presence of the noise enclosure for much of the construction period will have a positive effect on the control of dust generation.

It should be noted that the predictive model used to produce the contour maps does not account for the effects of natural or urban topographic influences. As can be seen from the *Figures* in *Annex A*, the TSP contours are primarily determined by wind speed and direction without the modifying effects of topography.

Annex A

TSP Contour Maps



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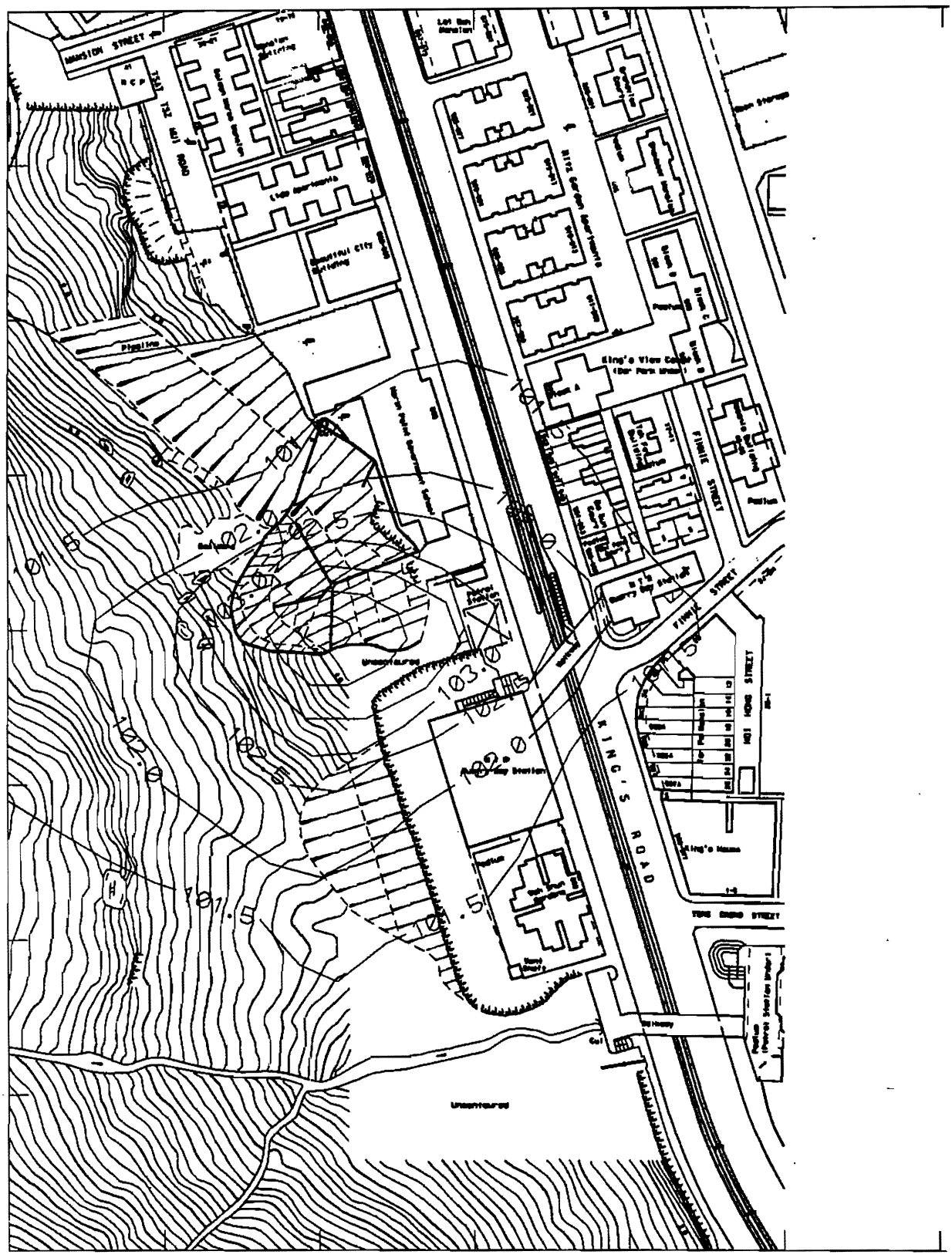
1 – hr averaged TSP concentrations (site preparation) at Quarry Bay in $\mu g\ m^{-3}$

DATE:	FIGURE No.
AUG 96	2.4a
SCALE: 1 : 1900	

Maunsell



24 – hr averaged TSP concentrations (site preparation) at Quarry Bay in $\mu g\ m^{-3}$

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SCALE: 1 : 1900

FIGURE No. 2.4b

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1 – hr averaged TSP concentrations (portal formation) at Quarry Bay $\mu g\ m^{-3}$

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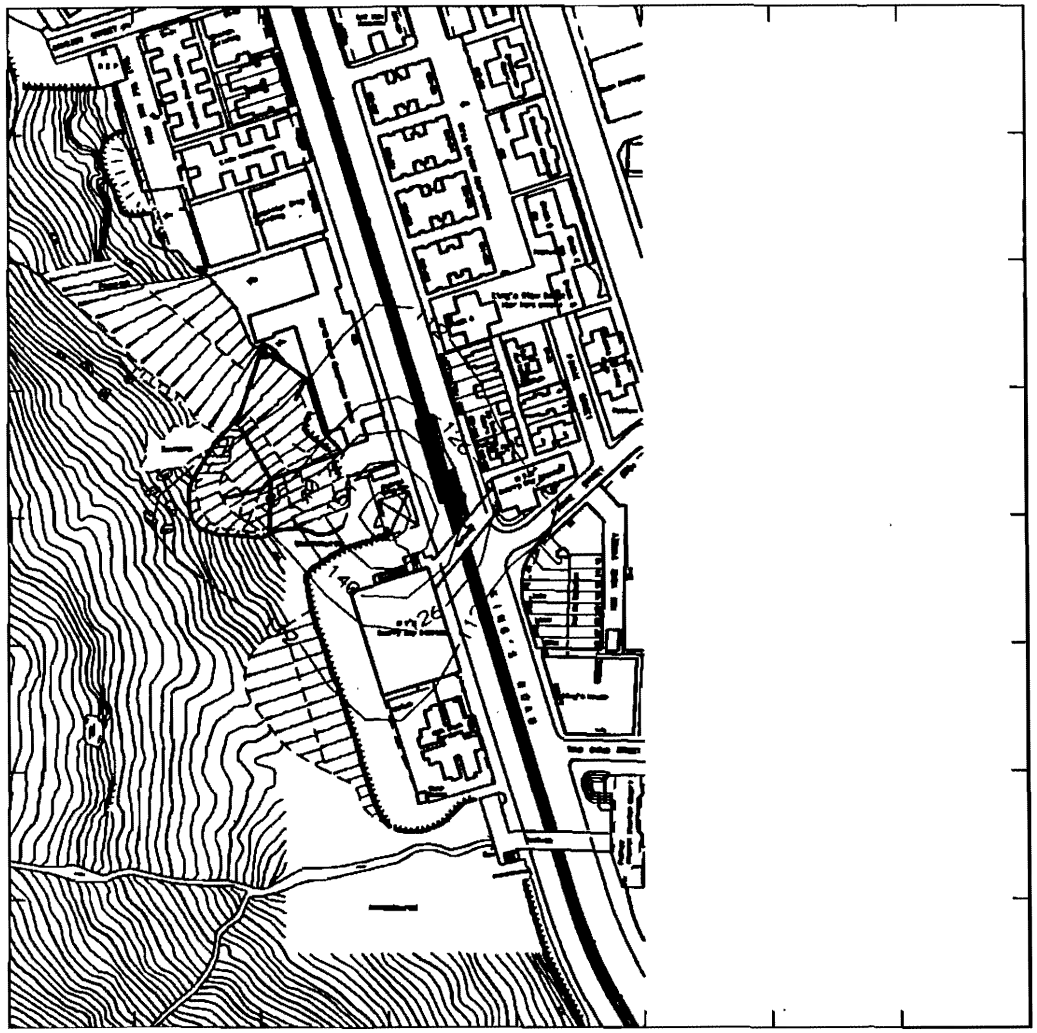
SCALE: 1 : 3000

FIGURE No. 2.4c

Maunsell



24 – hr averaged TSP concentrations (portal formation) at Quarry Bay $\mu g\ m^{-3}$

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SCALE: 1 : 3000

FIGURE No. 2.4d

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1 – hr averaged TSP concentrations (access adit) at Quarry Bay $\mu g\ m^{-3}$

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FIGURE No. 2.4e

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24 – hr averaged TSP concentrations (access adit) at Quarry Bay $\mu g\ m^{-3}$

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FIGURE No. 2.4f

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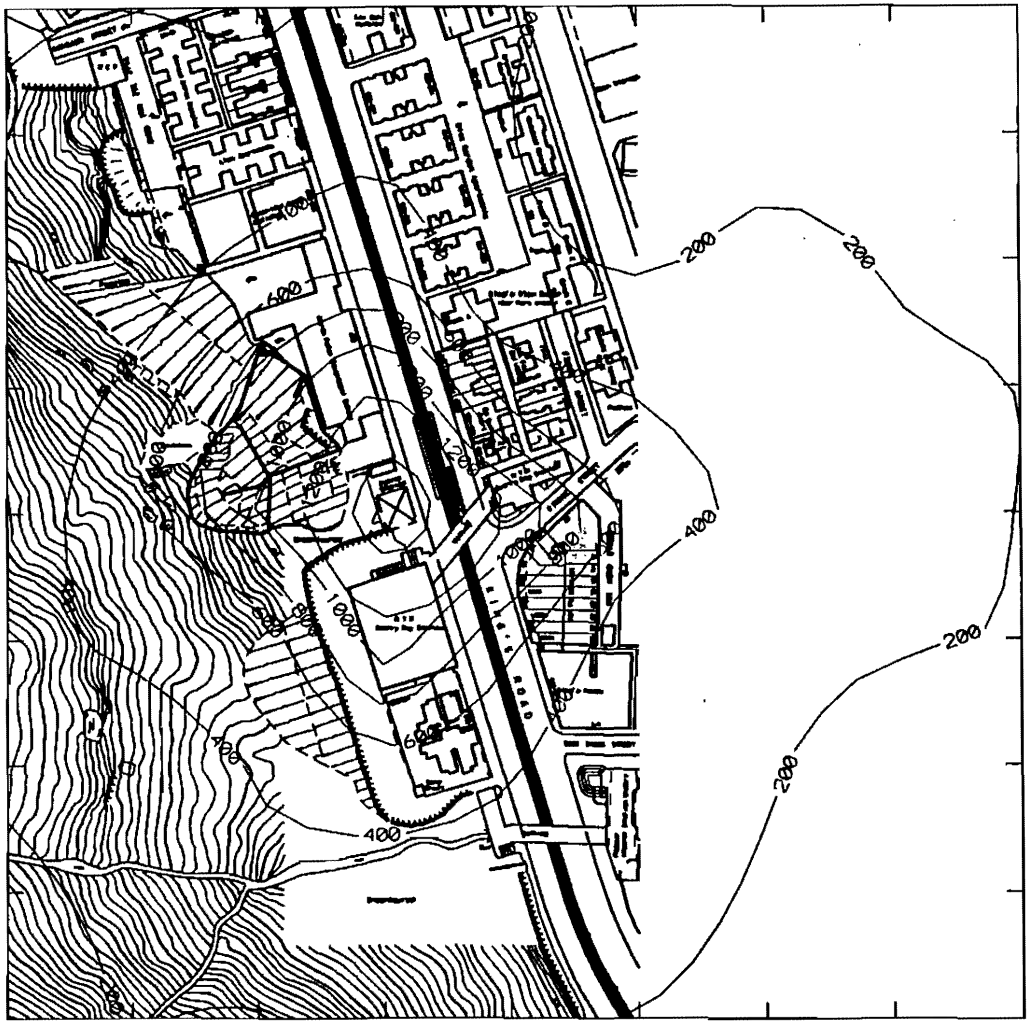

1 – hr averaged TSP concentrations (main tunnel) at Quarry Bay $\mu g\ m^{-3}$

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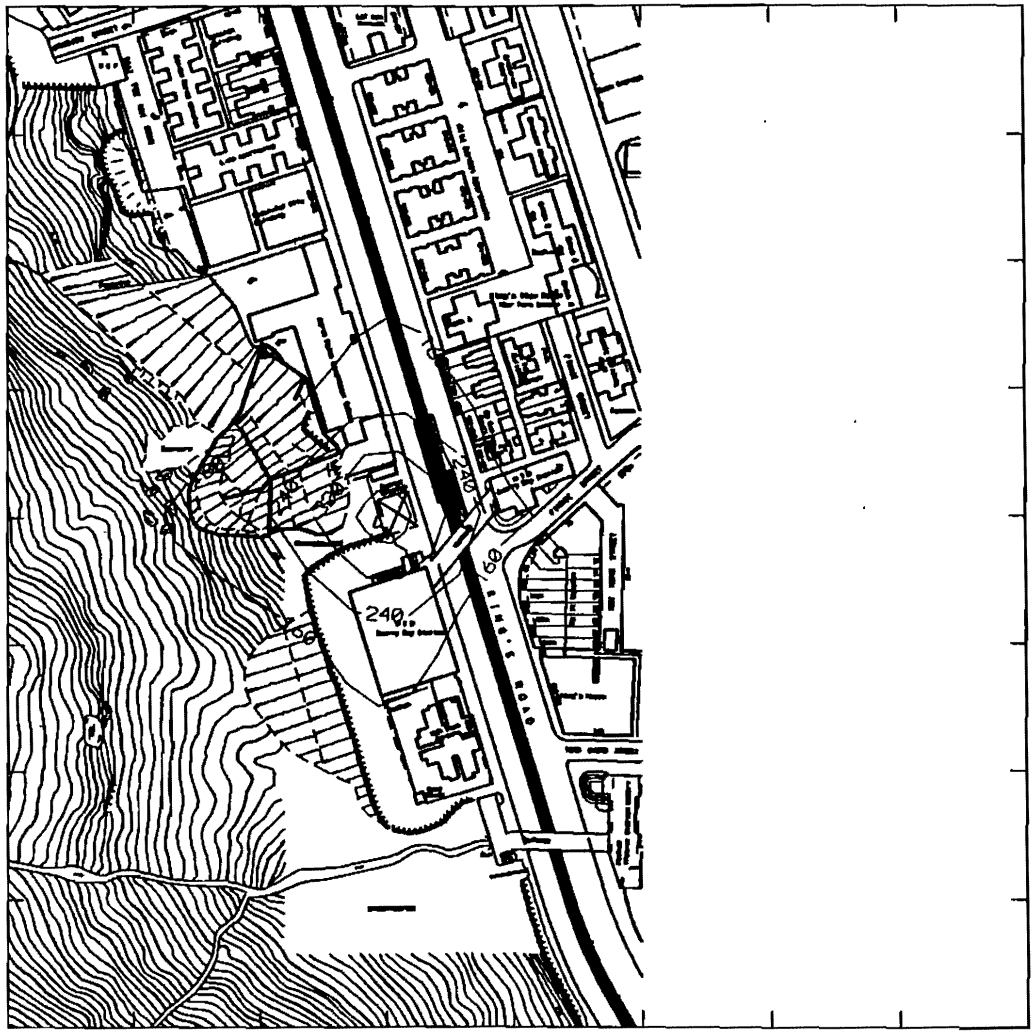
SCALE: 1 : 3000

FIGURE No. 2.4g

Maunsell



24 – hr averaged TSP concentrations (main tunnel) at Quarry Bay $\mu g\ m^{-3}$

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FIGURE No. 2.4h

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1 – hr averaged TSP concentrations (station) at Quarry Bay $\mu g\ m^{-3}$

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FIGURE No. 2.4i

Maunsell

24 – hr averaged TSP concentrations (station) at Quarry Bay $\mu g\ m^{-3}$

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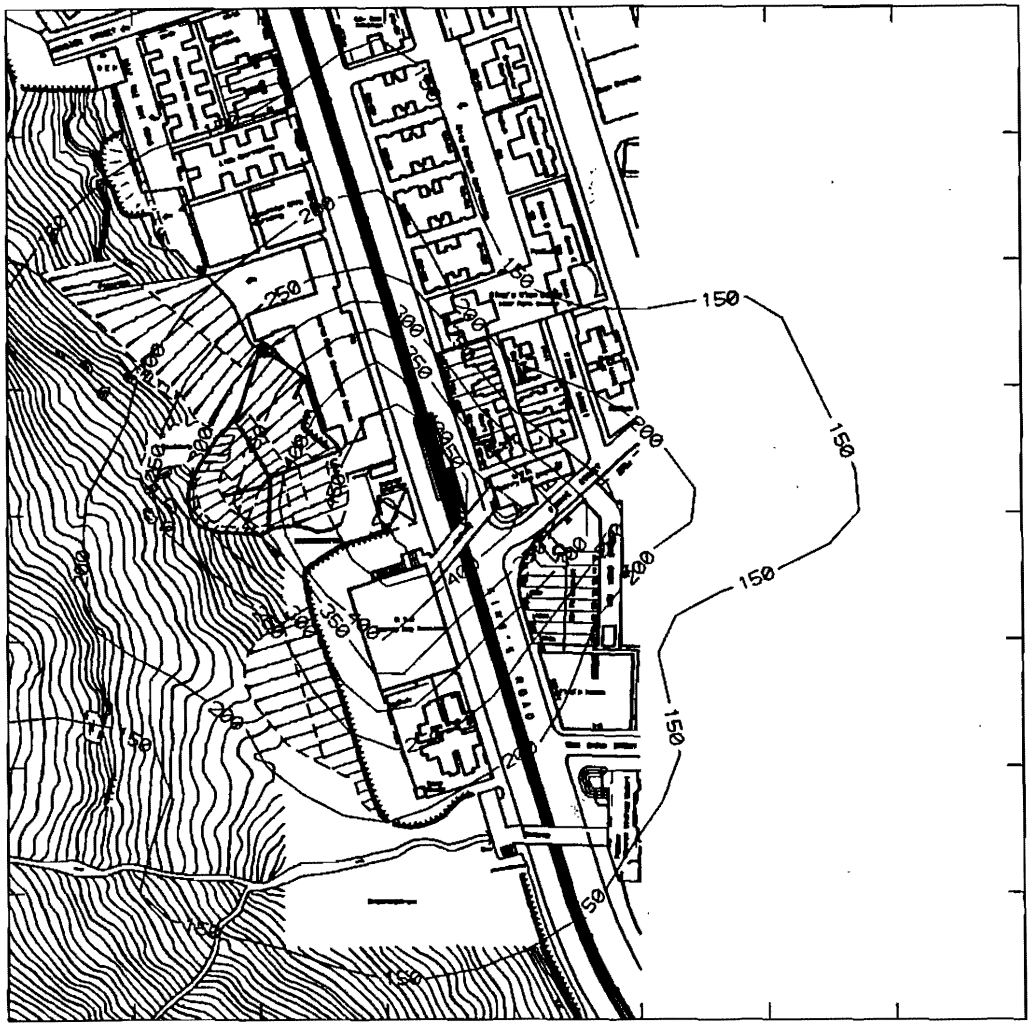
FIGURE No. 2.4j

Maunsell



Mitigated 1 – hr averaged TSP concentrations (main tunnel) at Quarry Bay $\mu g\ m^{-3}$

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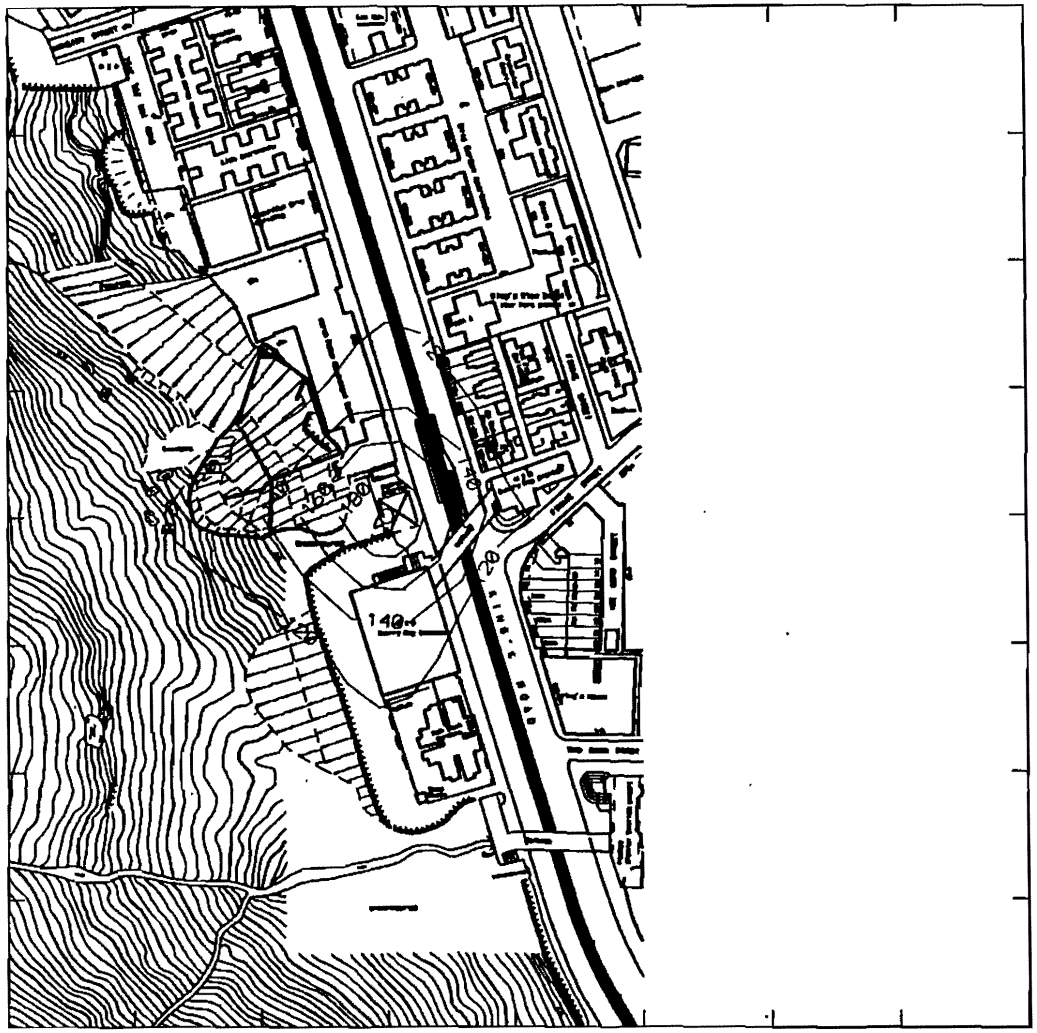
SCALE: 1 : 3000

FIGURE No. 2.4k

Maunsell



Mitigated 24 – hr averaged TSP concentrations (main tunnel) at Quarry Bay $\mu g\ m^{-3}$

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DATE: AUG 96

SCALE: 1 : 5000

FIGURE No. 2.41

Maunsell

Mitigated 1 – hr averaged TSP concentrations (station) at Quarry Bay $\mu g\ m^{-3}$

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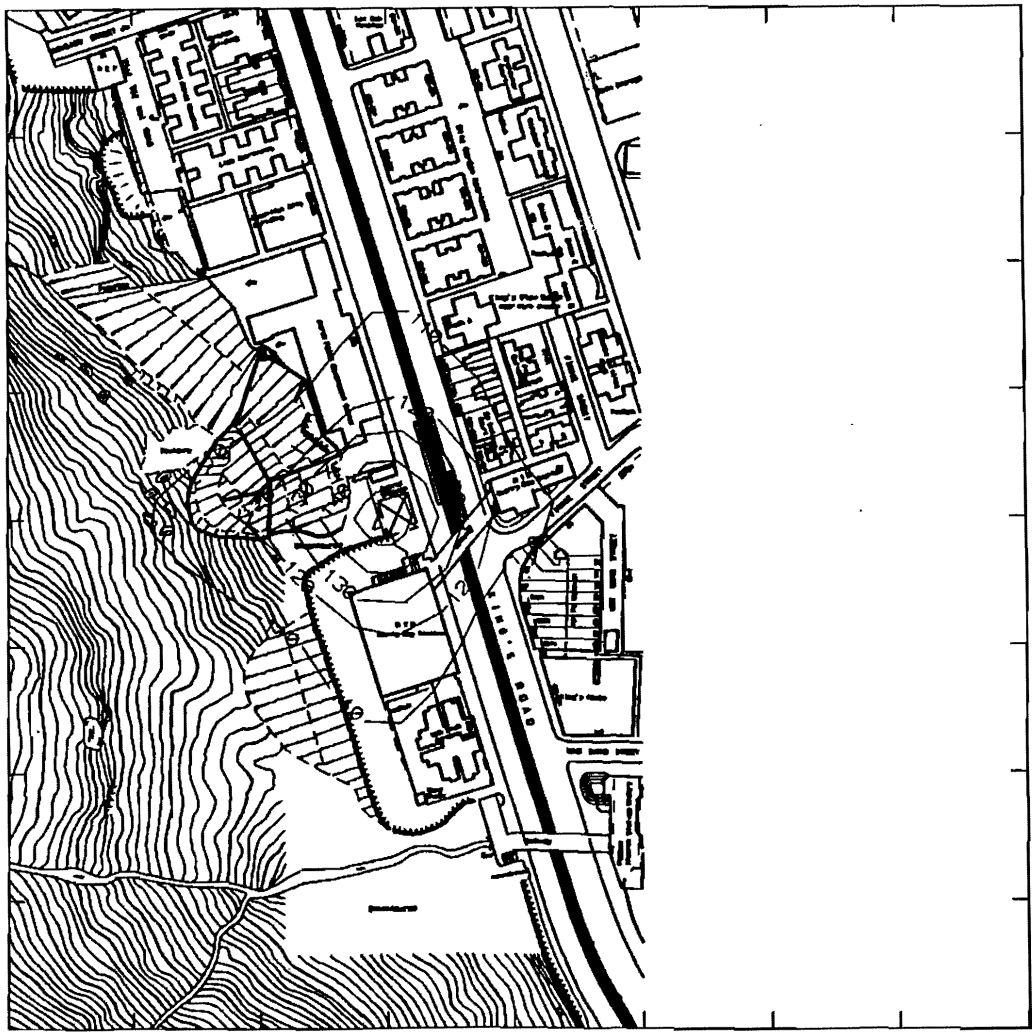
SCALE: 1 : 3000

FIGURE No. 2.4m

Maunsell



Mitigated 24 – hr averaged TSP concentrations (station) at Quarry Bay $\mu g\ m^{-3}$

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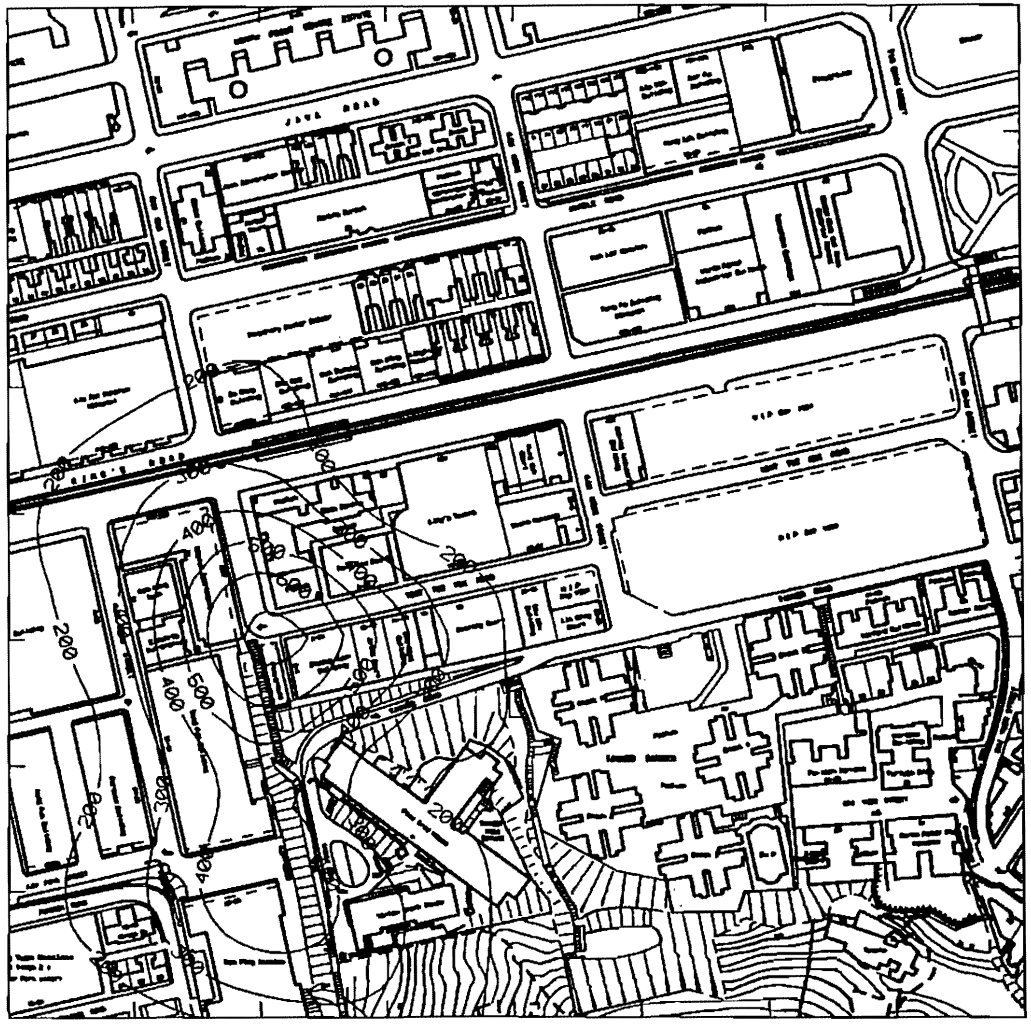
SCALE: 1 : 3000

FIGURE No. 2.4n

Maunsell



1 – hr averaged TSP concentrations at North Point $\mu g\ m^{-3}$

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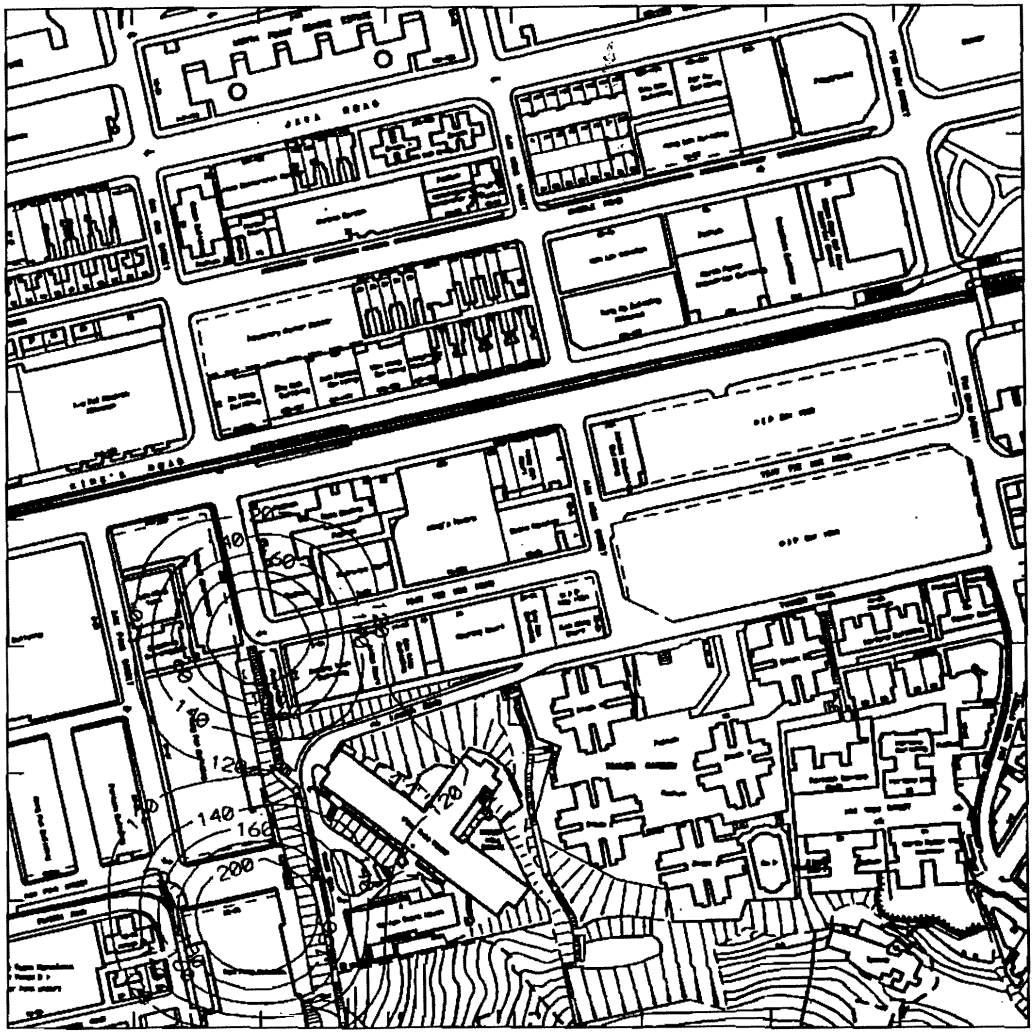
FIGURE No. 2.4o

Maunsell



24 – hr averaged TSP concentrations at North Point $\mu g\ m^{-3}$

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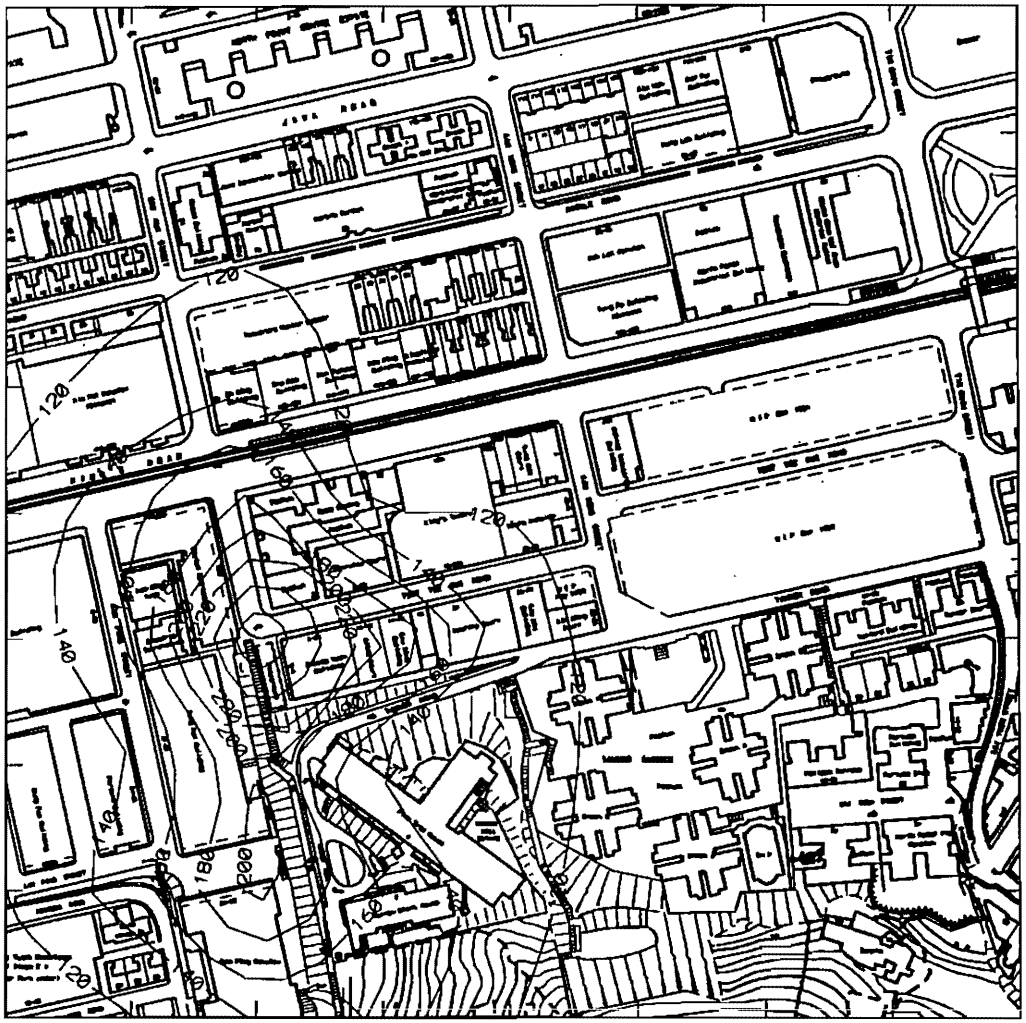
SCALE: 1 : 3000

FIGURE No. 2.4p

Maunsell



Mitigated 1 – hr TSP concentrations at North Point $\mu g\ m^{-3}$

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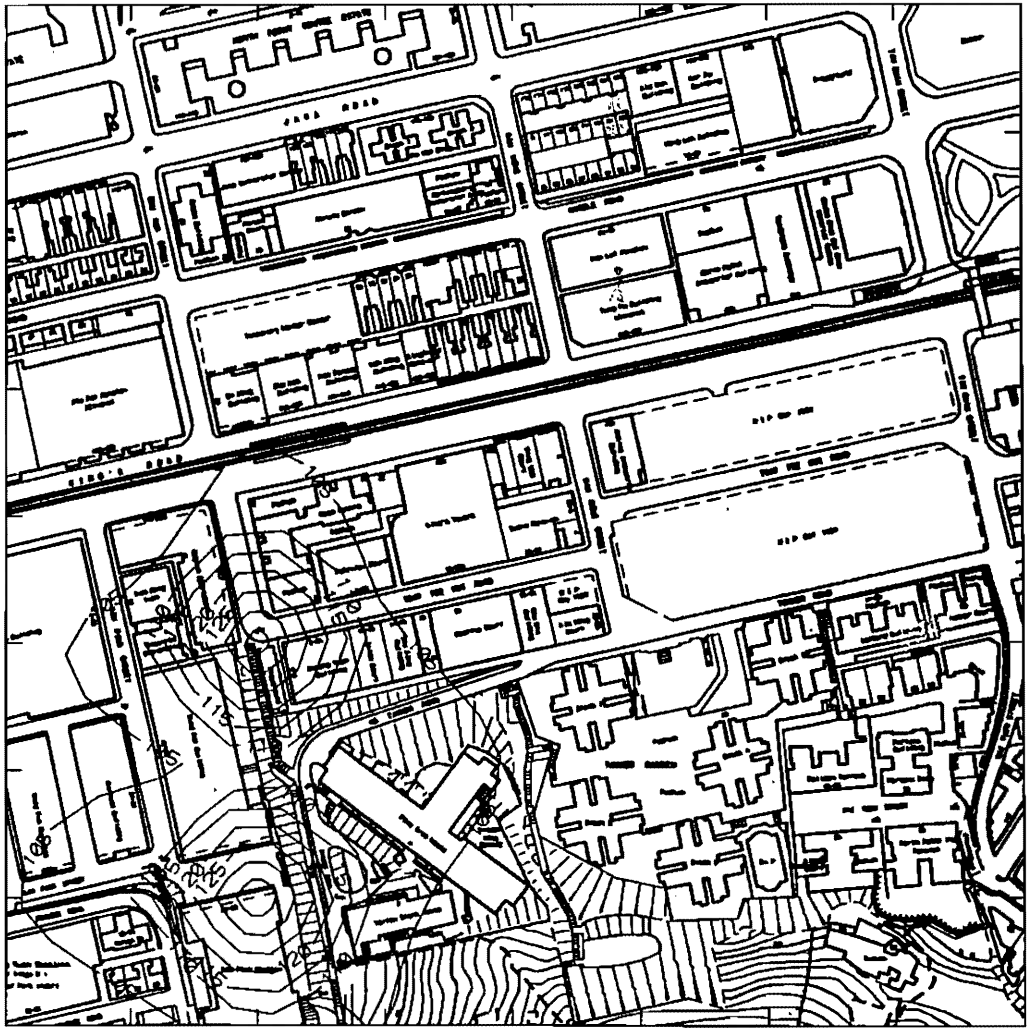
DATE: AUG 96

SCALE: 1 : 3000

FIGURE No. 2.4q

Maunsell



Mitigated 24 – hr TSP concentrations at North Point $\mu g\ m^{-3}$

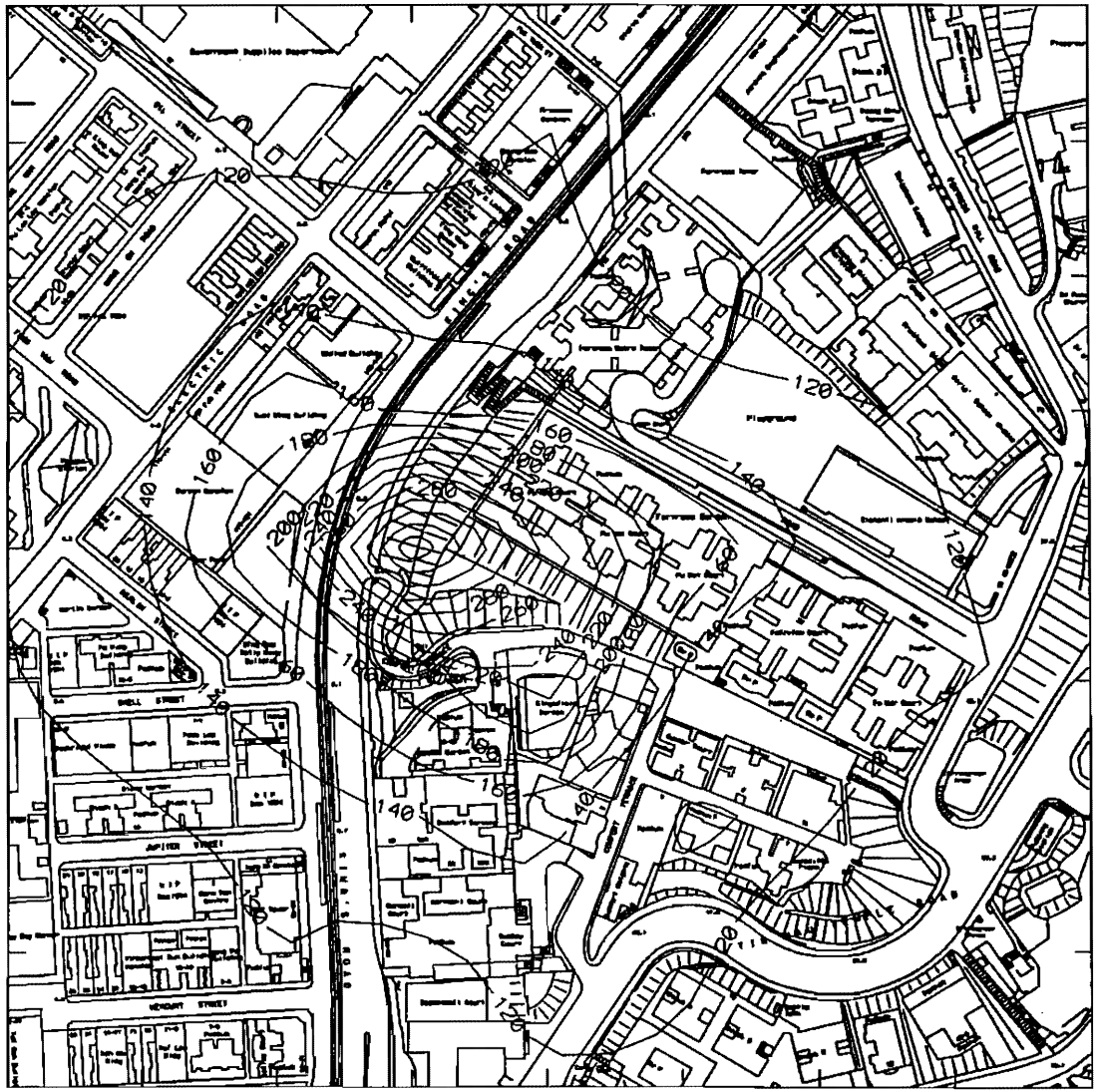
MAUNSELL CONSULTANTS ASIA LTD

DATE: AUG 96

SCALE: 1 3000

FIGURE No. 2.4f

Maunsell



1 – hr averaged TSP concentrations (site preparation) at Fortress Hill $\mu g\ m^{-3}$

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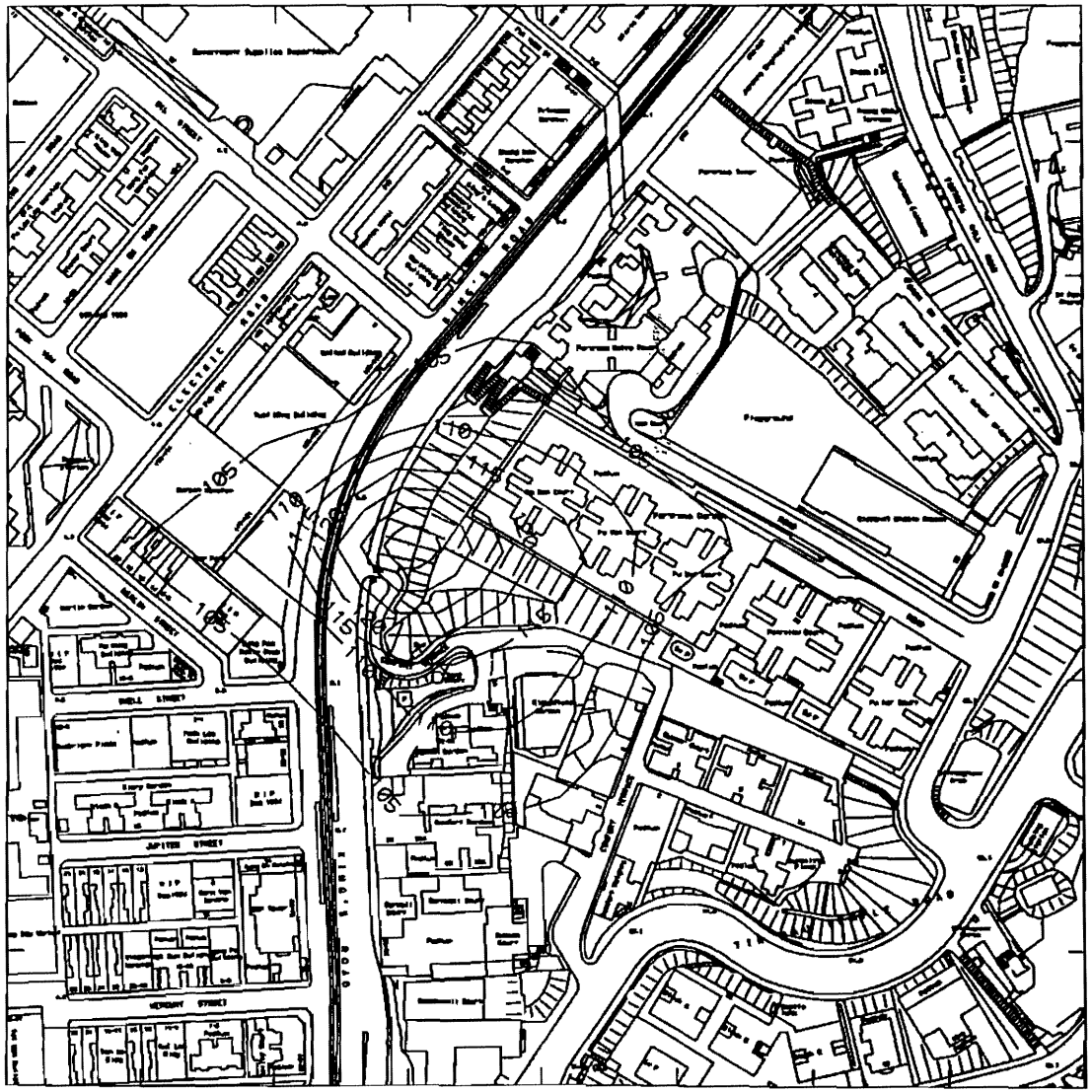
FIGURE No. 2.4s

Maunsell



24 – hr averaged TSP concentrations (site preparation) at Fortress Hill $\mu g\ m^{-3}$

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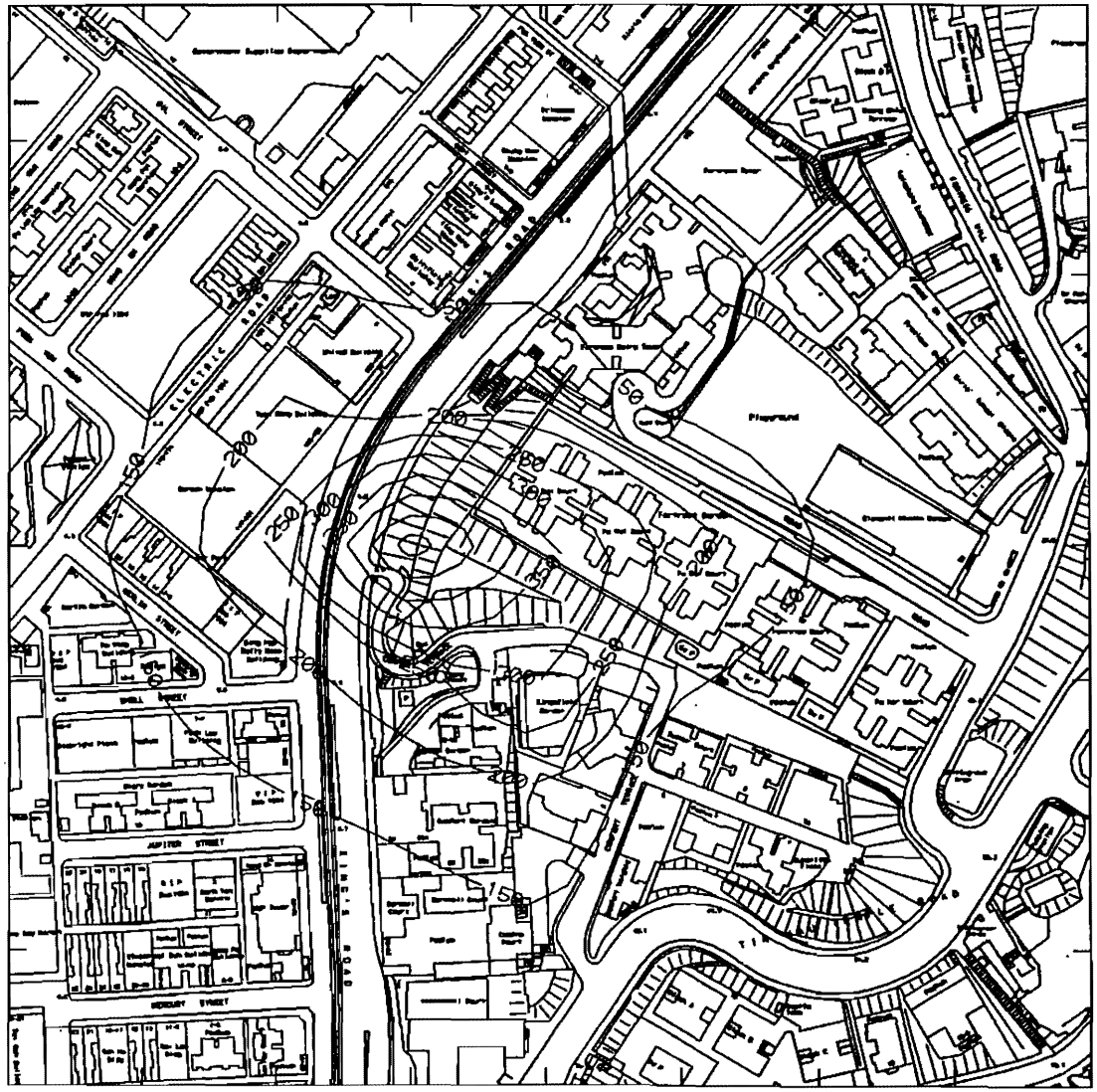
SCALE: 1 : 2800

FIGURE No. 2.4t

Maunsell



1 – hr averaged TSP concentrations (portal formation) at Fortress Hill $\mu g\ m^{-3}$

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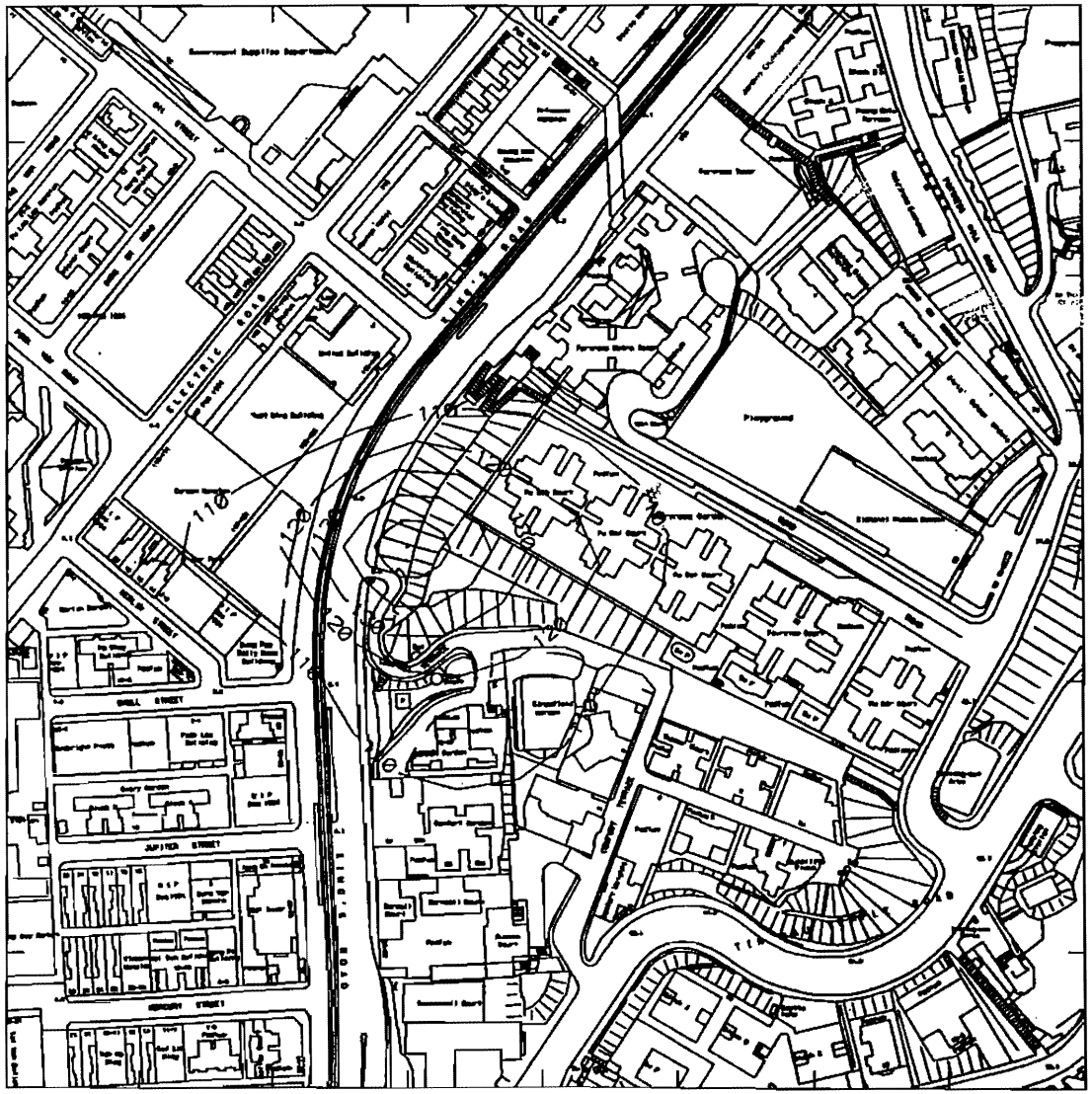
SCALE: 1 : 2800

FIGURE No. 2.4u

Maunsell



24 – hr averaged TSP concentrations (portal formation) at Fortress Hill $\mu g\ m^{-3}$

MAUNSELL CONSULTANTS ASIA LTD
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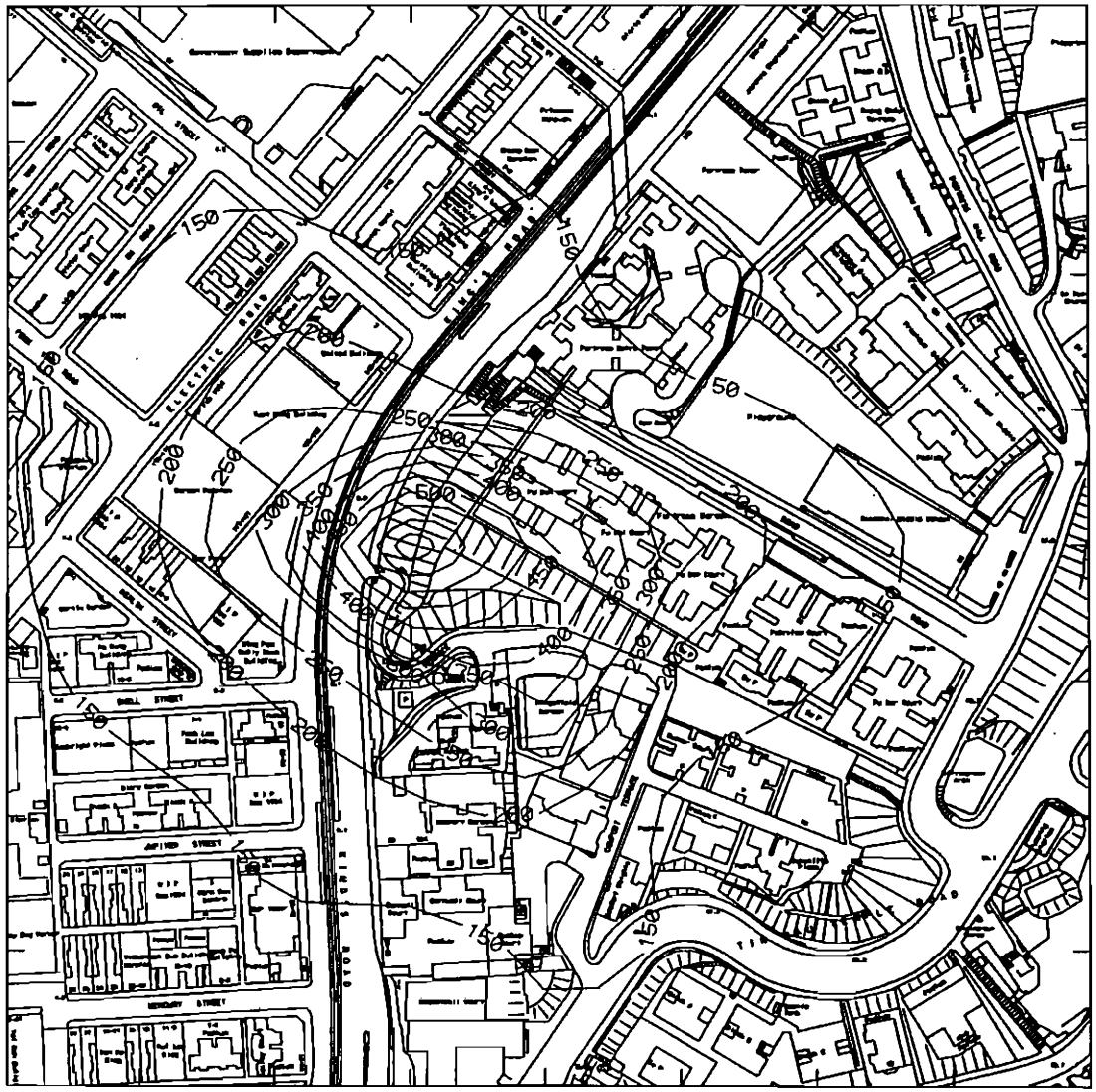
DATE: AUG 96

FIGURE No. 2.4v

SCALE: 1 : 2800

Maunsell



1 – hr averaged TSP concentrations (access adit) at Fortress Hill $\mu g\ m^{-3}$

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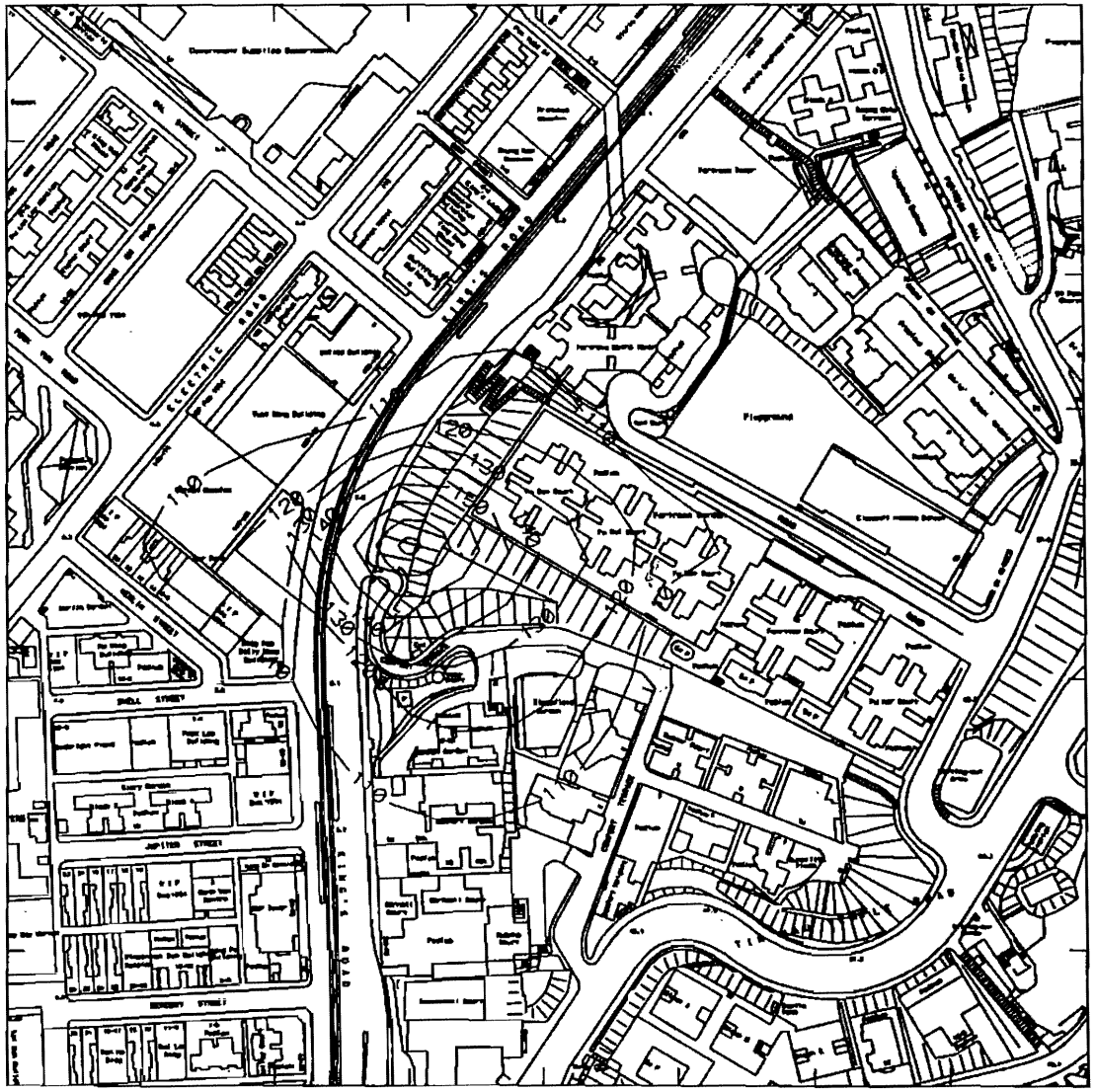
滙德工程顧問有限公司

DATE: AUG 96

SCALE: 1 : 2800

FIGURE No. 2.4W

Maunsell



24 – hr averaged TSP concentrations (access adit) at Fortress Hill $\mu g\ m^{-3}$

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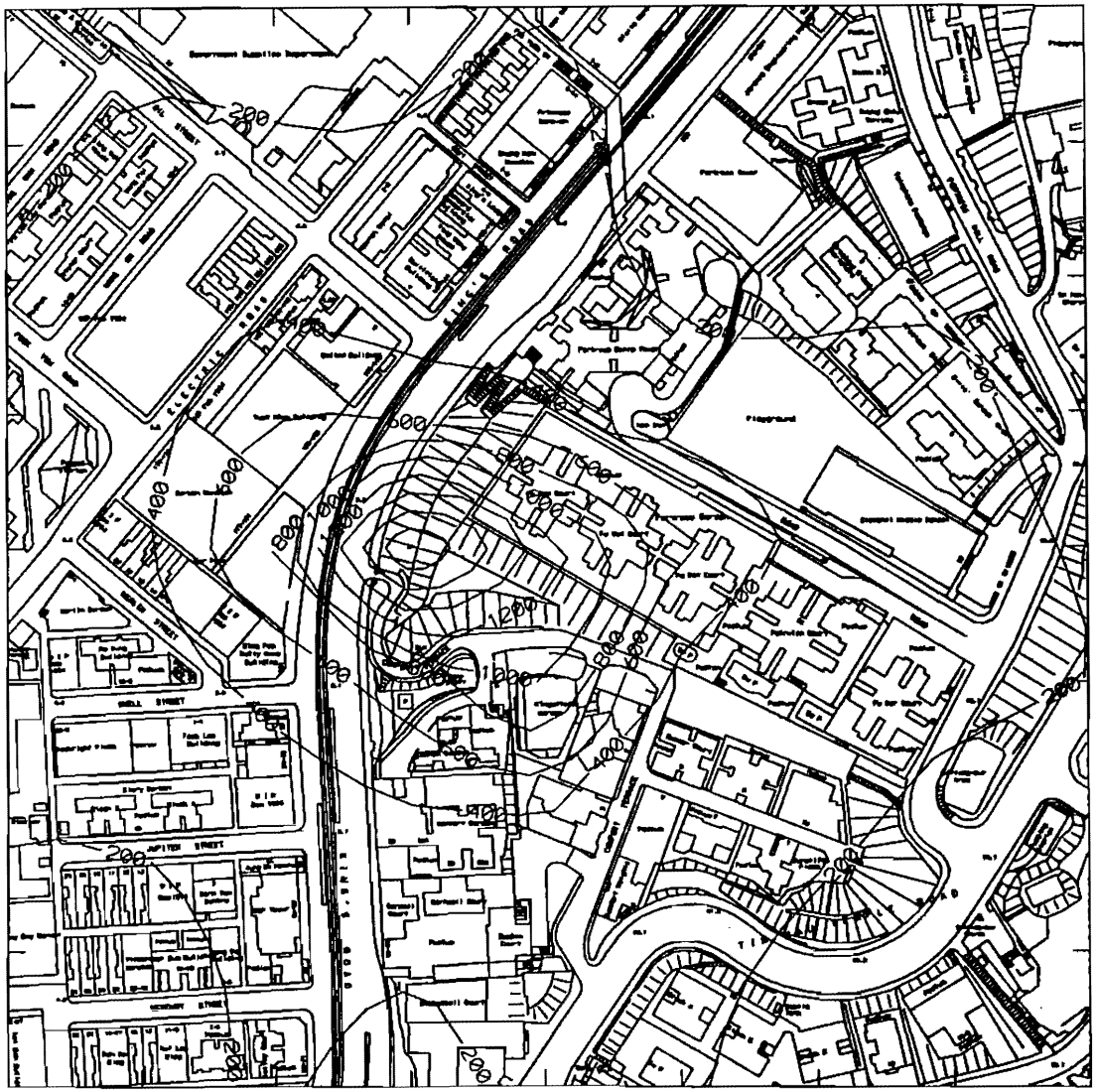
DATE: AUG 96

SCALE: 1 : 2800

FIGURE No. 2.4x

Maunsell



1 – hr averaged TSP concentrations (main tunnel) at Fortress Hill $\mu g\ m^{-3}$

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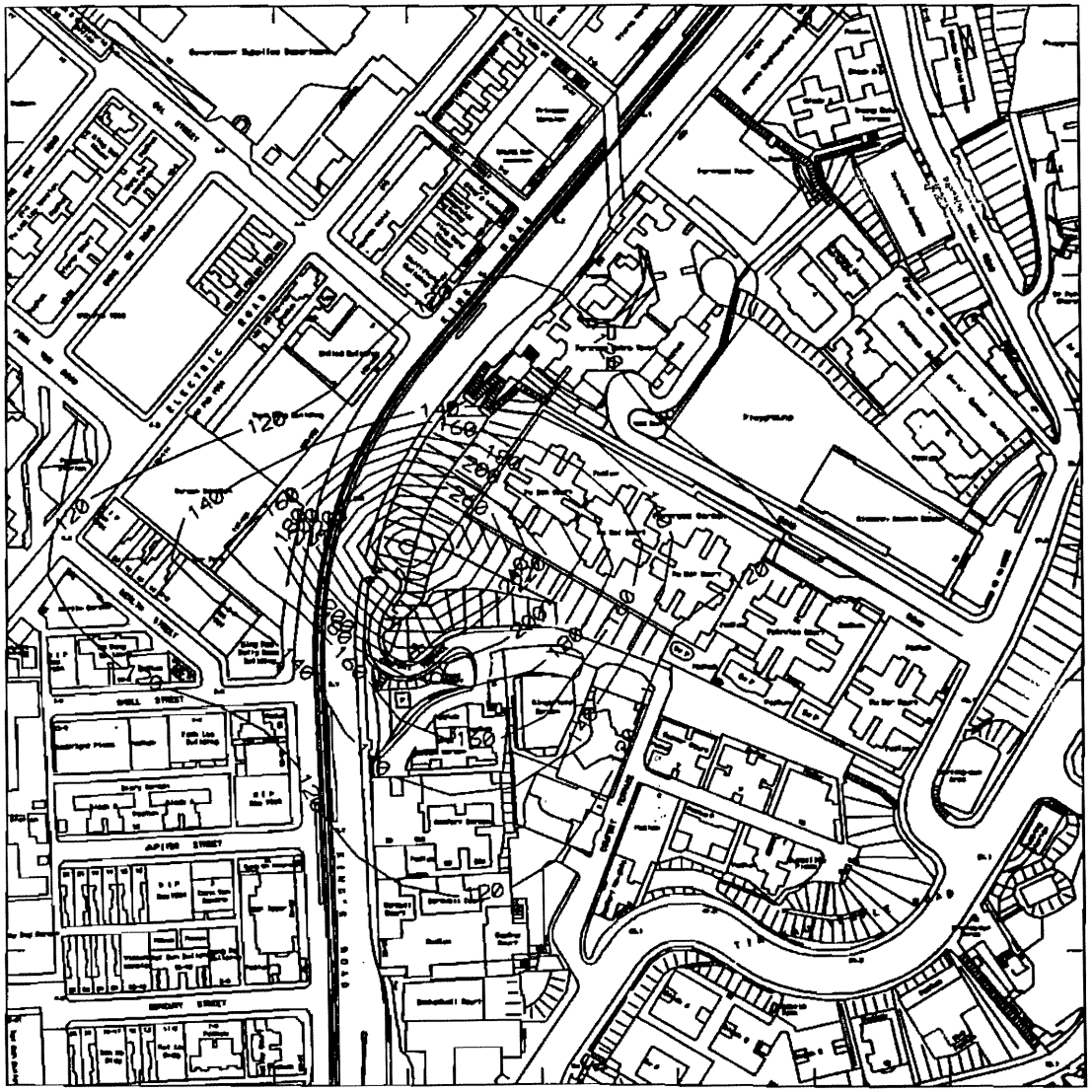
DATE: AUG 96

SCALE: 1 : 2800

FIGURE No. 2.4y

Maunsell



24 – hr averaged TSP concentrations (main tunnel) at Fortress Hill $\mu g\ m^{-3}$

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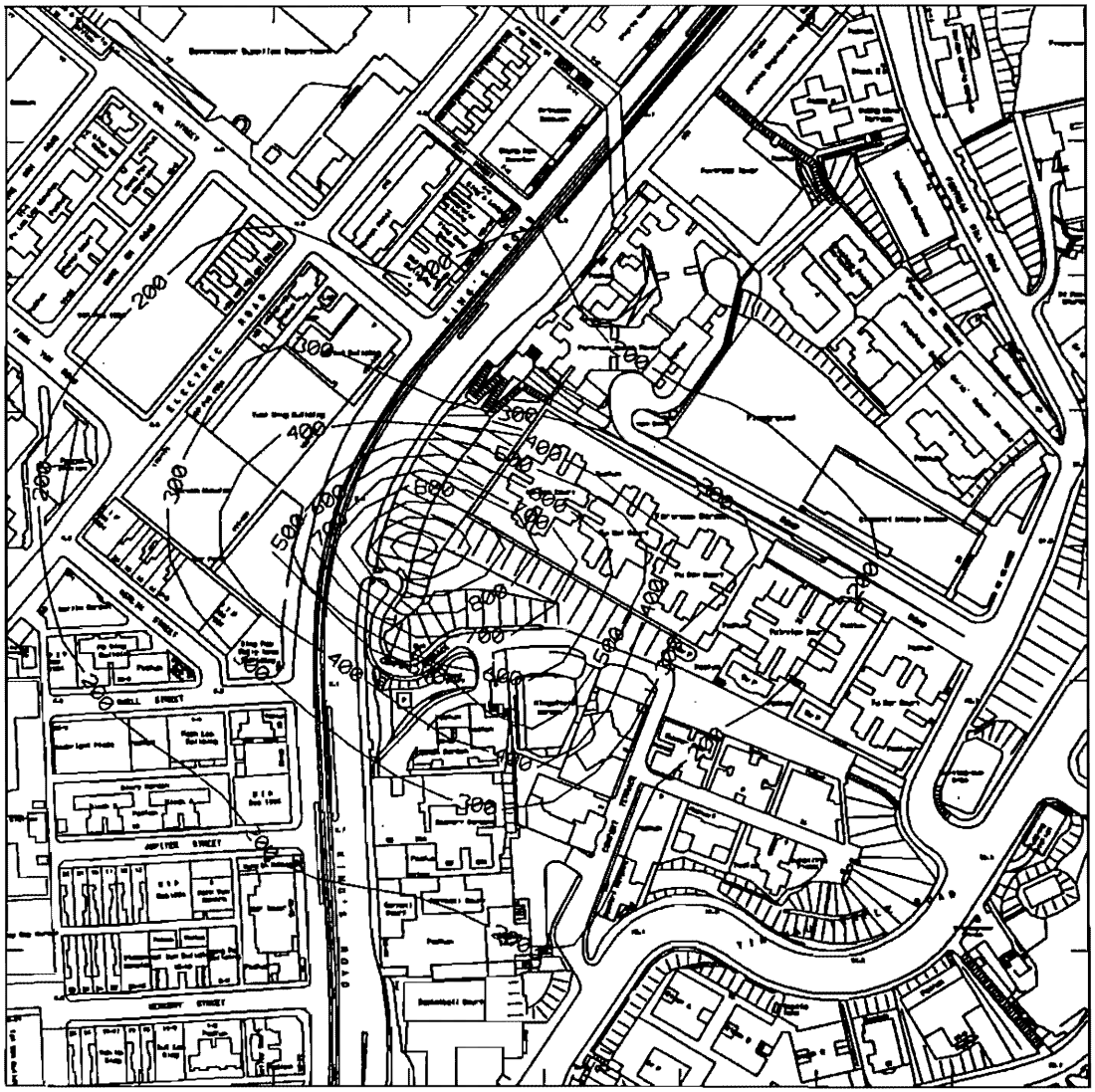
DATE: AUG 96

SCALE: 1 : 2800

FIGURE No. 2.4z

Maunsell



1 – hr averaged TSP concentrations (station) at Fortress Hill $\mu g\ m^{-3}$

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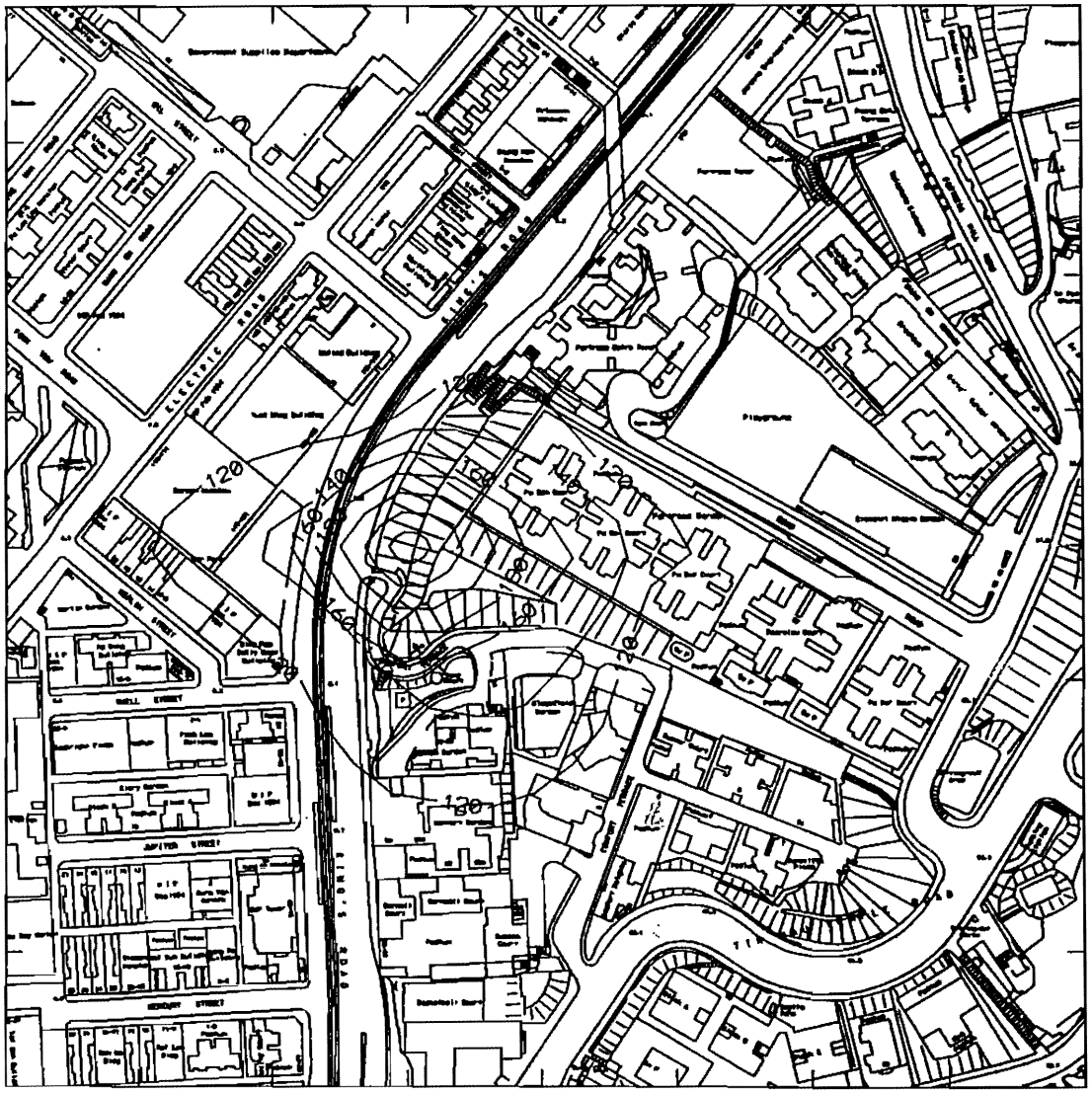
DATE: AUG 96

SCALE: 1 : 2800

FIGURE No. 2.4aa

Maunsell



24 – hr averaged TSP concentrations (station) at Fortress Hill $\mu g\ m^{-3}$

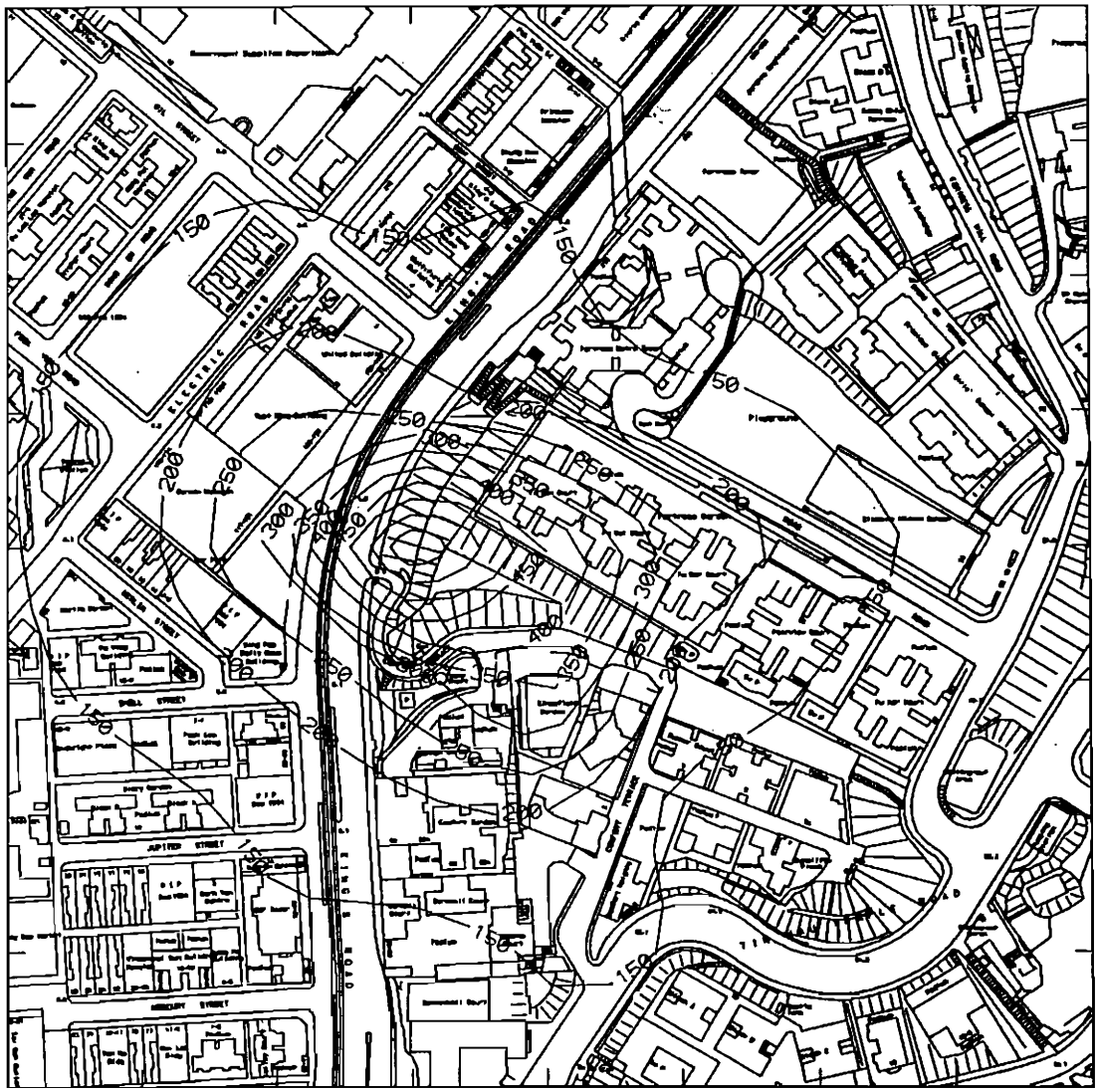
MAUNSELL CONSULTANTS ASIA LTD

DATE: AUG 98

SCALE: 1 : 2800

FIGURE No. 2.4bb

Maunsell



Mitigated 1 – hr averaged TSP concentrations (main tunnel) at Fortress Hill $\mu g\ m^{-3}$

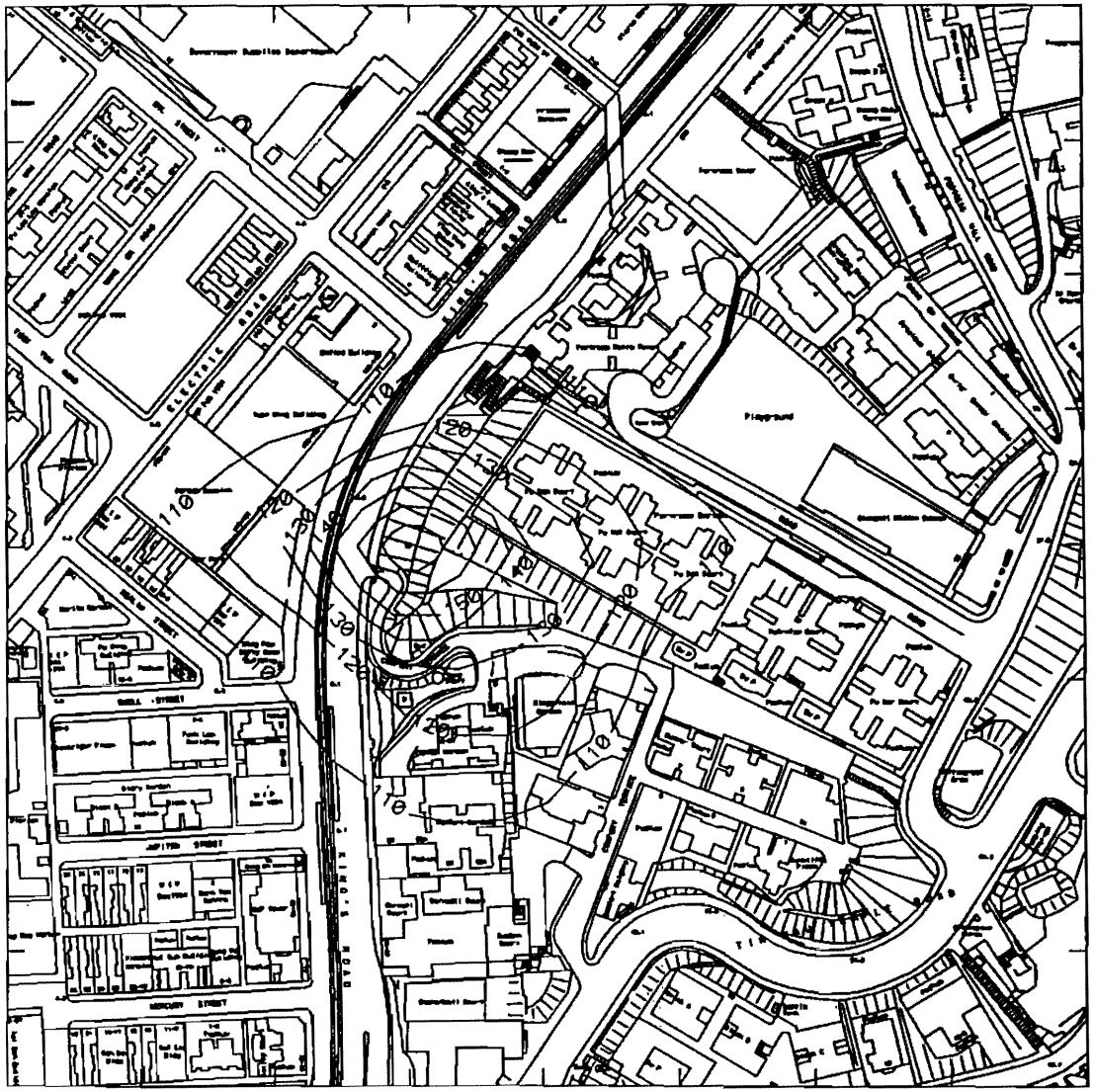
MAUNSELL CONSULTANTS ASIA LTD
茂盛工程顧問有限公司

DATE: AUG 96

SCALE: 1 : 2800

FIGURE No. 2.4cc

Maunsell



Mitigated 24 – hr averaged TSP concentrations (main tunnel) at Fortress Hill $\mu g\ m^{-3}$

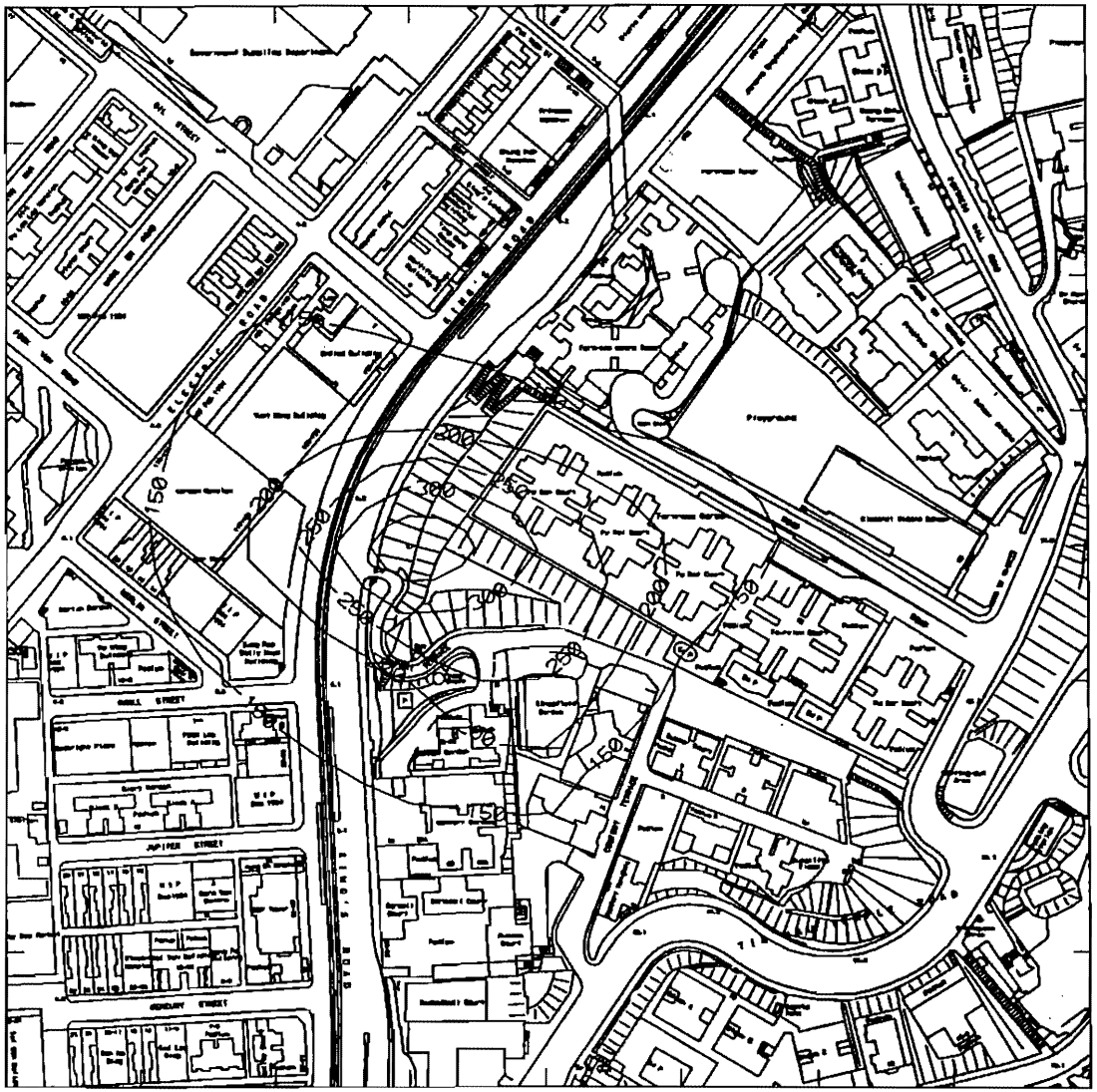
MAUNSELL CONSULTANTS ASIA LTD

DATE: AUG 96

SCALE: 1 : 2800

FIGURE No. 2.4dd

Maunsell



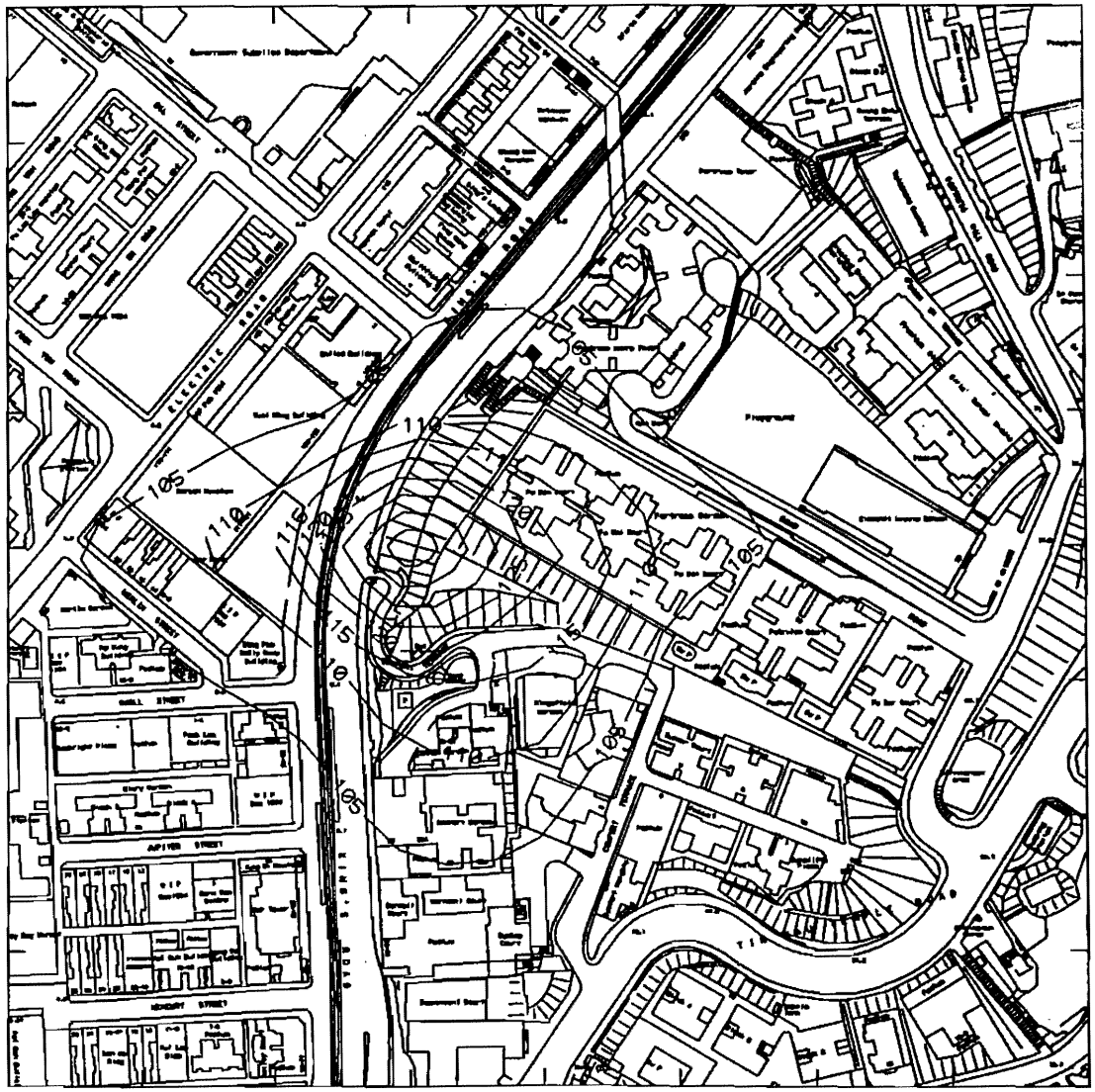
Mitigated 1 – hr averaged TSP concentrations (station) at Fortress Hill $\mu g\ m^{-3}$

MAUNSELL CONSULTANTS ASIA LTD

DATE: AUG 96

SCALE: 1 : 2800

FIGURE No. 2.4ee



Mitigated 24 – hr averaged TSP concentrations (station) at Fortress Hill $\mu g\ m^{-3}$

MAUNSELL CONSULTANTS ASIA LTD

DATE: AUG 96

SCALE: 1 : 2800

FIGURE No. 2.4ff

Maunsell

Annex B

Responses to Comments

Responses to Comments
Quarry Bay Relief Works
Additional Dust Impacts Supplementary Working Paper

No.	Department/Date	Reference	Comments	Consultants' Response
1	EPD/Alan Au 18 September 1996	N/A	I refer to your letter ref. C1365\42379\CONSULT dated 5.9.96. I have the following comments on the captioned report. <u>General Comments</u>	
		a)	The report should present full details of the parameters (such as emission rates, source height, down wind receptor height, wind angle etc) used in the modelling assessment so that we can evaluate the validity of the results.	The contour maps are produced from the same model files and have the same parameters as those quoted in the draft DEIA, thus the validity of the results is unchanged and it is only the form of presentation of the results which is new.
		b)	The maximum <u>unmitigated</u> 1-hour TSP level given in Table 2.1b is within 1-hour TSP guideline (ie at 5 m, 1-hour TSP level is 246 $\mu g/m^3$). However, the <u>mitigated</u> 1-hour TSP level at 50 m due to blasting in Table 2.4i of the Environmental Feasibility Report R8Q, February 1996 is 4738 $\mu g/m^3$, much greater than 1-hour TSP guideline level of 500 $\mu g/m^3$. Please explain for such great discrepancy in the modelling results.	The construction site locations, equipment and work methods have been considerably refined since the EFS, as described in the DEIA. In addition the inputs to the modelling recommended in US EPA - AP 42 have been revised downward in the 5th edition which has been used in the DEIA, whilst the 4th edition was used for the EFS.
		c)	The worst case wind speed is 1 m/s not 2 m/s (S.2.1.4). Air quality results should be presented for the worst case at direct downwind locations.	For blasting, the worst impacts were identified to arise with a wind speed of 2 m s^{-1} as noted in the Working Paper. For construction dust point source and contour calculations, real time met data was used as described in the DEIA.
		d)	Typical model input and output files and other details not explicitly presented in the report must be submitted for our review and reference.	These will be supplied immediately.

No.	Department/Date	Reference	Comments	Consultants' Response
		e)	The quality of contour maps need improvement. The pollutant concentrations given on the maps are not clear and units of concentrations should be sated. For clarify of presentation, the identified air sensitive receivers given in the Draft DEIA should be marked on the contour maps as appropriate.	It is accepted that the quality of the contour maps needs to be improved and this will be the case for the Final Report. Printing difficulties prevented this being achieved for the Working Paper which were issued as drafts given the urgency of the need to complete the Report. The units of concentration are $\mu g\ m^{-3}$ as used in the Working Paper and throughout this assessment. The ASRs will be included on the final version of the DEIA Figures.
		f)	Contour maps of dust impact due to site preparation at Quarry Bay are given in this assessment report. However, in the Draft DEIA, there is no assessment of dust impact due to site preparation at Quarry Bay. Please provide details of prediction of dust impact due to site preparation at Quarry Bay and give the predicted 1-hour average and 24-hour average TSP levels at the identified ASRs in Quarry Bay in the DEIA.	At the time of the DEIA, site preparation at Quarry Bay was not considered a dusty activity. Since then, the construction methodology has been revised and dusty activities will now occur during this phase. The results will be included in the revised Air Quality and Noise Sections of the draft DEIA, which will be submitted to the EPD for approval once the findings of the Working Paper have been agreed.
		<u>Specific Comments</u> a) S.2.1.3, p.1	Quantitative assessment of dust impact due to blasting is appropriate for this project. Therefore, the text should be amended accordingly.	The text of this section reflects the text of AP 42 and it is important that the caveat is retained accordingly.
		b) Table 2.1a, p.2	The Consultants should confirm if the assumed blast area is realistic assumption.	The Working Paper has already been reviewed and approved by the Client and their engineering consultants and all such details are correct.
		c) 1st sentence, 1st paragraph, p.3	Apparently, some lines are missing before "wide by 5 m long". Please check.	One line of text is missing and should read "The dust levels have been predicted based on blasting site dimensions of 5 m ..." replacement copies of page 3 will be supplied.

No.	Department/Date	Reference	Comments	Consultants' Response
		d) S.3, p.3	(i) As the work site NP in North Point is only recently added, details of assessment of dust impact arising from this work site together with details of modelling parameters should be provided. Also, the predicted 1-hour average and 24-hour average TSP levels at the identified ASRs in the North Point should be re-assessed. (ii) In the 4th sentence, based on the Draft DEIA, at unmitigated conditions, the predicted 1-hour TSP levels are also above the 1-hour TSP guideline level at ASRs near (i) North Point work sites during construction of access shaft and entrance, (ii) Fortress Hill work site during construction of main tunnel and North Point Station.	The impacts arising from the relocated and new construction sites (NP2 and NP) have been assessed and will be provided in addition to the contour maps which already include the cumulative impacts for the three sites' final locations. Whilst there are a number of exceedances of the criteria for unmitigated dust impacts, the standard mitigation measures described in the DEIA are sufficient to control these to within the established criteria at all ASRs as shown on the contour plots.

CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

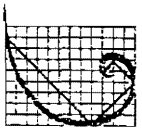
WORKING PAPER

Mass Transit Railway Corporation

Quarry Bay Relief Works :
Additional Dust Impact Assessment at Quarry Bay and North Point

16 October 1996

ERM-Hong Kong, Ltd
6/F Hecny Tower
9 Chatham Road, Tsimshatsui
Kowloon, Hong Kong
Telephone (852) 2722 9700
Facsimile (852) 2723 5660



ERM

WORKING PAPER

Mass Transit Railway Corporation

Quarry Bay Relief Works :
Additional Dust Impact Assessment at Quarry Bay and North Point

16 October 1996

Reference C1365

For and on behalf of ERM-Hong Kong, Ltd

Approved by: [signature]

Position: Deputy Managing Director

Date: 16 Oct. 1996.

CONTENTS:

1 INTRODUCTION

This Working Paper assesses the potential fugitive dust impacts associated with the relocation of Vent Shaft Site (NP2) at North Point and the excavation work required at Quarry Bay for the Quarry Bay Relief Works (QBR). The assessment is based on the study approach and methodology developed in the *Quarry Bay Extension: Detailed Environmental Impact Assessment*, however, due to the relocation of worksite of NP2, additional air sensitive receivers in the vicinity of the worksite have been identified.

2 CONSTRUCTION DUST IMPACT

2.1 ASSESSMENT METHODOLOGY

Potential cumulative dust levels from the construction works for the QBR were predicted with FDM at the identified ASRs in the vicinity of each worksite with parameters taken from the Compilation of Air Pollutant Emission Factors, 5th Edition, US Environmental Protection Agency, 1996, (US EPA - AP-42). Highest 1-Hour and 24-hour TSP Levels were predicted with real-time meterological data recorded at Tsim Sha Tsui Meteorological Station and compared for compliance with the recommended hourly limit of 500 $\mu g\ m^{-3}$ and the AQO of 260 $\mu g\ m^{-3}$ respectively. Details of the assessment methodology are presented in the *Quarry Bay Extension: Detailed Environmental Impact Assessment Report, Maunsell et al, July 1996.*

2.2 SENSITIVE RECEIVERS

Quarry Bay

Worksite QB1 will be located on the site of the existing petrol station at King's Road, as shown in *Figure 2.2a*. Existing residential uses on King's Road include the Beautiful City Building, Wah Shun Gardens, King's View Court, Wai Fong Court and King's House which are all identified as ASRs as is North Point Government School adjacent to the proposed worksite. The distances from the proposed worksite to the nearest ASRs are shown in *Table 2.2a* and the locations of the ASRs are shown in *Figure 2.2a.*

Table 2.2a ***Nearest ASRs in Quarry Bay***

Air Sensitive Receivers		Distance from Worksite (m)
AQ1.	Beautiful City Building	95
AQ2.	North Point Government School	20
AQ3.	Wah Shun Gardens	65
AQ4.	Ritz Garden Apartments 933-935 King's Road	95
AQ5.	King's View Court Block A	55
AQ6.	Bo Sun Court	30
AQ7.	963-2A King's Road	37
AQ8.	King' House	80

North Point

It is proposed that there will be three construction sites at North Point for the access shaft (NP1), the vent shaft (NP2) and the Kam Ping Street access adit (NP5) see *Figure 2.2b.* Vent shaft (NP2) which is originally proposed at the slope to the west of Block 1, Tanner Garden has been relocated to the slope to the north of Tanner Road. Similar to the previous proposed location, the overall area proposed for NP2 is large due to possible requirements for slope maintenance,

although the main working area will be limited to the mouth of vent shaft where spoil will be removed. Air sensitive receivers identified in the vicinity to these three worksites, which could be affected by cumulative impact, are residential uses at Shu Kuk Street, Tsat Tsz Mui Road and Tanner Road. The distances between the ASRs and the worksites are presented in *Table 2.2b*. The locations of the ASRs are shown in *Figure 2.2b*.

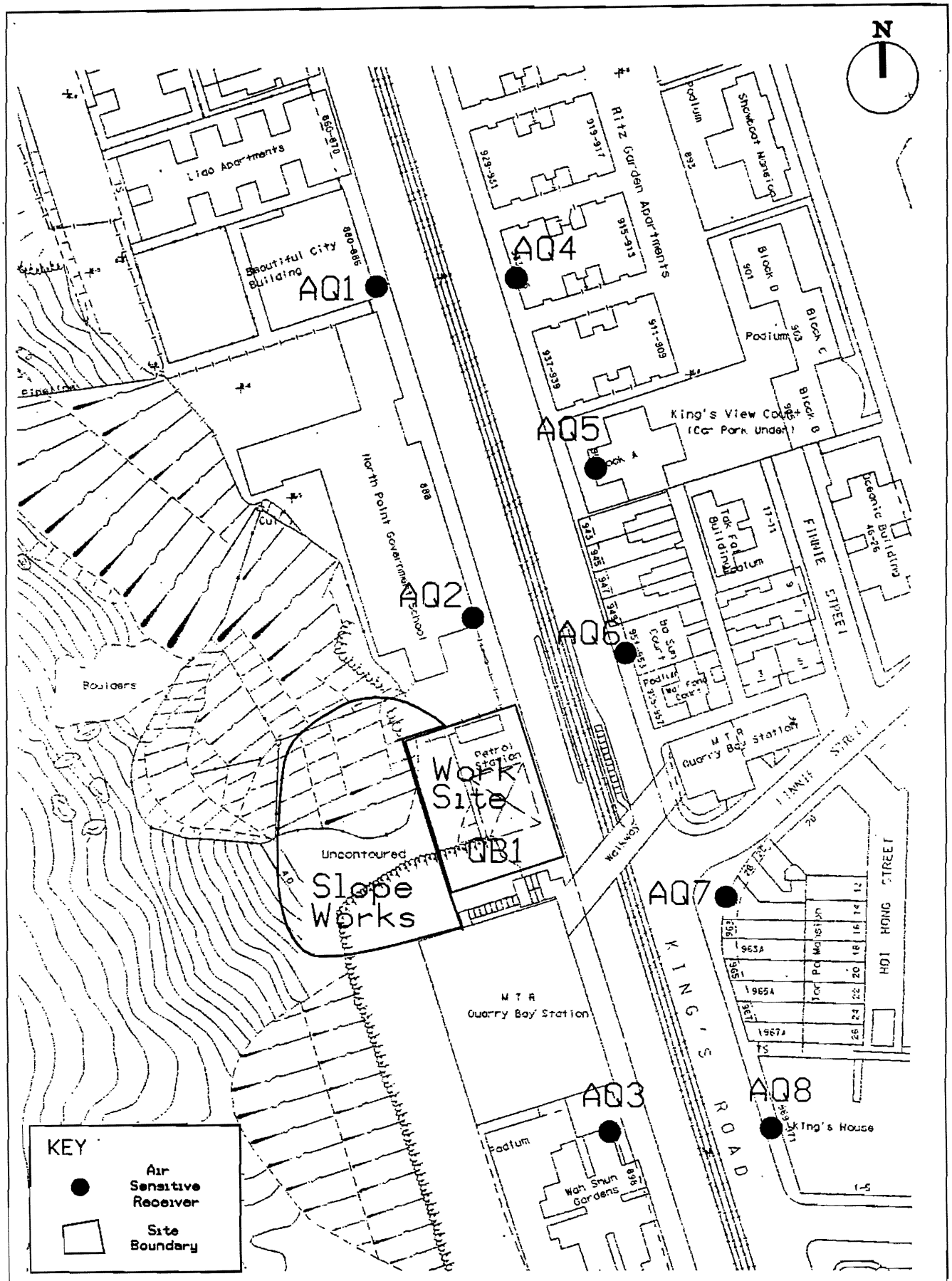
Table 2.2b *Nearest ASRs in North Point*

Air Sensitive Receivers		Distance from Worksites (m)		
		Access Shaft (NP1)	Vent Shaft (NP2)	Kam Ping Street access adit (NP5)
AN1	Maylun apartments	10	80	105
AN2	Tung Fat Building (north)	8	68	60
AN3	Kam Ping Mansion	65	90	3
AN4	Roca Centre	18	63	105
AN5	Fairview Court	25	40	100
AN6	Cheong Yuen Building	3	30	53
AN7	Pine Tree House (West)	28	30	20
AN8	Pine Tree House (East)	75	30	75
AN9	Tanner Garden Block 2	110	70	105
AN10	Tanner Garden Block 1 (West)	105	50	110
AN11	Kin Ming Court	115	63	130
AN12	Wealthy Court	80	25	85
AN13	Siu King Building	48	6	70
AN14	Tung Fat Building (south)	35	70	10
AN15	Pine Tree House (south)	60	45	32
AN16	Alice Court	35	10	70

2.3 POTENTIAL SOURCES OF IMPACT

Quarry Bay Section

QB1 worksite is located largely on flat land, and modification of the site is limited to demolition of the petrol station and the excavation of the area behind the petrol station at the base of the hill where some rock drilling, excavation and bolting will be required. The demolition works are considered to be a potential source of dust. However, dust emissions will be reduced by covering the petrol station with canvas and watering and, if such good practice measures are adopted, the demolition activities are unlikely to cause fugitive dust impacts to sensitive receivers. For rock drilling, it has been assumed that a wet drilling method will be employed and some fugitive dust is anticipated. In addition,



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ASR Locations in Quarry Bay

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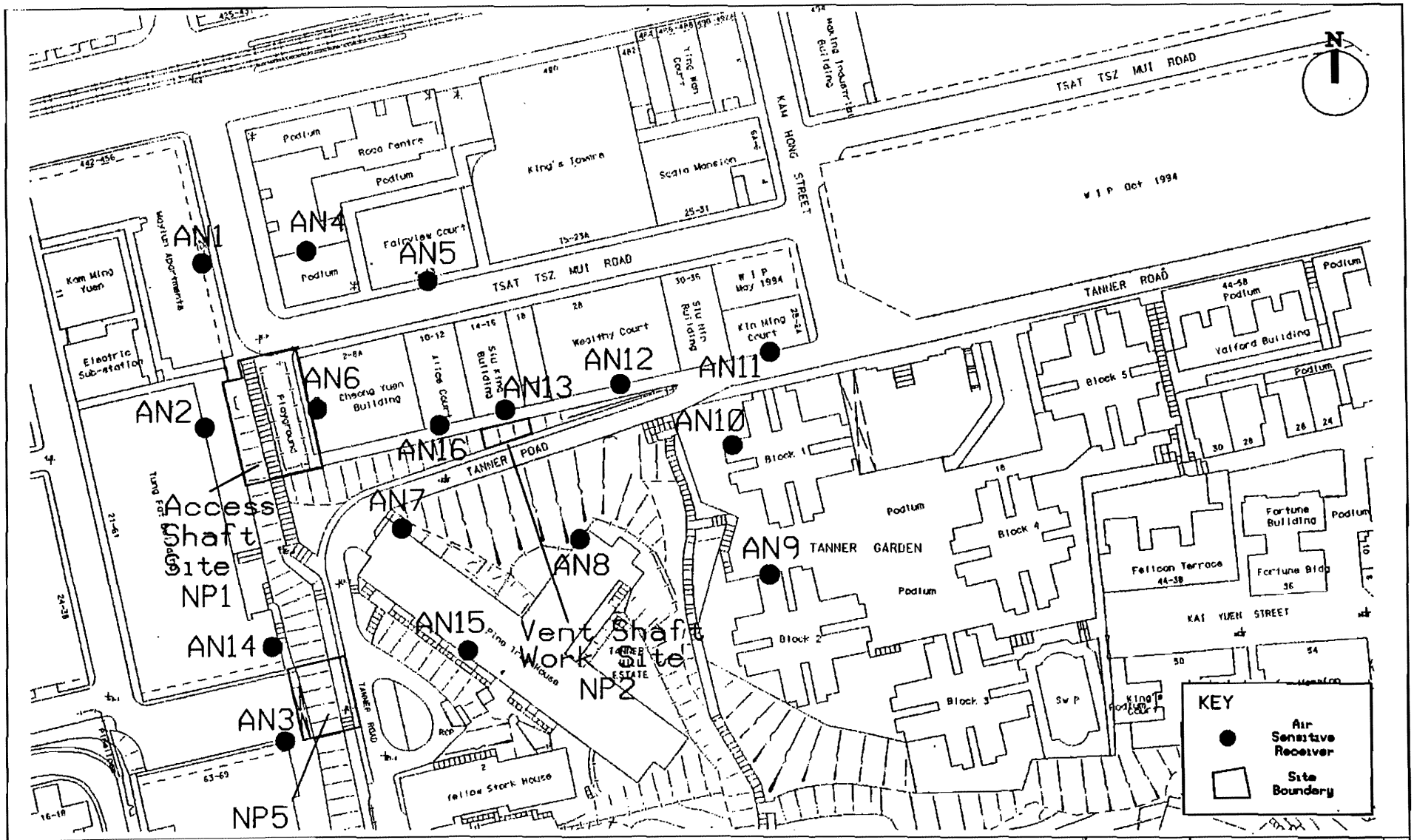
FIGURE No. 2.2a



ASR Locations in North Point

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DATE: OCT 96

SCALE: 1 : 1400

FIGURE No. 2.2b

dust impacts will also arise from the construction activities associated with removal of spoil from the work site. Lorries will be used for these construction activities. The amount of material handled for site preparation and the number of vehicles required are summarised in *Table 2.3a*.

Table 2.3a ***QB1 - Spoil Generation and Transportation***

Construction Activities	Spoil Quantity (m^3)	Maximum spoil removal capacity (m^3 day^{-1})	Number of Vehicles on site (veh hr^{-1})(1)
Site Preparation	10,000 rock 10,000 soil	140	4.90 lorries

Note (1) Number of lorries required estimated with assumptions of 12 working hours per day and capacity of 8 m^3, plus two concrete mixer lorries per hour.

North Point

There will be three worksites at North Point for the construction of an access shaft to the proposed station (NP1), a vent shaft (NP2) and access adit (NP5). The main works involved during the construction of these facilities are site clearance, piling, excavation, structures and reinstatement. Among these activities, most dust impacts are anticipated during the excavation works. The excavation works at all worksites will be undertaken inside noise enclosures. However, in assessing the maximum dust impact, the enclosure effect is not considered.

The main dust impacts arising from the construction activities are associated with the removal of spoil from the worksites. As for Quarry Bay, lorries will be used for spoil removal and concrete mixer lorries will also be required. The amount of material handled for each activity and the number of vehicles required are summarised in *Table 2.3b*.

Table 2.3b ***North Point Worksites - Spoil Generation and Transportation***

Construction Activities	Spoil Quantity (m^3)	Maximum spoil removal capacity (m^3 day^{-1})	Number of Vehicles onsite (veh hr^{-1})(1)
Access Shaft (NP1)	300 soft spoil 15,000 rock	300	8.25 lorries
Vent Shaft (NP2)	1000 soft spoil and rock	60	3.25 lorries
Work Site (NP5)	300 soft spoil 15,000 rock	300	8.25 lorries

Note (1) Number of lorries required estimated with assumptions of 12 working hours per day and capacity of 8 m^3, plus two concrete mixer lorries per hour.

The movement of the lorries within the access shaft and station entrance worksites may give rise to dust impacts. The work site for the vent shaft is adjacent to the paved Tanner Road and the work site area is limited, therefore, no dust impact is anticipated from vehicle movements.

2.4 PREDICTION OF IMPACTS

The 1-hour and 24-hour TSP levels arising from the construction work for the QBR at the ASRs at Quarry Bay and North Point, were predicted using the FDM under the worst case meterological condition and added to the background levels of 101 μg m^{-3}. The cumulative TSP levels from QB1 and from the three worksites (NP1, NP2, NP5) are presented in *Tables 2.4a* and *2.4b* respectively. It should be noted that the modelling results have excluded the positive effect of noise enclosures at all four sites, therefore, the dust levels at the ASRs should be lower than the predictions.

Table 2.4a ***Quarry Bay - Unmitigated TSP Concentrations arising from QB1 during Site Preparation (μg m^{-3})(1)***

ASRs		1-hour TSP Levels	24-hour TSP Levels
AQ1.	Beautiful City Building	104	101
AQ2.	North Point Government School	105	102
AQ3.	Wah Shun Gardens	105	101
AQ4.	Ritz Garden Apartments located at 933-935	103	101
AQ5.	King's View Court Block A	103	101
AQ6.	Bo Sun Court	105	102
AQ7.	963-2A King's Road	105	101
AQ8.	King' House	103	101

Note (1) Background TSP level of 101 μg m^{-3} is included.

Table 2.4b ***North Point - Unmitigated TSP Concentrations arising from NP1, NP2 and NP5 (μg m^{-3})(1)***

ASRs		Concentration	
		1-hour TSP levels	24-hour TSP levels
AN1	Maylun Apartments	827	126
AN2	Tung Fat Building	545	145
AN3	Kam Ping Mansion	509	188
AN4	Roca Centre	445	153
AN5	Fairview Court	426	129
AN6	Cheong Yuen Building	575	150
AN7	Pine Tree House (West)	263	129
AN8	Pine Tree House (East)	226	113
AN9	Tanner Garden Block 2	166	111
AN10	Tanner Garden Block1	165	107
AN11	Kin Ming Court	160	106
AN12	Wealthy Court	221	110
AN13	Siu King Building	193	115
AN14	Tung Fat Building (south)	487	143
AN15	Pine Tree House (south)	369	159
AN16	Alice Court	234	114

Note (1) Background TSP level of 101 μg m^{-3} is included.

Quarry Bay

The predicted, unmitigated worst case, 1-hour and 24-hour TSP levels at the ASRs in the Quarry Bay area during the site preparation are shown *Table 2.4a*. The cumulative 1-hour TSP is predicted to be highest at North Point Government School, which is 105 $\mu g\ m^{-3}$. As indicated from the modelling results, the 1-hour and 24-hour TSP levels are all below the EPD's criteria and the AQO, implying no adverse dust impacts are anticipated at the ASRs close to the worksites during the site preparation with wet drilling method. The predicted 1-hour and 24-hour TSP concentrations during the site preparation are presented in *Figures 2.4a* and *2.4b* showing similar results.

North Point

The predicted 1-hour and 24-hour TSP levels arising from the construction activities within each of the three proposed worksites are presented in *Table 2.4b*. The predicted 24-hour TSP levels are within the AQO at all the identified ASRs. However, the predicted 1-hour TSP levels exceed the EPD's recommended criteria at Maylun Apartments (AN1), Tung Fat Building (AN2), Kam Ping Building (AN3) and Cheong Yuen Building (AN6). These ASRs are located in the close proximity to worksites NP1 and NP5, and appropriate mitigation measures are necessary to control the dust impact.

With the limited works area for NP2 and the nearby paved Tanner Road, no unpaved haul road movements are anticipated. The main construction activity at NP2 will be limited to spoil removal at the mouth of vent shaft. The predicted 1-hour and 24-hour TSP levels at the ASRs close to NP2, including Wealthy Court (AN12), Siu King Building (AN13) and Alice Court (AN16) are well within the EPD's recommended criteria and the AQO.

The predicted 1-hour and 24-hour TSP concentrations during the construction period are also presented in contour format in *Figures 2.4c* and *2.4d*. The 1-hour and 24-hour TSP contours show similar results with modelling at discrete receivers. Fugitive dust impacts are anticipated at ASRs close to NP1 and predicted 1-hour TSP levels exceeded 500 $\mu g\ m^{-3}$ at some ASRs whilst the 24-hour TSP levels are within the AQO of 260 $\mu g\ m^{-3}$ throughout the North Point area.

As indicated from the modelling results, the main dust sources are identified to be NP1 and NP5 where a number of ASRs in close proximity will be subject to dust impacts in exceedance of the EPD's 1-hour criteria. Therefore, dust control measures are necessary and should aim to reduce the dust emission from these sources to meet the 1-hour TSP criteria.

Mitigation Measures

As described in the previous section, unmitigated construction works are likely to cause exceedances of the 1-hour TSP criteria at a number of the sensitive receivers around the worksites at North Point. Effective control measures are required to control TSP levels arising from the works to within the established criteria. Typical dust control measures for material handling and vehicle movements are recommended in the QBE DEIA Report. It has been assumed,

based on AP-42, that there will be 70% reduction of in dust generation from vehicle activity within active site areas through:

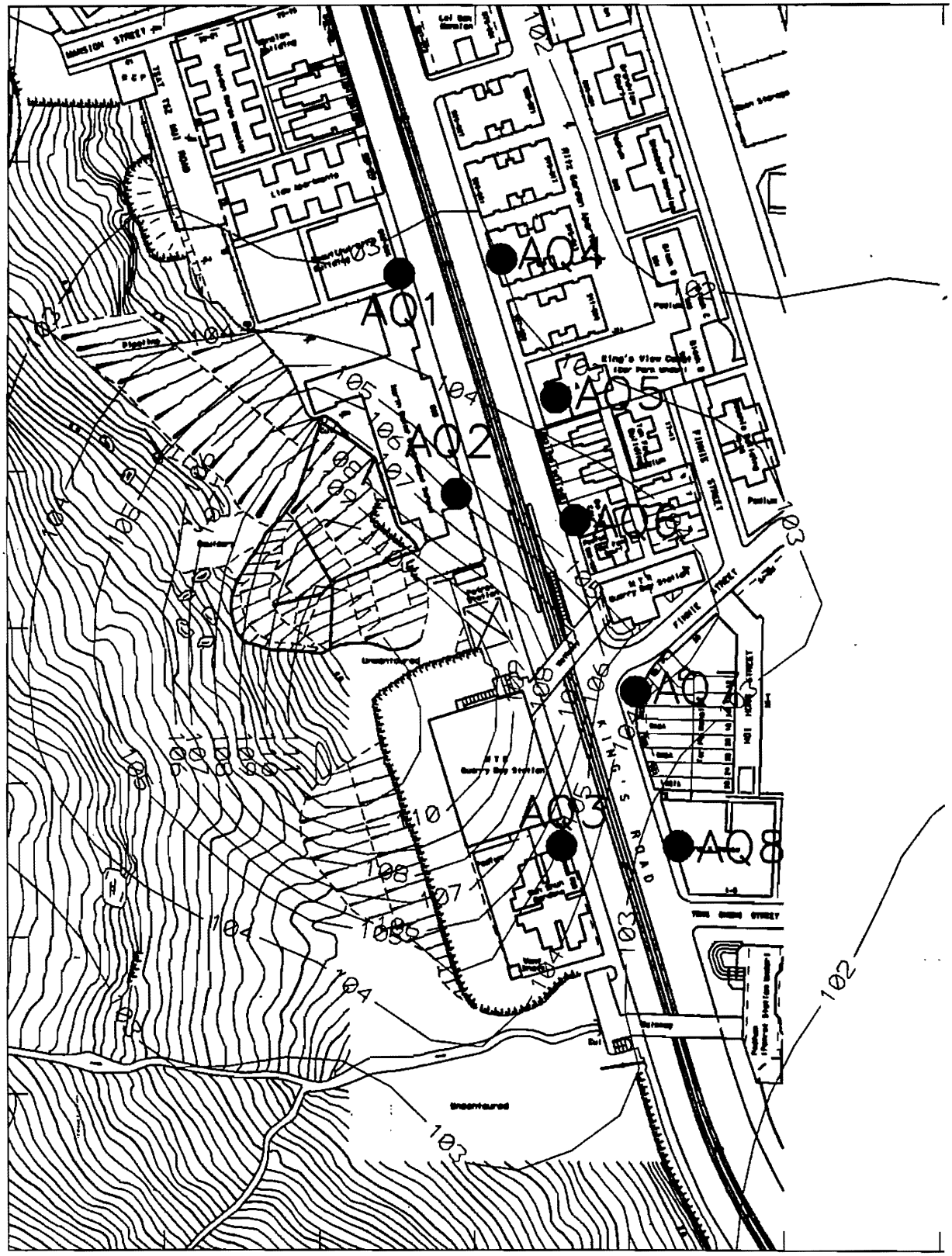
- 50% reduction from frequent surface watering and compacting on active areas on the site; and
- 60% reduction in dust emission potential from vehicle movements on site by restricting maximum speeds to 15 kph.

On the basis of this assumed dust suppression, the dust impacts were revised and the results are shown in *Table 2.5a* and *Figure 2.5a*. The ambient dust levels arising from general construction activities at North Point, can be reduced such that the hourly TSP levels are below the EPD's recommended level of 500 μg m^{-3} at all the identified ASRs.

Table 2.5a ***North Point - Mitigated 1-hour TSP Concentrations (μg m^{-3})(1)***

ASRs		Worksites NP1, NP2 & NP5
AN1	Maylun apartments	305
AN2	Tung Fat Building	228
AN3	Kam Ping Mansion	215
AN4	Roca Centre	202
AN5	Fairview Court	194
AN6	Cheong Yuen Building	235
AN7	Pine Tree House (West)	148
AN8	Pine Tree House (East)	136
AN9	Tanner Garden Block 2	119
AN10	Tanner Garden Block1	122
AN11	Kin Ming Court	118
AN12	Wealthy Court	135
AN13	Siu King Building	129
AN14	Tung Fat Building (south)	209
AN15	Pine Tree House (south)	176
AN16	Alice Court	139

Note (1) Background TSP level of 101 μg m^{-3} is included.



1 – hr averaged TSP concentrations (site preparation) at Quarry Bay in $\mu g\ m^{-3}$

MAUNSELL CONSULTANTS ASIA LTD 茂盛工程顧問有限公司	
DATE: AUG 96	FIGURE No. 2.4a
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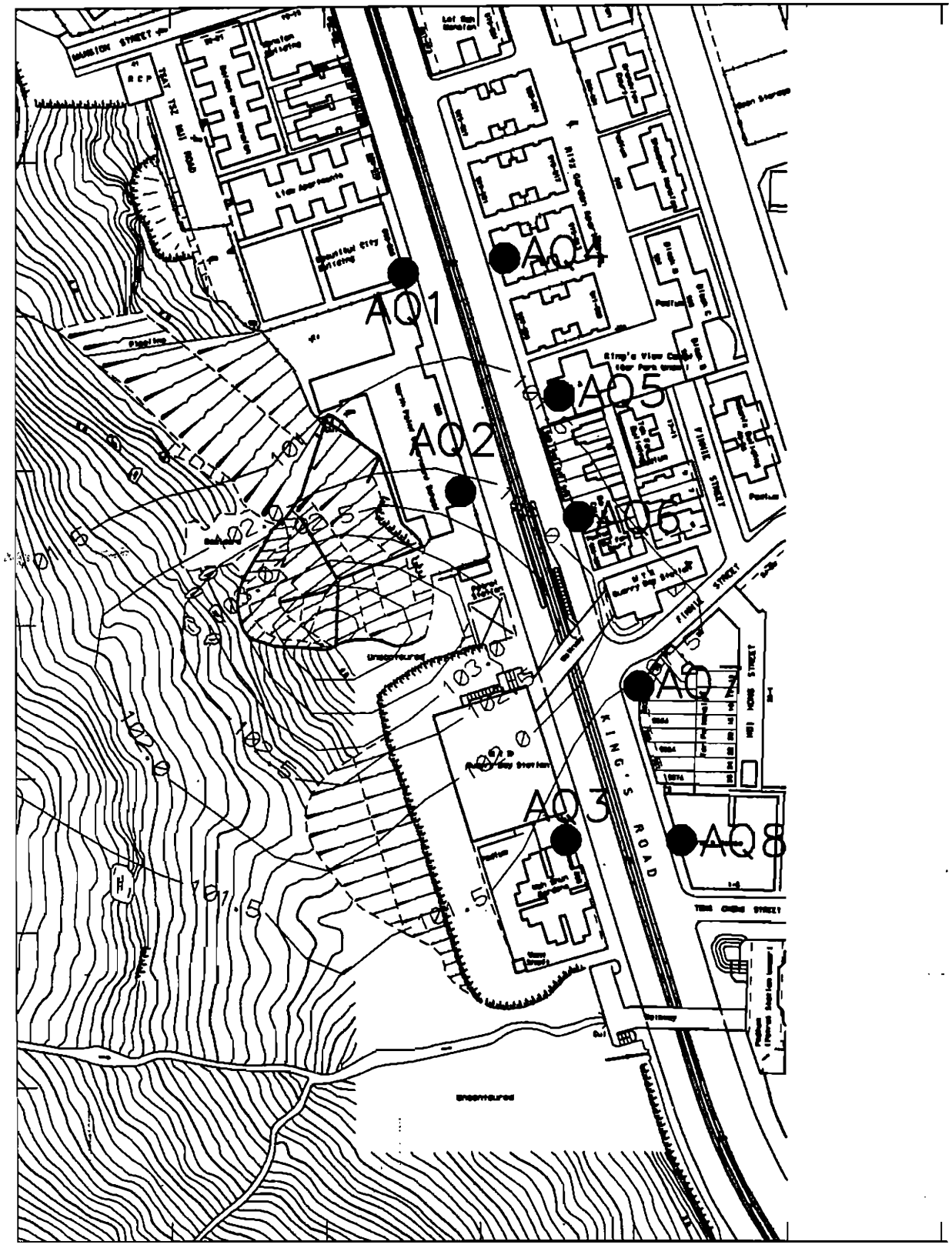

24 – hr averaged TSP concentrations (site preparation) at Quarry Bay in $\mu g\ m^{-3}$

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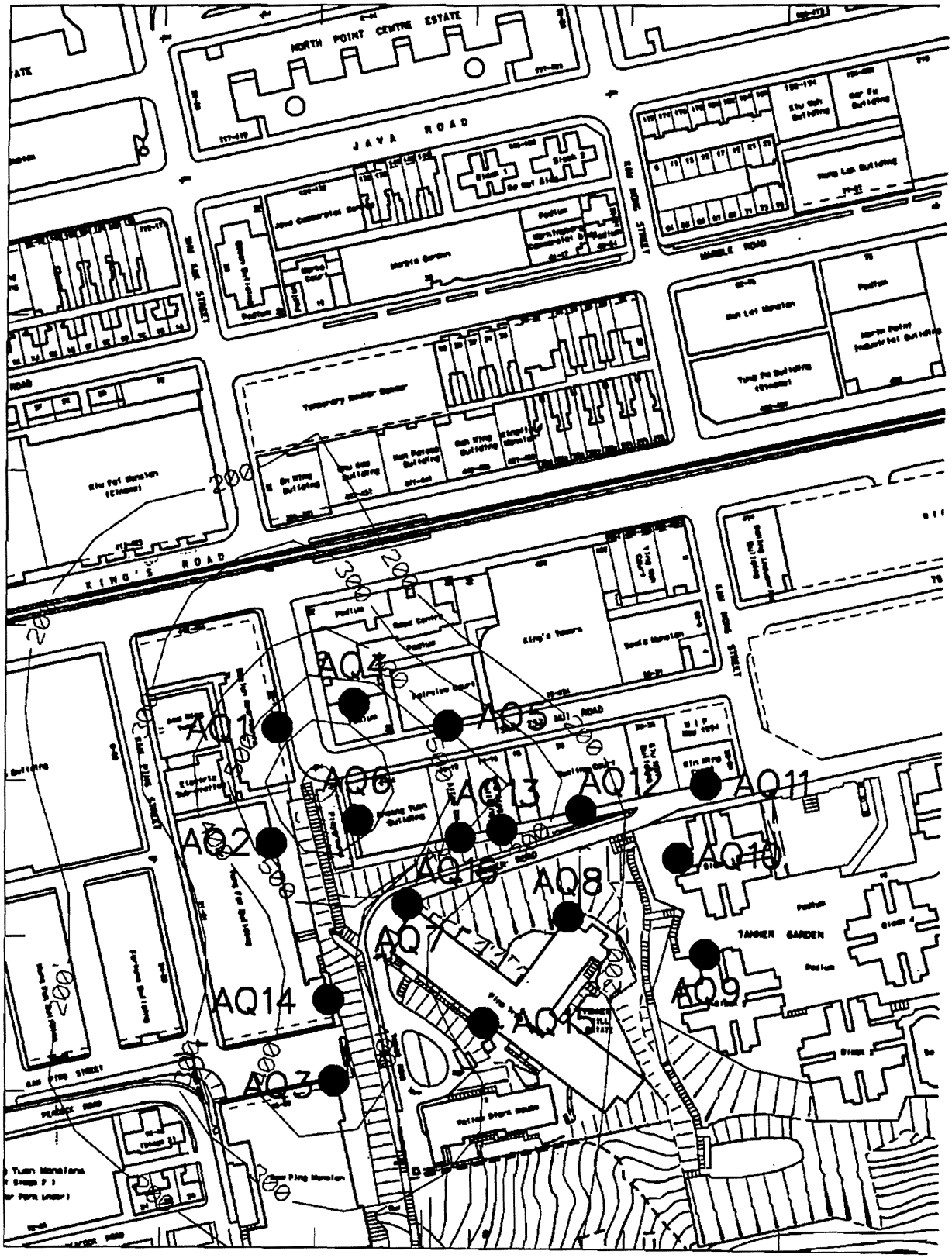
FIGURE No. 2.4b



1 – hr averaged TSP concentrations at North Point in $\mu g\ m^{-3}$

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茂盛工程顧問有限公司

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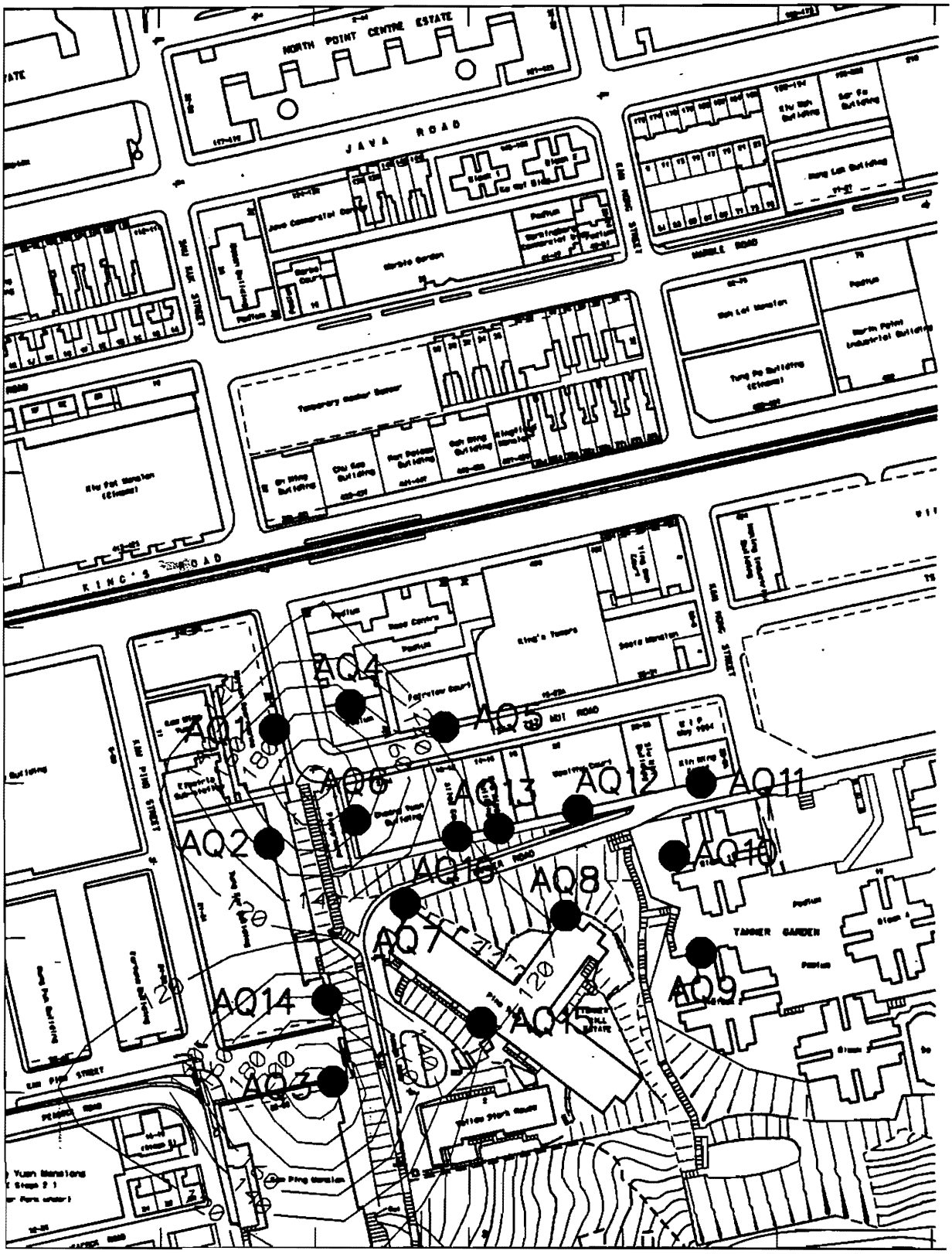

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24 – hr averaged TSP concentrations at North Point in $\mu g\ m^{-3}$

DATE: AUG 96	FIGURE No. 2.4d
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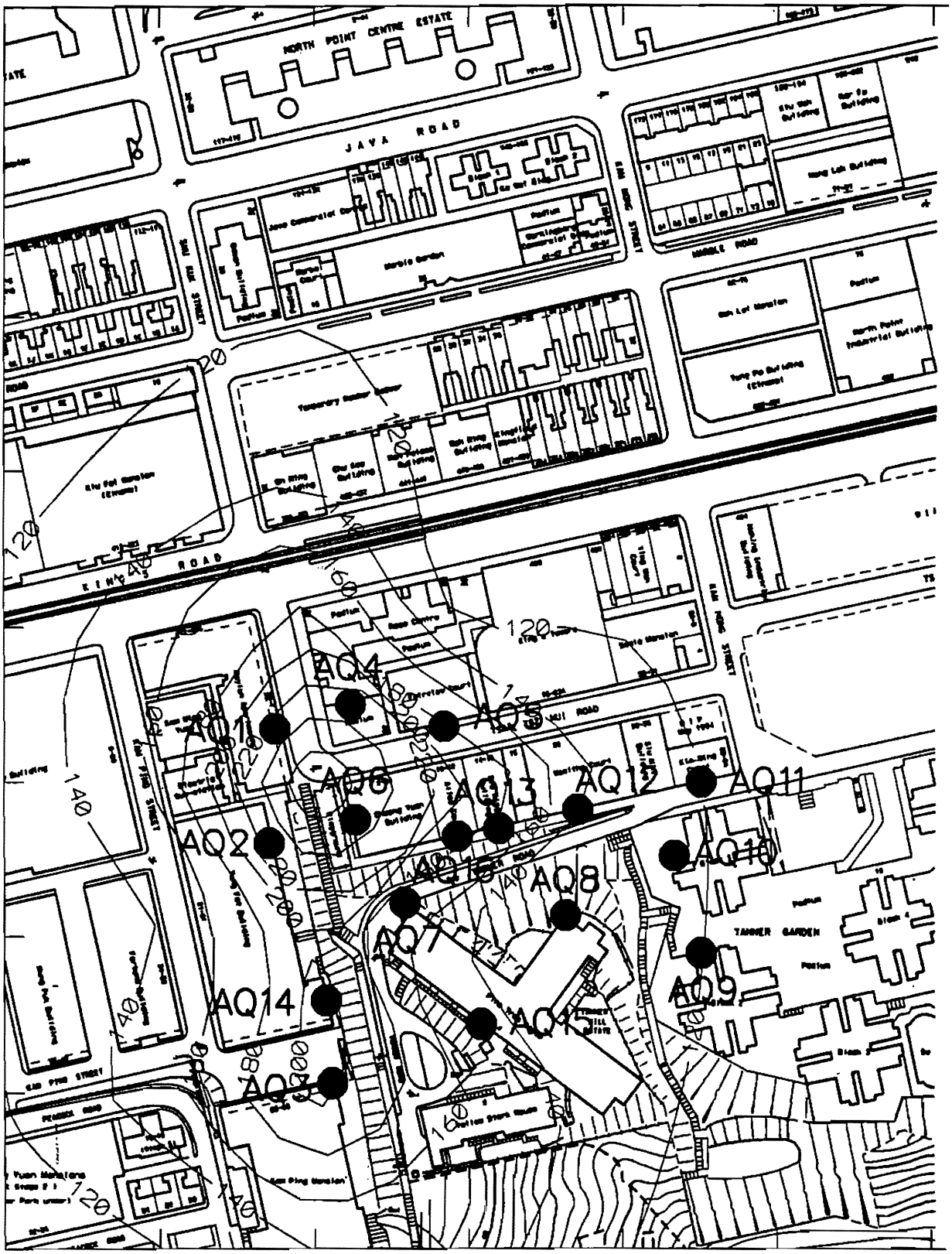


Mitigated 1 – hr averaged TSP concentrations at North Point in $\mu g\ m^{-3}$

MAUNSELL CONSULTANTS ASIA LTD

DATE: AUG 96	FIGURE No. 2.5a
SCALE: 1 : 1000	

3 CONCLUSIONS

A worst case assessment has indicated that the 1-hour and 24-hour TSP levels arising from site preparation at QB1 are all below the EPD's 1-hour criteria and the 24-hour AQO and no adverse dust impacts are anticipated at the ASRs close to the worksites during the site preparation with wet drilling method. Additionally, the modelling shows that there will be no adverse dust impacts from the relocation of NP2. However, dust impacts are predicted for the construction of the access shaft at NP1 and Kam Ping Street adit at NP5, which involve large amounts of spoil and dust mitigation measures will be necessary to meet the 1-hour TSP criteria. Mitigation measures such as frequent watering of the sites is recommended.

Annex A

Responses to Comments

Quarry Bay Relief Works DEIA
Response to Comments
Additional Dust Impact Assessment at Quarry Bay and North Point

No.	Department	Reference	Comments	Consultants' Response
1	EPD/Alan Y L Au 7 November 96	Ref C1365\44557\CONSULT C1365\45515\CONSULT	In your responses to comments enclosed in your above fax, there was no explanation of the change of emission factor. Please clarify. You may like to contact our Mr Y H Law of Air Policy Group (tel: 2594 6318) to explain the details.	The emission factor for blasting was taken from the 4th edition of AP-42, this has now been updated and the emission factor in the supplementary Working Paper to the DEIA was taken fro the 5th edition of AP-42.
		General Comments	Please confirm if the dust assessment in the Working Paper will replace that given in Draft DEIA.	The final version of the DEIA Report will contain the findings of the supplementary Working Papers.
			Please confirm if site preparation work in Quarry Bay will take place with the construction activities identified in Draft DEIA simultaneously. If it is so, cumulative TSP impacts due to the construction activities should be predicted.	Site preparation is a separate activity, there will be no cumulative impacts with other construction activities.
			Whilst reference is made to the Draft DEIA, please indicate the following information in the current Working Paper for additional dust impact assessment in Quarry Bay and North Point: i) the source of the emission factors (ie relevant sections of AP-42). ii) the parameters assumed (such as construction areas, haul road length travelled by vehicles, amount of material handled and vehicle speed etc.). iii) the emission factors derived based on the above. iv) particle dust size categories. v) meteorological data. vi) model files for each of the study areas.	Unless specified otherwise in the Working Papers, the emission factors and dust size categories are as specified in the Technical Annex to the DEIA. The parameters and meteorological data are contained in the model files. Please note that Table B1.3d in the Technical Annex should read as follows: Dust Particle Size — Portion of Emission Rate 0-2.5 — 0.119 2.5-5.0 — 0.131 5.0-10.0 — 0.200 10.0-15.0 — 0.175 15.0-30.0 — 0.375

No.	Department	Reference	Comments	Consultants' Response
		Specific Comments Tables 2.3a, 2.3b	i) Please confirm if the number of vehicles required has been accepted by Site Engineer. Also, it seems that as maximum spoil removal capacity is greater, then the number of vehicles required for spoil removal will also be greater. However, based on the data in the tables, such assumption may not be appropriate in this case. Please clarify. ii) There is a typing error in each of the tables. The unit of volume is m^3, not m^{-3}.	All TKE/QBR environmental reports have been reviewed and approved by both the engineering consultants and the client before issue. The ratio between spoil removal capacity and the predicted number of lorries varies between sites and sufficient vehicular capacity has been included. The unit of volume will be amended as advised.
		Table 2.4c	For completeness, please also predict mitigated 24-hour average TSP concentrations and produce 24-hour TSP level contours.	As the unmitigated levels for 24-hour TSP at North Point and 1-hour and 24-hour TSP at Quarry Bay were all well within the AQO criteria, mitigation was not necessary and therefore not modelled.
		Figures 2.4c, 2.4d	The air sensitive receives' designation should be in the form 'ANX', where X stands for 1---14.	The ASRs are numbered AQ1-8 for Quarry Bay and AN1-16 for North Point.

Facsimile message

C1365/RTC/44557
16 April 1997

Response to Comments
Quarry Bay Relief Works DEIA

No.	Department	Reference	Comments	Consultants' Response
1	EPD/Alan Au/ 3 October 1996	(36) in An(5) to EP1/G/72 V	Response to General Comments (a) and (b) As the air quality assessment is strongly related to the emission level, it is important to present all the assumptions used in deriving the emission rates. In particular, the number of blast per hour or per day should be stated. Furthermore, for assessing the dust impact due to blasting, please provide details to support the change of emission factors. Please note that details of blasting have not been given in the DEIA.	The modelling parameters are provided on the model files which have been sent as requested. The blasting emission rate is based on one blast at a site in any one hour and a blasting area of 5 m x 5 m, these factors will be clearly stated in the Final Report which will incorporate the finding of the Working Papers.
			Response to General Comments (d) Sample files of air quality assessment of blasting impact are still outstanding.	Samples files have now been provided.
			Response to Specific Comments (a) According to Section 13.2.3 of AP-42, it is the blasting factor in Table 11.24-1, -2 which is not considered appropriate for general construction activities. Since an alternative emission factor for blasting as given in Table 11.9-1 has instead been used, the report should make this clear and avoid giving the impression that either the emission factor or the quantitative assessment is not appropriate.	The emission factor provided in Table 11.9-1 of AP-42 has ben used in the Working Paper as it is the most appropriate for this assessment. This will be clearly sated in the Final Report and the reference to tis unsuitability for general construction activities will be deleted to avoid confusion.

WORKING PAPER

CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

Mass Transit Railway Corporation

Quarry Bay Relief Works : *Detailed EIA for Additional Worksite at Pak Fuk Road*

20 March 1997

ERM-Hong Kong, Ltd
6/F Hecny Tower
9 Chatham Road, Tsimshatsui
Kowloon, Hong Kong
Telephone (852) 2722 9700
Facsimile (852) 2723 5660

ERM

WORKING PAPER

Mass Transit Railway Corporation

Quarry Bay Relief Works : *Detailed EIA for Additional Worksite at Pak Fuk Road*

20 March 1997

Reference C1365 / 53941

For and on behalf of ERM-Hong Kong, Ltd

Approved by: S.M. Laister

Signed:

Position: Dep. Managing Director

Date: 20th March 1997

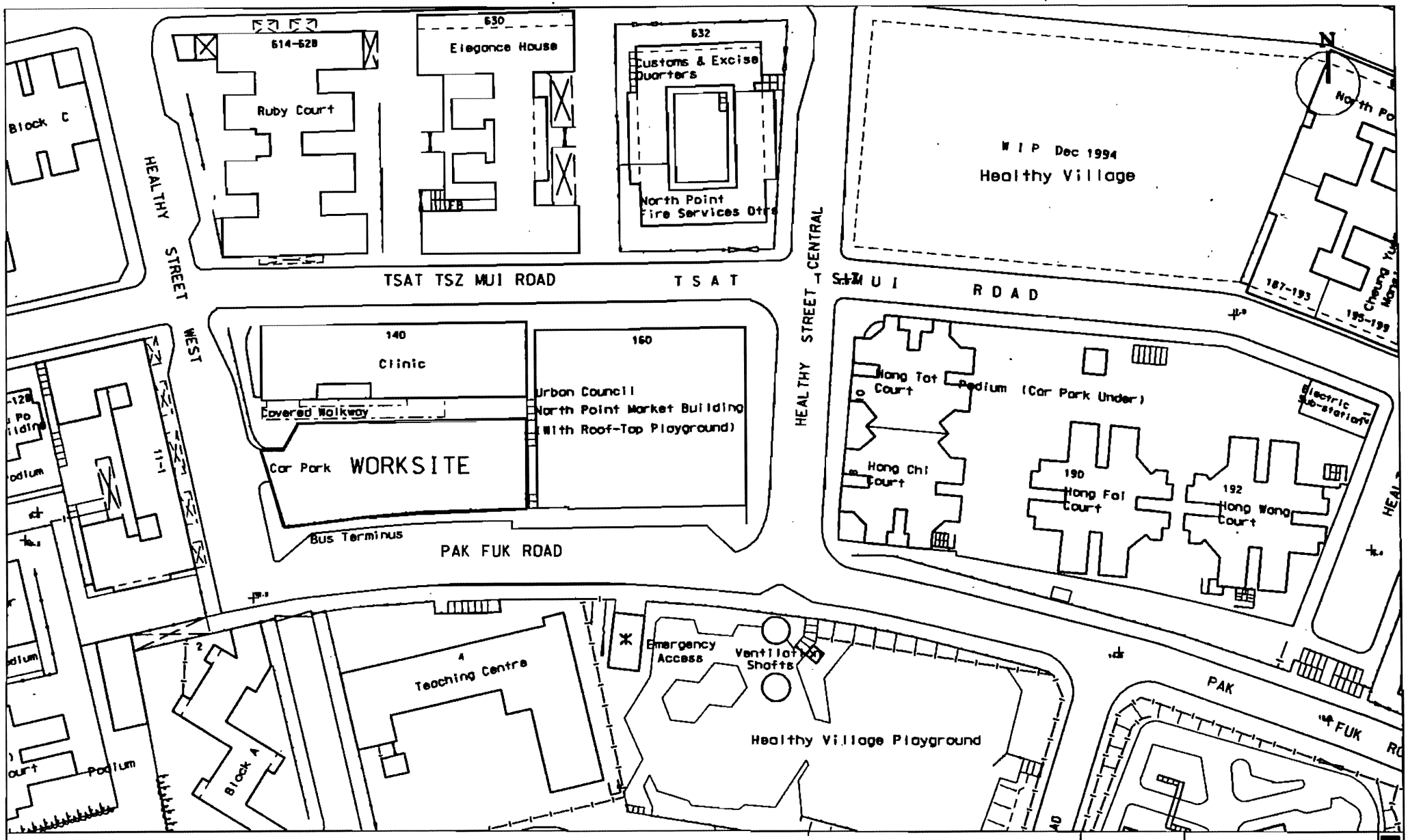
CONTENTS:

1 INTRODUCTION

1.1 THE SITE

An additional work site for the Quarry Bay Relief Works (QBR) is proposed at Pak Fuk Road. The site is currently used as a car park (see *Figure 1.1a*). Upon completion of the works, the site will be returned to it previous use as a car park and no operational facilities are proposed, therefore, no operational environmental impacts are anticipated.

Construction works at the proposed site will include excavation of the abandoned shaft created during the construction of the MTR Island Line (ISL) and, by driving an adit from the bottom of the shaft, gain underground access for construction of the North Point (NOP) tunnels and station. The main construction activities will be removal of excavated materials and deliveries of concrete at the proposed site. This Working Paper focuses on the potential environmental impacts including air, noise, water, waste and visual impacts associated with these construction activities at the proposed work site. The assessment is based on the study approach and methodology developed in the *Quarry Bay Extension: Detailed Environmental Impact Assessment*.



LOCATIONS OF PROPOSED WORKSITE &
THE SURROUNDING ENVIRONMENT

MAUNSELL CONSULTANTS ASIA LTD
茂盛工程顧問有限公司

DATE: JAN 97	FIGURE No. 1.1a
SCALE: 1 : 1000	

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2 AIR QUALITY

2.1 INTRODUCTION

This Section addresses the air quality impacts associated with the proposed Pak Fuk Road work site. The proposed work site will be used for the removal of excavated material from the NOP tunnels and station during the construction stage of the QBR. The main air quality impacts will be from fugitive dust from materials handling and earth moving activities. Impacts from the exhaust emissions of construction plant should be limited due to the relatively small numbers of plant involved within the construction sites and need not be addressed in this Study. After the completion of the construction work, the proposed site will be returned to its previous use as a car park, no adverse air quality impacts are anticipated during the operation phase of the QBR.

2.2 LEGISLATION AND STANDARDS

The principal legislation for the management of air quality is the *Air Pollution Control Ordinance* (APCO) (Cap 311). The whole of the Hong Kong Territory is covered by the *Hong Kong Air Quality Objectives* (AQOs) which stipulate the statutory limits for air pollutants and the maximum allowable numbers of exceedances over specific periods. The AQOs are shown in *Table 2.2a*.

Table 2.2a *Hong Kong Air Quality Objectives ($\mu g\ m^{-3}$)*[(i)]

Pollutant	Averaging Time				
	1 Hour [(ii)]	8 Hours [(iii)]	24 Hours [(iii)]	3 Months [(iv)]	1 Year [(iv)]
Total Suspended Particulates (TSP)	-	-	260	-	80
Respirable Suspended Particulates [(v)] (RSP)	-	-	180	-	55
Sulphur Dioxide (SO_2)	800	-	350	-	80
Nitrogen Dioxide (NO_2)	300	-	150	-	80
Carbon Monoxide (CO)	30,000	10,000	-	-	-
Lead	-	-	-	1.5	-

Note:
(i) Measured at 298 K (25°C) and 101.325 kPa (one atmosphere).
(ii) Not to be exceeded more than three times per year.
(iii) Not to be exceeded more than once per year.
(iv) Arithmetic means.
(v) Respirable suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 10 micrometres and smaller.

There is no AQO for hourly total suspended particulates (TSP) but it is generally accepted that an hourly average TSP concentration of 500 $\mu g\ m^{-3}$ should not be exceeded at ASRs. Such a control limit has no statutory basis but has been applied to a number of construction projects in Hong Kong in the form of contractual clauses. Therefore, this hourly TSP criteria is also considered in this Study.

The *Air Pollution Control (Open Burning) Regulation*, made under the APCO, prohibits open burning for the purposes *inter alia* of the disposal of construction waste or the clearance of a site in preparation for construction works.

2.3 BASELINE CONDITIONS

In the North Point and Quarry Bay area, the existing traffic on King's Road and the Island Eastern Corridor is the main source of air quality impacts with an annual averaged daily traffic flow of over 40,000 on King's Road. There is also a small industrial presence in North Point, however, these are mainly light industrial premises and the contribution to the overall background air quality is limited.

2.4 AIR SENSITIVE RECEIVERS

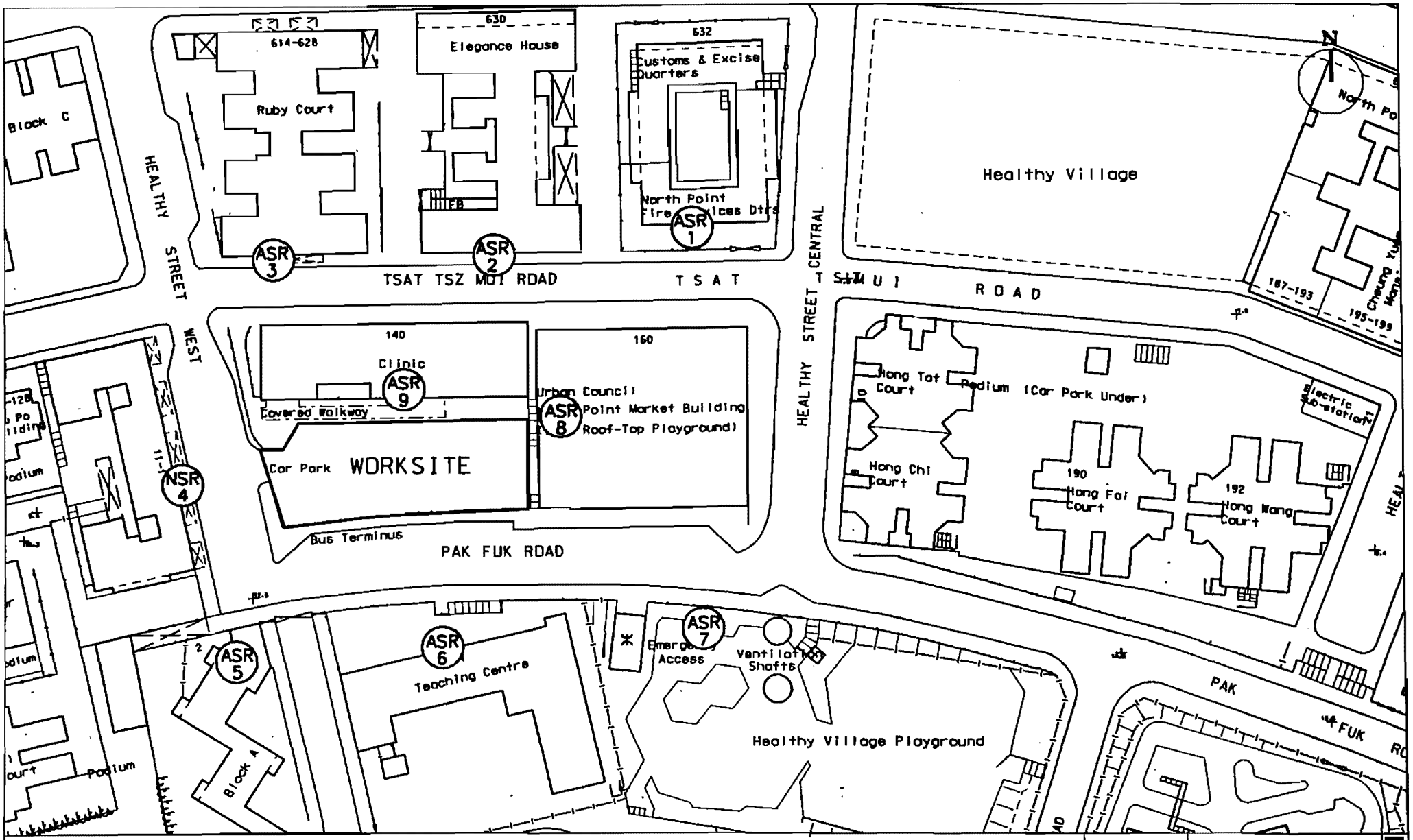
The proposed work site will be located on the site of the existing car park at Pak Fuk Road, as shown in *Figure 2.4a*. The access point for the excavation works will be located at the western boundary of the proposed work site. In accordance with the *Hong Kong Planning Standards and Guidelines* (HKPSG), sensitive receivers include residential uses, schools and active and passive recreational uses. The proposed work site is within a built-up urban area and the Study Team has identified the potential air sensitive receivers (ASRs) within 100 m of the work site for the assessment of the effects of fugitive dust. The distances from the proposed work site to the nearest ASRs are shown in *Table 2.4a* and the locations of the ASRs are shown in *Figure 2.4a*.

Table 2.4a *Nearest ASRs in Quarry Bay*

Air Sensitive Receivers		Landuse	Distance from Work Site (m)
ASR1	Customs and Excise Quarters	Residential	50
ASR2	Elegance House	Residential	30
ASR3	Ruby Court	Residential	30
ASR4	Nos.1-11, Healthy Street West	Residential	15
ASR5	Police Quarters	Residential	35
ASR6	Teaching Centre	Educational Institution	28
ASR7	Healthy Village Playground	Recreational	40
ASR8	Roof-top playground on Urban Council North Point Market Building	Recreational	5
ASR9	Anne Black Health Clinic	G/IC	5

2.5 POTENTIAL SOURCES OF IMPACT

The atmospheric pollutants which may arise during the construction phase include dust and vehicular emissions. Dust impact is the main aspect addressed in this section. Vehicular emissions will impose limited impacts upon the



LOCATIONS OF THE PROPOSED WORKSITE & AIR SENSITIVE RECEIVERS

ASR 1 AIR SENSITIVE RECEIVER

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DATE: JAN 97

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FIGURE No. 2.4a

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surrounding area since the extent of potential sources are limited in comparison with the high traffic flows on King's Road, adjacent to the work site.

If a noise enclosure is installed as a noise mitigation measure, powered mechanical equipment (PME) such as compressors, drills and trucks used within the noise enclosures should be maintained in good condition to minimise fume discharge and limit air quality impacts. Lorries used for loading and unloading spoil are usually kept idling with engines switched on at all times which may also give rise to potential air quality concerns. Whilst the health and safety implications are outside the scope of this study, the impacts particularly on enclosed sites should be thoroughly addressed by the contractor.

Initially, construction works will involve excavation at the abandoned shaft from the ISL and excavation is expected to be in fill material. Blasting will only be required at depths of approximately 15-20 m underground and dust impact will therefore be negligible. Construction fugitive dust will be generated from excavation at the ground level and materials handling at the proposed site. It has been estimated that the maximum amount of material handled at the proposed site will be 150 m^3 per day.

The size of the proposed site is so limited that there will be no haul road. Additionally, a wheel wash unit will be provided at the entrance and exit of the work site and, with the proper use of these facilities, there will be no dust nuisance arising outside the work site.

2.6 *ASSESSMENT METHODOLOGY*

Cumulative impacts were assessed for construction dust from the proposed work site at the identified ASRs. Construction works for the Healthy Street Redevelopment is on-going, however, during the site visit on 10 January 1997, civil construction works had been completed and no construction dust was noted to be generated from the site. No other construction schemes have been planned in the vicinity of the proposed work site and it is anticipated that the only other major sources of impacts will be the general Hong Kong pollution levels, including vehicular emissions from nearby major roads. The averaged air quality monitoring results at stations all over Hong Kong were used in the assessment as there are currently no air monitoring stations in the Quarry Bay Area. An annual averaged TSP level of 101 $\mu g\ m^{-3}$ in 1994, which is the latest year for which records are available, was used for the current background levels to estimate the cumulative impacts of QBR works (*Air Quality in Hong Kong for 1994, Environmental Protection Department, 1996).*

Dispersion Model

The Fugitive Dust Model (FDM) is an air quality model specifically designed for computing concentration and deposition impacts from fugitive dust sources, including point, line and area sources. The model was used to predict the extent of impacts from the construction of the alignment, tunnels, stations and depot. Five categories of dust size were assumed in the model, particle size multipliers, provided in the *Compilation of Air Pollutant Emission Factors, 5th Edition, US Environmental Protection Agency, 1996* (AP-42). The dominant dust source for the construction works is anticipated to be vehicle movements within the unpaved work site, therefore, the proportion of the emission rate arising from haul road movement for each dust size established in Section 13.2.2-4, AP-42 is adopted in

the model and are summarised in *Table 2.6a*. The gravitational settling velocity for each dust category was calculated by the FDM.

Table 2.6a ***Dust size and the Portion of Emission Rate***

Dust Size (μm)	Portion of Emission Rate
0 - 2.5	0.095
2.5 - 5.0	0.105
5.0 - 10	0.16
10 - 15	0.14
15 - 30	0.3
30 - 100	0.2

Assessment Parameters

The impact of fugitive dust sources on air pollutant levels depends on the quantity, as well as the drift potential of the dust particles injected into the atmosphere. Large dust particles will settle out near the source and particles that are 30-100 μm in diameter are likely to undergo impeded settling. These particles, depending on the extent of atmosphere turbulence, would settle within a distance of 100 m from the source. The main dust impact will arise from fine particles, less than 30 μm in diameter, dispersed over greater distance from the sources and identified as TSP. To evaluate the dust impact from the Pak Fuk Road work site, TSP levels were predicted.

1-Hour TSP Levels

The normal construction hours in Hong Kong are 07.00-19.00, Monday to Saturday and a maximum working period of twelve hours was used with the corresponding meteorological records included in the input data for the FDM. The model predictions were made on an hourly basis for different activities. The highest predicted TSP levels were presented and compared to the recommended hourly target level of 500 $\mu g\ m^{-3}$.

24-hour TSP Levels

The daily TSP impact was modelled with the default option of a 24-hour averaging period and the meterological data for the period 07.00-19.00. The construction works will only be carried out for half the assessment period (12 hours out of a 24 hour day), however, variations of dust emission levels with time is not considered in the FDM. Therefore, the modelled 24-hour TSP levels were factored to account for the construction works taking place for 12 hours out of the 24 hour period (ie 50%). The calculated 24-hour TSP levels were then compared against with the AQO of 260 $\mu g\ m^{-3}$.

Meteorological Input

In consultation with the EPD, sequential 1994 meterological data from the Royal Observatory, for Tsim Sha Tsui Meterological Station, were used for assessing the impacts of real-time meterological conditions. Meterological data for the corresponding 12-hour working period was selected for modelling. The input data included temperature, wind speed direction and mixing height.

TSP Emission Rates

This assessment focuses on dust emissions from general construction activities including materials handling and vehicle movement within the work site. Estimations of emission factors have been made in accordance with AP-42. The emission factors used in the modelling assessment are presented in *Table 2.6b* below.

Table 2.6b ***Emission Factors for Construction activities at Station Work site***

Activities	Emission Factor	Remarks
Handling of excavated spoil	0.12 g te^{-1}	• Based on USEPA AP-42 Vol. 1 5th Edition, Section 13.2.4-4. • Emission factor is a function of wind speed and the wind dependent factor is input in the model. • Assume moisture content of 4.8%.

Soft spoil and hard materials in Hong Kong are generally wet, with moisture contents in the order of ten percent (referenced to the recent geological study for the *Feasibility Study for Kennedy Town Extension, Working Paper EC2, Initial Geotechnical Interpretation Report, 22 March 1996, MTRC).* The AP-42 equation for the derivation of the emission rate for material handling is based upon a moisture content in the range of 0.25 - 4.8%. The assessment is based, therefore, on material which is more friable than the spoil which will be generated by the works for a worst case scenario, i.e. 4.8%. Typical densities of 2500 kg m^{-3} for rock and 1800 kg m^{-3} for soil were also assumed in the model.

2.7 PREDICTION OF IMPACTS

The 1-hour and 24-hour TSP levels arising from the construction work at the proposed site, including the background levels of 101 µg m^{-3}, under the worst meterological conditions in 1994 are shown in *Table 2.7a* below.

Table 2.7a ***Predicted Averaged TSP Concentrations (µg m^{-3}) without Mitigation***

ASR		1-hour TSP levels	24-hour TSP levels
ASR1.	Customs and Excise Quarters	105	102
ASR2.	Elegance House	106	102
ASR3.	Ruby Court	106	102
ASR4.	Nos. 1-11 Healthy Street West	112	104
ASR5.	Police Quarters	106	102
ASR6.	Teaching Centre	106	102
ASR7.	Healthy Village Playground	106	101
ASR8	Roof-top playground on Urban Council North Point Market Building	112	105
ASR9	Anne Black Health Clinic	108	104

Remark: Figures include background TSP level of 101 µg m^{-3}

2.8 EVALUATIONS OF IMPACTS

As indicated in *Table 2.7a*, the predicted 1-hour and 24-hour TSP levels at the ASRs in the vicinity of the work site are predicted to be in range of 105-112 μg m^{-3} and 101-105 μg m^{-3} respectively, well within the EPD's recommended hourly TSP level of 500 μg m^{-3} and AQO of 260 μg m^{-3} at all ASRs.

It should also be noted that the assessment is based on the plan distance between the ASRs and the site and take no account of any screening effects generated by the proposed noise enclosure. In addition, the dust levels have predicted at same elevation of the work site without consideration of the topography of the area and the levels of the building. The dust levels at the upper levels of high rise buildings, such as residential block along Healthy Street West and the playground at the roof of the market will be further reduced due to the settlement of dust. Nevertheless, dust mitigation measures are summarised in the section below for the Contractor's information.

2.9 MITIGATION MEASURES

Unmitigated construction work is likely to cause dust impacts exceeding the established criteria at most of the ASRs close to the sites. The following dust control measures are recommended as good construction practice and will minimise dust nuisance arising from the works:

Materials Handling

- the heights from which excavated materials are dropped should be controlled to a minimum practical height to limit the fugitive dust generation from unloading;
- all stockpiles of aggregate or spoil of more than 50 m^3 should be enclosed or covered and water applied in dry or windy conditions;

Vehicle Dust

- effective water sprays should be used on the site to dampen potential dust emission sources such as unpaved areas used by site traffic and active construction areas;
- vehicles transporting materials that have the potential to generate dust should have properly fitting side and tail boards;
- materials transported by vehicles should be covered, with the cover properly secured and extended over the edges of the side and tail boards;
- materials should also be dampened, if necessary, before transportation,
- on-site vehicle speeds should be controlled to reduce dust re-suspension and dispersion by traffic within the sites;
- wheel washing facilities should be provided at the exit of the site to prevent dusty material from being carried off-site on vehicles and deposited on public roads; and

Excavation

- to minimise dust emissions, the amount of soil exposed and the dust generation potential should be kept as low as possible, this can be accomplished by surface compaction, temporary fabric covers, minimising the extent of exposed soil and the prompt re-vegetation of completed earthworks.

2.10 CONCLUSIONS

Dust has been identified as the potential air quality impact from the construction work within the proposed work site at Pak Fuk Road work site, with initial excavation works and material handling being identified as the main sources of dust. The construction works will be small in scale and the predicted dust levels at all ASRs are well within the identified criteria. Mitigation measures have, however, been recommended for good house-keeping, to minimise air quality impact from the construction works at the proposed site.

3 NOISE

3.1 INTRODUCTION

This Section discusses the likely noise impacts arising from the construction works for the proposed site upon the nearby noise sensitive receivers (NSRs). Appropriate mitigation measures will be recommended to mitigate any unacceptable impacts exceeding the relevant noise criteria.

3.2 LEGISLATION AND GUIDELINES

In Hong Kong the control of construction noise other than Percussive Piling during restricted hours (19.00-07.00 and all days on Sundays and Public Holidays), is governed by the Noise Control Ordinance (NCO) and the subsidiary technical memoranda. However, the NCO does not provide for the control of construction activities during normal working hours (07.00 - 19.00 Monday to Saturday, excluding Public Holidays). A limit of $L_{Aeq, 30\ min}$ 75 dB is proposed in the *Practice Note For Professional Persons, Professional Persons Environmental Consultative Committee, Noise from Construction Activities - Non-statutory Controls, June 1993* (ProPECC *PN2/93*) for residential dwellings. This limit has been applied on major construction projects, including the Lantau and Airport Railway (LAR) and will be adopted in this study in order to protect residential NSRs to an appropriate extent.

For schools, the ProPECC PN2/93 recommended noise level during normal school days is $L_{Aeq, 30\ min}$ 70 dB, this is lowered to $L_{Aeq, 30\ min}$ 65 dB during exam periods. The mitigation measures that are recommended later in this section aim to control noise levels to below the normal level for schools ($L_{Aeq, 30\ min}$ 70 dB), additional measures would, therefore, be required during exam periods if these occur within noisy construction phases.

There are further subsidiary regulations, *Noise Control (Hand held percussive breakers) Regulations* and *Noise Control (Air Compressors) Regulations* controlling the noise from hand held breakers and air compressors which require compliance with the relevant noise emission standards and the fixing of noise emission labels to the plant (i.e. 114 dB for hand-held breakers and 104 dB for air compressors).

Percussive piling is only permitted within the constraints of a CNP. The *Technical Memorandum on Noise From Percussive Piling* (TM1) sets out the requirements for working under a CNP, the determination of the permitted hours of operations and, when necessary, other conditions. Percussive piling is prohibited during restricted hours unless specifically exempted. ANLs for percussive piling are set out in TM1 and are dependent on the type of NSR. The ANLs for daytime percussive piling are presented in *Table* 3.2*a*.

Table 3.2a *Acceptable Noise Levels for Daytime Percussive Piling*

Type of Receptor	Acceptable Noise Level (dB(A))
Noise Sensitive Receiver (NSR) with no windows or other openings	100
NSR with central air conditioning systems	90
NSR with windows or other openings but without central air conditioning system	85

It should be noted that for hospitals, clinics, schools, courts of law or other particularly sensitive receivers, the ANL is 10 dB(A) below that quoted in *Table 3.2a.*

The permitted hours of operations are determined by comparing the Corrected Noise Level (CNL) and the ANL at the NSR. *Table 3.2b* presents the permitted hours of operation for percussive piling.

Table 3.2b *Permitted Hours of Operation for Percussive Piling*

Amount by which CNL exceeds ANL	Permitted hours of operation on any day not being a holiday
more than 10 dB(A)	08.00-09.00 AND 12.30-13.30 AND 17.00-18.00
between 1 - 10 dB(A)	08.00-09.30 AND 12.00-14.00 AND 16.30-18.00
no exceedance	07.00-19.00

Control of construction noise other than Percussive Piling during restricted hours is governed by the NCO and the subsidiary technical memoranda namely the *Technical Memorandum on Noise From Construction Work Other Than Percussive Piling* (TM2). These technical memoranda prescribe the permitted noise levels for construction work depending upon working hours and the existing noise climate.

A subsidiary technical memoranda, the *Technical Memorandum on Noise from Construction Work in Designated Areas* (TM3) is applicable during restricted hours, within designated areas, including Hong Kong Island, as defined by the *Noise Control (Construction Work Designated Areas) Notice, Legal Supplement No. 2 to Gazette No. 2/1996, 12 January 1996.*

TM3 will cover the use of the following specified powered mechanical equipment: hand-held breaker; bulldozer; concrete mixer lorry; dump truck; and hand-held poker vibrator. The prescribed construction works are: erection or dismantling of formwork or scaffolding; loading, unloading or handling of rubble, wooden boards, steel bars, wood or scaffolding material; and hammering.

The NCO criteria for TM2 and TM3 are dependent upon the type of area containing the NSR rather than the measured background noise level. The NCO requires that noise levels from construction at affected NSRs be less than a specified Acceptable Noise Level (ANL) which depends on the Area Sensitivity Rating (ASR) for the NSR under consideration.

It is intended that the construction activities of the proposed works should be planned and controlled in accordance with the NCO. Works requiring the use of PME during restricted hours will require a Construction Noise Permit (CNP) and

will need to achieve the applicable ANL. The ANL is derived from the Basic Noise Levels (BNL) determined in TM2/TM3 by applying corrections for the duration of the works and the effect of any other nearby sites operating under a CNP. For this assessment, current information indicates that these corrections are negligible and so have been set to zero. As a result, the ANLs are equal to the BNLs. The ANLs for the construction work other than percussive piling and for the construction work in designated areas are shown in *Table 3.2c* and *3.2d* below.

Table 3.2c ***Acceptable Noise Levels for Construction Noise other than Percussive Piling ($L_{Aeq\ 5\ min}$ dB)***

Time Period	ASR"A"	ASR"B"	ASR"C"
All days during the evening (1900-2300) and general holidays (including Sundays) during the day and evening (0700-2300)	60	65	70
All days during the night-time (2300-0700)	45	50	55

Table 3.2d ***Acceptable Noise Levels for Construction Noise in Designated Areas ($L_{Aeq\ 5\ min}$ dB)***

Time Period	ASR"A"	ASR"B"	ASR"C"
All days during the evening (1900-2300) and general holidays (including Sundays) during the day and evening (0700-2300)	45	50	55
All days during the night-time (2300-0700)	30	35	40

3.3 BASELINE CONDITIONS

The area surrounding the proposed construction site at Pak Fuk Road consists of residential buildings, a teaching centre, a clinic and Urban Council Recreational Complex. The main residential developments are the Police Quarters (Tanner Road); Nos. 1-11, Healthy Street West; and Ruby Court, Elegance House and North Point Fire Services Married Quarters in Tsat Tsi Mui Road. The Education Department Advisory Inspectorate is located to the south of the proposed site and Anne Black Health Clinic is situated adjacent to the northern boundary of the site (see *Figure 1.1a*).

The dominant noise sources in the vicinity are the traffic using King's Road and local access roads serving the area. The *Annual Traffic Census 1994, Hong Kong Government Transport Department, June 1995*, records the average daily traffic flows on King's Road as over 30,000 vehicles, and it is thus classified as a major road according to TM2/TM3. The proposed work site is located within urban area and King's Road is considered as an Influencing Factor which indirectly affects the noise background at the study area, therefore, the ASR of the NSRs is classified as "C".

3.4 NOISE SENSITIVE RECEIVERS

NSRs as defined by HKPSG and the NCO were identified in this study. The construction noise impacts at the worst affected representative NSRs (within a maximum distance of 100 m from the construction Works Area) have been

considered, and the NSR locations are shown in *Figure 3.4a*. The NSRs are assumed to have direct line of sight to the proposed site, however, lower floors of Ruby Court is actually screened by the clinic. During the site visit on 10 January 1997, it is noted that all identified NSRs in exception of the library have no central air conditioning systems.

Table 3.4a *Noise Sensitive Receivers*

Representative NSR	Landuse	Distance from the construction site (m)
NSR1 Ruby Court	Residential	43
NSR2 Healthy Street West No1-11	Residential	30
NSR3 Police Quarters Tanner Road	Residential	42
NSR4 Education Department Advisory Inspectorate	Educational Institution	31
NSR5 Library	G/IC	30
NSR6 Anne Black Health Clinic	G/IC	10

3.5 POTENTIAL SOURCE OF IMPACTS

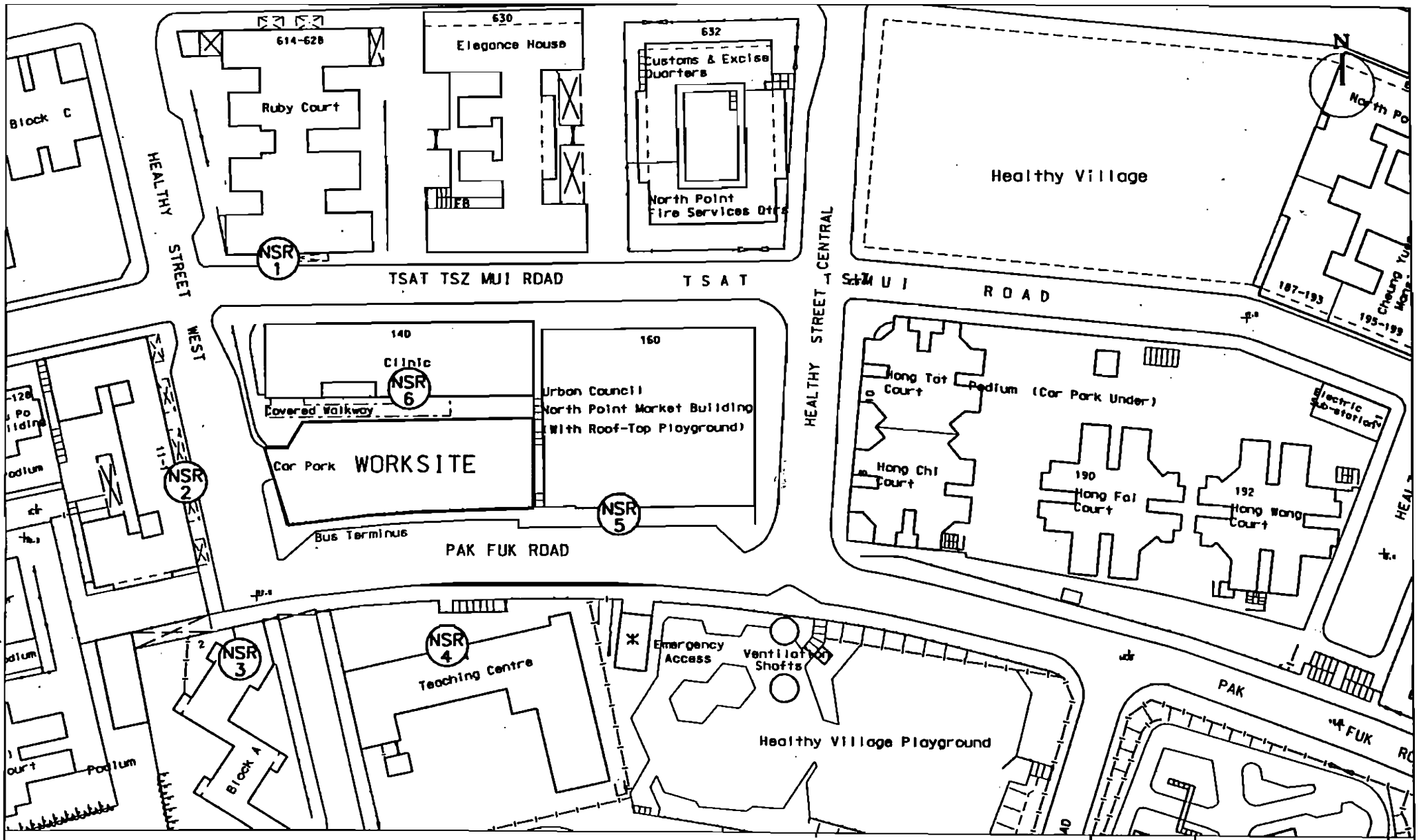
Potential sources of impact from the proposed work site will include the following construction activities:

- Site preparation will include clearance of the site, breaking for footings and the erection of the site boundary hoarding or noise enclosure if noise enclosure is considered as noise mitigation measure. During this phase the only opportunities available for mitigation are the use of quiet plant, moveable noise barriers and a reduction in the number of plant operating at any one time. At the initial stage, excavator mounted breakers will be involved for breaking and this activity will last for 2-3 weeks. Standard types of construction plant will be used for a period which is expected to last for 2-3 months.

- Excavation work will take approximately 15 months to complete. This phase has been split into two elements; initial (6 months) and final (9 months) excavations. During the initial excavations, excavators will be used for excavation of soft materials from the abandoned shaft. The final excavations will involve standard construction plant and this stage is expected to be quieter as construction works will take place underground.

- Following the excavation works for the NOP tunnel and station, construction of station will take approximately 12 months. During this construction stage, the main construction works will involve delivery of concrete and associated facilities into the tunnel and stations. The main construction plant involved will be concrete trucks, crane and hoist.

- Following completion of the QBR construction works, the site hoarding or the noise enclosure will be dismantled and removed. For standard construction site hoarding, it is expected that minimal construction works will be required for removal of the footing. Potential noise impact is not anticipated for hoarding removal while if noise enclosure is recommended, dismantling the



LOCATIONS OF THE PROPOSED WORKSITE & NOISE SENSITIVE RECEIVERS

NSR 1 NOISE SENSITIVE RECEIVER

MAUNSELL CONSULTANTS ASIA LTD 萬德工程顧問有限公司

DATE: JAN 97

SCALE: 1:1000

FIGURE No. 3.4a

Maunsell

enclosure and removal of the foundations will be a potential source of noise impact. This will take approximately 2-3 months and will involve breakers, loaders and lorries and the only available methods of noise mitigation are the use of quiet plant, moveable barriers and limiting the number of plant operating.

3.6 ASSESSMENT METHODOLOGY

General Construction Noise

A methodology for assessing noise from the construction of the proposed alignment has been developed based on the *Technical Memorandum on Noise from Construction Work other than Percussive Piling* (TM2). In general, the methodology is as follows:

- locate NSRs that may be affected by each work site;
- identify plant items for construction activities based on available information;
- assign sound power levels (SWLs) to plant based from TM1;
- calculate the maximum total site SWL for construction activities using the plant inventory and the SWL data given for each plant in TM1;
- calculate distance attenuation to NSRs from the work site notional noise source point;
- calculated predicted noise levels (PNLs) at NSRs in the absence of any mitigation measures; and
- compare predicted levels with established noise criteria.

The noise criteria for residential premises and schools are 75 dB(A) and 70 dB(A) (65 dB(A) during examination) respectively. Since there are no specific construction noise criteria for libraries and clinics, the limit for educational institution of 70 dB(A) has been used.

If the noise assessment criteria are exceeded at NSRs, mitigation measures must be considered. A re-evaluation of the total SWL for activities will be made assuming the use of practicable mitigation measures such as silenced equipment and noise barriers. If the criteria are still exceeded, further mitigation measures such as a reduction in the number of noisy plant working simultaneously and noise enclosure would be recommended.

No percussive piling is proposed and therefore, assessment under TM1 is not required.

Assumed Construction Plant Inventories

The above ground construction works at the proposed Pak Fuk Road site will be site preparation (including the erection of the noise enclosure), excavation, and the reinstatement (including removal of noise enclosure). The breakdown of these activities and the plant teams, provided by the Maunsell Engineering Design Team, for each activity are given in *Annex A*. The excavation phase has been divided into two activities, above ground and underground, as it has been assumed that initially all the PME will be in operation at the surface. However, as the works progress most of the PME will operated underground and hence, the majority of the noisy plant will be screened from the NSRs.

Blasting

The control of all blasting operations in Hong Kong is vested in the Mines and Quarries Division (M&Q) Division of the Civil Engineering Department (CED). Permits for the storage and use of explosives must be obtained from the Mines and Quarries Division which also stipulates particular restrictions on blasting procedures.

For Hong Kong, a conservative limiting peak particle velocity (ppv) of 25 mm s^{-1} for reinforced concrete structures, below which no damage to the structures are likely, is recommended. Both the MTRC and China Light and Power recommended 25 mm s^{-1} ppv to minimise the risk of damage to their structures from vibration. Water retaining structures tend not to be as resilient as buildings, and the Water Supplies Department recommends 13 mm s^{-1} ppv to minimise damage to their structures from vibration impacts.

A methodology for estimating the likely levels of vibration is given by the Dupont formula, which when tailored to the situation in Hong Kong can be used to give indicative vibration levels. However, the M&Q Division of the CED require an assessment of blasting vibration and its effects on nearby structures to be carried out by qualified blasting specialists and submitted to them for approval. This assessment will be carried out by the specialist contractor prior to commencement of the works at each site. Hence a detailed assessment of blasting vibration is outside the scope of this study. It should, however, be noted that the controls on blasting likely to be required to safeguard nearby structures, including existing MTRC facilities, will provide a significant degree of mitigation of the possible impacts on nearby sensitive landuses.

3.7 PREDICTION OF IMPACTS

The minimum distances from the notional source point of each construction activity to each identified NSR is given in *Annex A*. The total PNL for each NSR for each construction stage has been calculated and presented in *Annex A*. All NSRs are assumed to have a direct line of sight to the appropriate construction site and no screening correction has been applied. Details of the calculations are shown in *Annex A*.

These results can be considered as 'worst case' since plan distances, rather than slant distances, were used in the calculation of distance corrections. It should be noted that some of the NSRs, namely the lower floors of Ruby Court, are screened off from the work site by the Health Clinic, whilst upper floors of NSRs will have larger buffer distances from the work site such that noise impact at these NSRs will be less than predicted. The predicted noise levels without mitigation measures are shown in *Table 3.7a* below.

Table 3.7a ***Predicted Noise Levels ($L_{Aeq\ 30min}$) at NSRs***

Phase	NSR		Unmitigated Noise Level
Site preparation (Initial) (0.5 month)	NSR1	Ruby Court	***85***[1]
	NSR2	Healthy Street W	***88***
	NSR3	Police Quarters	***85***
	NSR4	Teaching Centre	***88***
	NSR5	Library	***78***
	NSR6	Anne Black Health Clinic	***98***
Site preparation (Final) (2.5 months)	NSR1	Ruby Court	***77***
	NSR2	Healthy Street W	***80***
	NSR3	Police Quarters	***78***
	NSR4	Teaching Centre	***80***
	NSR5	Library	70
	NSR6	Anne Black Health Clinic	***90***
Excavation (Initial) (6 months)	NSR1	Ruby Court	***81***
	NSR2	Healthy Street W	***84***
	NSR3	Police Quarters	***81***
	NSR4	Teaching Centre	***84***
	NSR5	Library[2]	***74***
	NSR6	Anne Black Health Clinic	***94***
Excavation (Final) (9 months)	NSR1	Ruby Court	***80***
	NSR2	Healthy Street W	***83***
	NSR3	Police Quarters	***80***
	NSR4	Teaching Centre	***83***
	NSR5	Library	***73***
	NSR6	Anne Black Health Clinic	***93***
Station Construction (12 months)	NSR1	Ruby Court	***79***
	NSR2	Healthy Street W	***82***
	NSR3	Police Quarters	***79***
	NSR4	Teaching Centre	***82***
	NSR5	Library	***72***
	NSR6	Anne Black Health Clinic	***92***
Enclosure removal (2 months)	NSR1	Ruby Court	***79***
	NSR2	Healthy Street W	***82***
	NSR3	Police Quarters	***79***
	NSR4	Teaching Centre	***82***
	NSR5	Library	***72***
	NSR6	Anne Black Health Clinic	***92***
Removal of Enclosure foundation (1 month)	NSR1	Ruby Court	***80***
	NSR2	Healthy Street W	***83***
	NSR3	Police Quarters	***80***
	NSR4	Teaching Centre	***83***
	NSR5	Library	***73***
	NSR6	Anne Black Health Clinic	***93***

Note :

(1) Exceedances of the daytime noise criteria of 75 dB(A) for residential uses and 70 dB(A) for schools, library and clinic are shown in Bold and Italic.

(2) A noise reduction of 10 dB(A) is considered for Library.

It is proposed that below ground tunnel works will continue through the night-time period. Therefore, tunnel ventilation involving the operation of fans will be required. One vent fan will be located in the roof of the noise enclosure and will be operated continuously to supply fresh air for the tunnel works. The sound pressure level at 1 m from the vent fan is assumed to be 75 dB(A) to ensure the public will not be unduly affected by high noise levels when in the vicinity of the ventilation fan and the fan is assumed to be 1 m in diameter. The PNL at each identified NSR are shown in *Table 3.7b*.

Table 3.7b ***Predicted Noise Levels from Enclosure Ventilation Fan***

NSR	Horizontal Distance From Vent Fan (m)	Predicted Noise Levels (dB(A))
NSR1	43	39
NSR2	30	42
NSR3	42	40
NSR4	31	42
NSR5	30	42
NSR6	10	5

3.8 EVALUATION OF IMPACTS

As indicated in *Table 3.7a*, without any noise mitigation measures, the predicted noise levels at the residential uses (NSRs1-3) are 79-88 dB(A), which would exceed the daytime noise criterion of 75 dB(A). In addition, the predicted noise levels at the teaching centre (NSR4), the library (NSR5) and the Anne Black Health Clinic (NSR6) are 72-94 dB(A), and exceed the ProPECC noise criterion of 70 dB(A) for schools. Adverse construction noise impacts have been predicted during all the construction phases at all NSRs. A package of mitigation measures have been included for noise mitigation and details are discussed below.

As shown in *Table 3.7b* no exceedances of the NCO criteria from the vent fans operations have been predicted in considering that the assumed sound pressure level of 75 dB(A) at 1 m from the fan is achievable with use of silencer. Therefore, no adverse noise impact is anticipated from the operation of the vent fans.

3.9 MITIGATION MEASURES

The following forms of mitigation are recommended.

- good site practice to limit noise emissions at source;
- selection of quiet plant and working methods;
- use of movable barriers;
- reduction in the numbers of plant operating in critical areas close to NSRs;
- avoidance of simultaneous noisy activities;
- noise enclosure

Good Site Practice

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

- only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme;
- silencers or mufflers on construction equipment should be utilised and should be properly maintained during the construction programme; and
- whenever practicable, mobile plant should be sited as far away from NSRs as possible.

- machines and plant (such as trucks) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;

- plant known to emit noise strongly in one direction, should, where practicable, be orientated so that the noise is directed away from nearby NSRs;

- material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

The noise benefits of these techniques are difficult to quantify, and whilst they would provide some attenuation, they cannot be assumed to guarantee a high level of noise mitigation and have not, therefore, been included in the calculation of mitigated levels.

General Mitigation Measures

Recommendations for mitigation measures to achieve the noise criteria have generally been specified as a combination of plant noise performance specifications and noise barriers. It is considered too restrictive to recommend that the Contractor has to use specific items of plant for the construction operations, particularly as the Contractor will probably vary the anticipated construction programme and will need to develop a different package of mitigation measures than those used in this Working Paper to meet the required noise standards.

Selecting Quiet Plant and Working Methods

The Contractor may be able to obtain particular models of plant that are quieter than the standard types given in TM2. The benefits achievable in this way will depend on the details of the Contractor's chosen methods of working. The suggested performance specification requires the Contractor to incorporate 'quiet' or silenced plant, or reduced plant inventories for specific construction activities so that noise levels at nearby NSRs are kept below the noise criteria.

Quiet plant is defined as PME whose actual sound power level is less than the value specified in TM2 for the same piece of equipment. Examples of SWLs for specific silenced PME, which are known to be used, are given in Annex A. Reductions of up to 7 dB(A) can be achieved for specific items of PME.

It should be noted that various types of silenced equipment can be found in Hong Kong. However, the Noise Control Authority, when processing a CNP application, will apply the noise levels specified in TM2 unless the noise emission of a particular piece of equipment can be validated by certificate or demonstration to the satisfaction of the Authority, as required under TM2.

Movable Noise Barriers

Site perimeter barriers would generally be ineffective in reducing noise levels since most NSRs are close to, and would overlook the barriers. However, movable noise barriers of 3-5 m in height and of a superficial surface density of at least 15 kg m^{-2}, located close to particular types of plant, as listed below, could give a reduction of up to 5 dB(A) from screening effects (estimated in accordance with TM2). Certain types of PME, such as generators and compressors, can be

completely enclosed giving a reduction of 10 dB(A) or more.

Plant that could benefit from mobile noise barriers include:

- backhoe breaker;
- crane;
- mini backhoe;
- compressor; and
- excavator.

Noise Enclosure

Reductions of at least 20 dB(A) have been achieved at Lai King Station site from the use of a noise enclosure. It is considered that this result could be improved upon if the openings in the noise enclosure are further restricted (the Lai King enclosure was open along one whole side) and a superficial surface density of at least 15 kg m^{-2} is achieved. However, it is also acknowledged that NSRs facing the opening of the enclosure might be affected by traffic entering and leaving the site and noise reduction at these specific receivers might be less than 20 dB(A). Accordingly, careful design of the enclosure will be required to avoid a direct line to the NSRs. In addition, doors should remain closed between vehicle movements to achieve the best practicable noise reduction.

Restricting Plant Teams

In general, the numbers of particular items of plant should be left to the choice of the Contractor allowing flexibility in the choice of working methodologies. However, in combination with the selection of quiet plant, limiting plant numbers would further reduce noise levels.

Recommended Mitigation Measures

A summary of the recommended mitigation measures, as listed below, for the noisiest construction phases are presented in the following sections.

Mitigation 1 -use of quiet plant;

Mitigation 2 -Mitigation 1 plus 3 m high moveable barriers with skid footing and a small cantilevered upper portion located within a few metres of static plant and within 5 m of mobile plant; and

Mitigation 3 -Mitigation 2 plus limiting the numbers of each plant type operating within the construction site to one.

Mitigation 4 - Mitigation 3 plus noise enclosure

The predicted construction noise levels which can be achieved with these mitigation measures are shown in *Table 3.7c* and the effectiveness are discussed below.

Table 3.7c *Predicted Noise Levels ($L_{Aeq\ 30min}$) at NSRs with Mitigation Measures*

Phase	NSR		Mitigation 1 - Quiet plant	Mitigation 2 - Quiet plant, moveable barriers	Mitigation 3 - Quiet plant, moveable barriers and reduction of no. of plant	Mitigation 4 - Quiet plant, reduction of no. of plant and noise enclosure
Site	NSR1	Ruby Court	***85***	75	75	-
preparation	NSR2	Healthy Street W	***88***	***78***	***78***	-
(Initial)	NSR3	Police Quarters	***85***	***76***	76	-
(0.5 month)	NSR4	Teaching Centre	***87***	***78***	***78***	-
	NSR5	Library	***78***	68	68	-
	NSR6	Anne Black Health Clinic	***97***	***88***	***88***	-
Site	NSR1	Ruby Court	70	69	69	69
preparation	NSR2	Healthy Street W	73	72	72	72
(Final)	NSR3	Police Quarters	71	69	69	69
(2.5 months)	NSR4	Teaching Centre	***73***	***71***	***71***	***71***
	NSR5	Library	63	62	62	62
	NSR6	Anne Black Health Clinic	***83***	***81***	***81***	***81***
Excavation	NSR1	Ruby Court	75	75	75	55
(Initial)	NSR2	Healthy Street W	***78***	***78***	***78***	58
(6 months)	NSR3	Police Quarters	***76***	***76***	75	55
	NSR4	Teaching Centre	***78***	***78***	***77***	57
	NSR5	Library	68	68	68	58
	NSR6	Anne Black Health Clinic	***88***	***88***	***87***	67
Excavation	NSR1	Ruby Court	***77***	***77***	***76***	56
(Final)	NSR2	Healthy Street W	***80***	***80***	***79***	59
(9 months)	NSR3	Police Quarters	***78***	***78***	***76***	56
	NSR4	Teaching Centre	***80***	***80***	***79***	59
	NSR5	Library	70	70	69	59
	NSR6	Anne Black Health Clinic	***90***	***90***	***89***	69
Station	NSR1	Ruby Court	***77***	***77***	***76***	56
Construction	NSR2	Healthy Street W	***80***	80	***79***	59
(12 months)	NSR3	Police Quarters	***78***	78	***76***	56
	NSR4	Teaching Centre	***80***	***80***	***79***	59
	NSR5	Library	***70***	70	69	59
	NSR6	Anne Black Health Clinic	***90***	***90***	***89***	69
Enclosure	NSR1	Ruby Court	70	69	69	69
removal	NSR2	Healthy Street W	73	72	-	-
(2 months)	NSR3	Police Quarters	71	69	-	-
	NSR4	Teaching Centre	73	71	-	-
	NSR5	Library	63	62	-	-
	NSR6	Anne Black Health Clinic	83	***81***	-	-
Removal of	NSR1	Ruby Court	74	70	-	-
Enclosure	NSR2	Healthy Street W	77	73	-	-
foundation	NSR3	Police Quarters	74	70	-	-
(1 month)	NSR4	Teaching Centre	77	73	-	-
	NSR5	Library	67	63	-	-
	NSR6	Anne Black Health Clinic	***86***	***83***	-	-

Note : (1) Exceedances of the daytime noise criteria of 75 dB(A) for residential uses and 70 dB(A) for schools are shown in Bold and Italic.
(2) A noise reduction of 10 dB(A) is considered for Library.

Site Preparation

During the site preparation stage, mitigation measures including the use of quiet plant, movable barriers for mobile and stationary plant and reducing the number of plant operating at any one time have been proposed. A 10 dB(A) reduction could be obtained with the all above noise control measures (Mitigation 3). This would give predicted noise levels at the residential properties in the range of 75-78 dB(A); predicted noise level at Ruby Court would be mitigated below the EPD's recommended daytime noise criterion of 75 dB(A) whilst at Nos. 1-11 Healthy Street West and the Police Quarters the criterion is exceeded by 1-3 dB(A) for the 2-3 week period of this activity.

At the final stage of site preparation works, it is anticipated that the excavator mounted breaker will not be required and a further 7 dB(A) reduction could be obtained. The resulting noise levels at Nos. 1-11 Healthy Street West and the Police Quarters will thus be reduced to 71 and 69 dB(A) respectively, within the daytime noise criterion. The predicted noise level at the Anne Black Health Clinic is 88 dB(A) in this initial stage of 2 to 3 weeks of site preparation with the mitigation measures described above and will be reduced to be 81 dB(A) where excavator mounted breaker is not in use.

A more stringent daytime noise criterion has been imposed at the teaching centre, and library, i.e. 70 dB(A). The predicted noise levels at these NSRs during the site preparation stage are 78 and 68 dB(A) respectively. The noise criterion will be exceeded by 8 dB(A) at the teaching centre, and the excavator mounted breaker is the dominant noise source. It is anticipated that the excavator mounted breaker will only be used for 2-3 weeks.

Excavation

Mitigation measures, including the use of quiet plant, movable barrier and reducing the number of operational plant would give 7 dB(A) and 4 dB(A) reductions during the initial and final excavation stages respectively. With Mitigation 3, the noise levels at the residential uses (NSRs1-3) during the initial and final excavation stages are reduced to 75-79 dB(A). Exceedances of the noise criterion of 75 dB(A) for residential uses are predicted at No1-11 Healthy Street West during initial excavation stage and Ruby Court, No.1-11 Healthy Street West and Police Quarters during the final excavation stage. In addition, the predicted noise levels at the teaching centre would still exceed the noise criteria of 70 dB(A) by 7-9 dB(A), and at the Anne Black Health Clinic by 17-19 dB(A).

Since noise exceedances are still predicted with the use of quiet plant, movable barrier and reducing the number of operational plant, a more substantial noise mitigation measure is required, i.e. noise enclosure. With the noise enclosure, the predicted noise levels are reduced to below the noise criteria of 75 dB(A) for residential uses; and the 70 dB(A) for the teaching Centre and the Anne Black Health Clinic. Therefore, a noise enclosure is recommended at Pak Fuk Road work site.

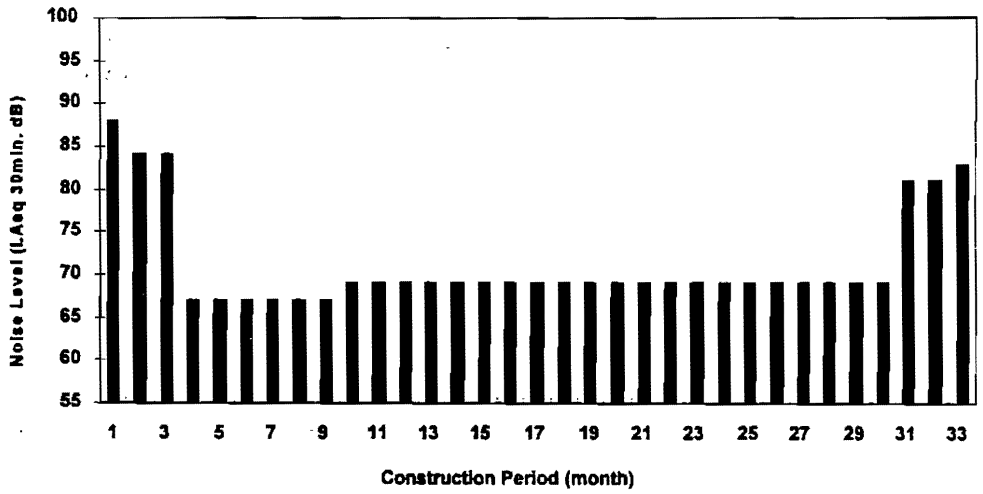
Station Construction

Construction activities for station construction will be mostly below ground and the predicted noise impact will be similar to that arising from excavation during the final stage. As above, provision of a noise enclosure is recommended to mitigate the noise generated during excavation. With the enclosure, the predicted noise levels during station construction at all NSRs are below the noise

criteria for residential uses and schools.

With the enclosure in place, the predicted noise levels arising from excavation and station construction works at residential uses are in range of 56-59 dB(A). The acceptable noise level for Designated Areas of 55 dB(A) during the evening period is marginally exceeded during final excavation and station construction by 1 dB(A) at Ruby Court and Police Quarters and 4 dB(A) at Nos.1-11 Healthy Street West. It is considered that the performance of the noise enclosure will mainly be dependent on the actual design of the enclosure and the types of materials used, and the additional 1-4 dB(A) noise reduction could be achieved by careful design of the enclosure including lining with absorbent materials to reduce the reverberant noise. Thus with a noise enclosure of appropriate design, predicted construction noise levels will be below the evening noise criteria for designated area. However, if the noise enclosure is found to be not effective enough to bring the noise level below the relevant noise criteria, above ground work should not be carried out in the evening or night-time while construction works underground could be take place as noise generated underground will be screened off.

Figure 3.9a ***Indicative Noise Trend During the Construction Period at the Health Clinic***



Enclosure Removal

Dismantling of enclosure is necessary following the completion of station construction. A package of mitigation measures including the use of quiet plant, movable barriers and reducing the number of operational plant, has been proposed during this stage (Mitigation 3). Up to 11 dB(A) and 10 dB(A) reductions in noise levels could be obtained during the enclosure and foundation removal stages respectively. The predicted noise levels at the residential uses are below the EPD's daytime noise criterion but noise exceedances are predicted at the Teaching Centre (1-3 dB(A)) for 1 month and at the Anne Black Health Clinic (6-8 dB(A)) for 3 months.

An indicative noise trend during the construction period at the worst affected NSR, i.e. the Anne Black Health Clinic is shown in *Figure 3.9a*. With the recommended mitigation measures, Mitigation 4, the predicted noise levels at

this NSR would only exceed the noise criterion during the initial and final stage of the construction period and will be within the noise criterion over 80 % of the construction programme. NSRs further away from the proposed site will experience noise impact in lesser extent.

3.10 CONCLUSIONS

Noise has been identified as the main impact arising from the construction work within the proposed work site at Pak Fuk Road. In the absence of any mitigation measures, noise levels that exceed the accepted voluntary daytime noise limits are predicted at the neighbouring NSRs. A noise enclosure is necessary to mitigate daytime construction noise during excavation and station construction which will last for 33 months. With the recommended mitigation measures, including the erection of a noise enclosure, use of quiet plant and reduction in the total number of plant, noise exceedances at NSRs during the main construction period will be avoided.

The provision of enclosure will enable the evening noise criterion for an ASR of C to be met, so that working hours could be extended to 23.00. However, as a result of the dense residential development in the area, the night-time noise limit of 40 dB(A) is still below that achievable by available mitigation measures, and hence surface works (for example spoil removal) will not be possible during the period 23.00-07.00. Additionally, if the noise enclosure is found to be not effective enough to bring the noise level below the relevant noise criteria, above ground work should not be carried out in the evening or night-time while construction works underground could be take place as noise generated underground will be screened off. It should also be noted, that whilst an ASR of C has been assumed for all NSRs assessed in the QBR DEIA, applications for CNPs will be decided by the EPD Local Control Office. The Local Control Office will identify the ASR rating for each individual NSR and if a rating of B is considered appropriate, a more stringent noise limit will be applied. However, only minor improvements to noise attenuation equipment would be necessary to ensure the night-time operation of the ventilation system.

During site preparation prior to the provision of the noise enclosure, exceedances of 1-3 dB(A) have been predicted for a 2-3 week period, even with available mitigation measures at residential NSRs. For the same 2-3 week period, the Anne Black Health Clinic will be exposed to noise levels of up to 88 dB(A). Similarly, residual exceedances of 1-3 dB(A) for three months at the Teaching Centre, and noise levels of 81-83 dB(A) at the Anne Black Health Clinic are predicted during the removal of the enclosure.

All rooms in the Anne Black Clinic which face the car park are fitted with air conditioning and do not, therefore, need to have open windows for ventilation. This will further reduce noise impacts at the clinic by at least 10 dB(A). In view of the short duration of the exceedances, that all practicable direct mitigation measures have been applied and that the works will enable the provision of the noise enclosure which will provide longer term benefits, these exceedances are generally considered acceptable within the context of the project. However, opportunities for the application of additional, indirect, mitigation measures to deal with the residual noise impacts should also be considered.

4 WATER QUALITY

4.1 INTRODUCTION

The following Section presents an assessment of the construction phase water quality impacts which may occur as a result of the proposed work site at Pak Fuk Road. As the site will be returned to its original use after the completion of the construction works, no operational impacts will arise.

4.2 LEGISLATION

Under the *Water Pollution Control Ordinance* (WPCO)(Cap 358), Hong Kong waters are subdivided into 10 Water Control Zones (WCZ), each of which has a designated set of statutory Water Quality Objectives (WQO). The marine waters of Victoria Harbour WCZ (Phase 3) comprise the receiving water body which may be impacted by the works. Victoria Harbour WCZ was declared in three phases. Phase 1 was declared in November 1994, covering Kwai Chung, East Kowloon and their adjacent waters. Phase 2 was declared in September 1995, covering North, South and West Kowloon (including Stonecutters Island) and their adjacent waters. Phase 3, which was declared on 1 April 1996, covers the north shore of Hong Kong Island from Kennedy Town to Sai Wan Ho and its adjacent waters.

The WQOs for the Victoria Harbour WCZ (Phase 3) will be the statutory water quality criteria against which the Project will be assessed. The WQOs of most relevance during the construction phase will be those for suspended solids (SS) and dissolved oxygen (DO), as listed below:

- The level of DO should not fall below 4 mg l^{-1} for 90% of the sampling occasions during the whole year; values should be calculated as the annual water column average. In addition, the concentration of dissolved oxygen should not be less than 2 mg l^{-1} within 2 m of the seabed for 90% of the sampling occasions during the whole year.

- Human activity should not cause the SS concentration to be raised more than 30% nor give rise to accumulation of SS which may adversely affect aquatic communities.

In addition, all discharges during both the construction and operational phases of the QBR Project will be required to comply with the *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* (TM), issued under *Section 21* of the WPCO, which defines acceptable discharge limits to different types of receiving waters. Under the TM, effluents discharged into the waters of the WCZ are subject to standards for particular volumes of discharge. These are defined by the EPD and specified in licence conditions for any new discharge within a WCZ. For this assessment, the TM standards for effluents discharged into the inshore waters of Victoria Harbour WCZ will apply to the construction and operation of QBR. These discharge standards are presented in *Table 4.2a*.

Table 4.2a ***Standards for Effluents Discharged into the Inshore Waters of Victoria Harbour Water Control Zone (All Phases)***

Flow Rate (m^3 day^{-1})	≤10	>10 & ≤200	>200 & ≤400	>400 & ≤600	>600 & ≤800	>800 & ≤1000	>1000 & ≤1500	>1500 & ≤2000	>2000 & ≤3000	>3000 & ≤4000	>4000 & ≤5000	>5000 & ≤6000
Determinant												
pH	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9
Temp (°C)	40	40	40	40	40	40	40	40	40	40	40	40
Colour	1	1	1	1	1	1	1	1	1	1	1	1
SS	50	30	30	30	30	30	30	30	30	30	30	30
BOD	50	20	20	20	20	20	20	20	20	20	20	20
COD	100	80	80	80	80	80	80	80	80	80	80	80
Oil & Grease	30	20	20	20	20	20	20	20	20	20	20	20
Iron	15	10	10	7	5	4	2.7	2	1.3	1	0.8	0.6
Boron	5	4	3	2.7	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2.7	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.7	0.5	0.4	0.25	0.2	0.15	0.1	0.1	0.1
Toxic metals	2	2	1.6	1.4	1	0.8	0.5	0.4	0.3	0.2	0.14	0.1
Cyanide	0.2	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.03	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.13	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total CL	1	1	1	1	1	1	1	1	1	1	1	1
Total N	100	100	100	100	100	100	80	80	50	50	50	50
Total P	10	10	10	10	10	10	8	8	5	5	5	5
Surfactants (total)	20	15	15	15	15	15	10	10	10	10	10	10
E. coli (count per 100 ml)	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000

(All units in m gl^{-1} unless otherwise stated; all figures are upper limits unless otherwise stated)

Source: EPD (1991) *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*

4.3 SENSITIVE RECEIVERS AND BASELINE CONDITIONS

The water sensitive receivers (WSRs), and the associated baseline water quality conditions, are detailed below in accordance with the HKPSG, which provide guidelines for planning development in Hong Kong. Nearby WSRs are illustrated in *Figure 4.3a*.

Victoria Harbour is the nearest large receiving water body and WSR, which may be impacted by the works on the Pak Fuk Road construction site. In addition, those cooling water intakes along the Victoria Harbour frontage, which could be impacted by increases in SS within the water column.

The nearest biological sensitive receiver is Tung Lung Chau Fish Culture Zone. However, this is approximately 9 km from the harbour frontage adjacent to North Point, which is considered to be sufficiently far away that there is no potential for this fish culture zone to be impacted by activities on the site.

Water quality within Victoria Harbour is well documented by the EPD routine marine water quality monitoring programme. The nearest water quality monitoring station to the study area is VM2, illustrated in *Figure 4.3a*, which provides a good indication of the water quality in the vicinity of North Point.

In general the data from VM2 indicates that water quality is poor, exhibiting DO depth profiles with large gradients during the summer, when oxygen depletion occurs in the bottom layers. It is considered that this may be caused by the large amount of organic matter entering the water column from local sewage derived discharges. This is substantiated by high 5 day biological oxygen demand levels measured at Station VM2 (0.4-1.7 mg l^{-1} during 1994), and the high numbers of *E. coli* that occur on occasions (5,367-210,667 counts 100 ml^{-1} in 1994). Concentrations of SS, a parameter of key concern with regard to water quality, ranged between 3.3-14.2 mg l^{-1} and averaged 6.9 mg l^{-1} in 1994. However, this monitoring station is located at a distance of approximately 500 m from the coast in the main flow channel, and it is considered that the SS concentrations further inshore may be locally elevated as a result of polluted discharges in the area.

Although water quality within Victoria Harbour is already poor, it will be important to ensure that neither construction or operation of the project lead to further deteriorations in water quality.

The urban storm drainage system in the vicinity of Pak Fuk Road work site would be likely to be the main recipient of impacts from any contaminated surface runoff or discharge that may arise from the sites.

4.4 POTENTIAL SOURCE OF IMPACTS

Potential construction phase impacts will be associated with site runoff and construction drainage; general construction activities, sewage from the on-site construction workforce, and impacts associated with disposal of excavated material as detailed below.

Potential sources of pollution from site runoff include erosion of site surfaces and drainage channels and erosion from earthworks and stockpiles, which may contain increased loads of sediments, other SS and contaminants. Potential contaminants may include shotcrete fines, grouting materials, drainage from dust suppression sprays, and fuel, oil and lubricants from construction vehicles and

equipment.

Site runoff and construction drainage may cause physical, chemical and biological impacts. Physical effects of concern may arise from increased SS concentrations in receiving drainage systems, including accelerated siltation and blockages in stormwater drains, and impacts upon cooling water intakes such as blocked filters. Major biological effects of high suspended solids in the water column include suffocation of marine fauna and benthic biota. Other biological effects include toxicity caused by mixtures of hydrocarbons and grouting materials. Primary chemical effects could include localised elevations in pH, and accretion of solids, whereas a number of secondary effects may also result in toxic effects to marine biota due to elevated pH values, and localised increases in the proportion of un-ionised ammonia.

Construction activities will have the potential to cause water pollution from general site refuse such as food packaging and other debris which may enter the drainage system, resulting in floating refuse in the vicinity of the site. Spillages of liquids such as oil, diesel and solvents are also likely to affect water quality if they enter surrounding water bodies and drainage systems.

Sewage effluents arising from the on-site construction workforce have the potential to cause water pollution. Any effluents generated would require appropriate treatment, to meet the TM standards before discharge from the QBR construction sites.

Water quality impacts could result from marine disposal of excavated material, these could include the release of SS and associated contaminants into the water column at the disposal site and during transportation unless carefully controlled. Reuse of materials and land based disposal, the preferred options, are not expected to lead to unacceptable water quality impacts. Marine disposal of excavated material should only be regarded as the last resort after the feasibility of reuse and land-based disposal options (eg. public dump, landfills) have already been fully explored.

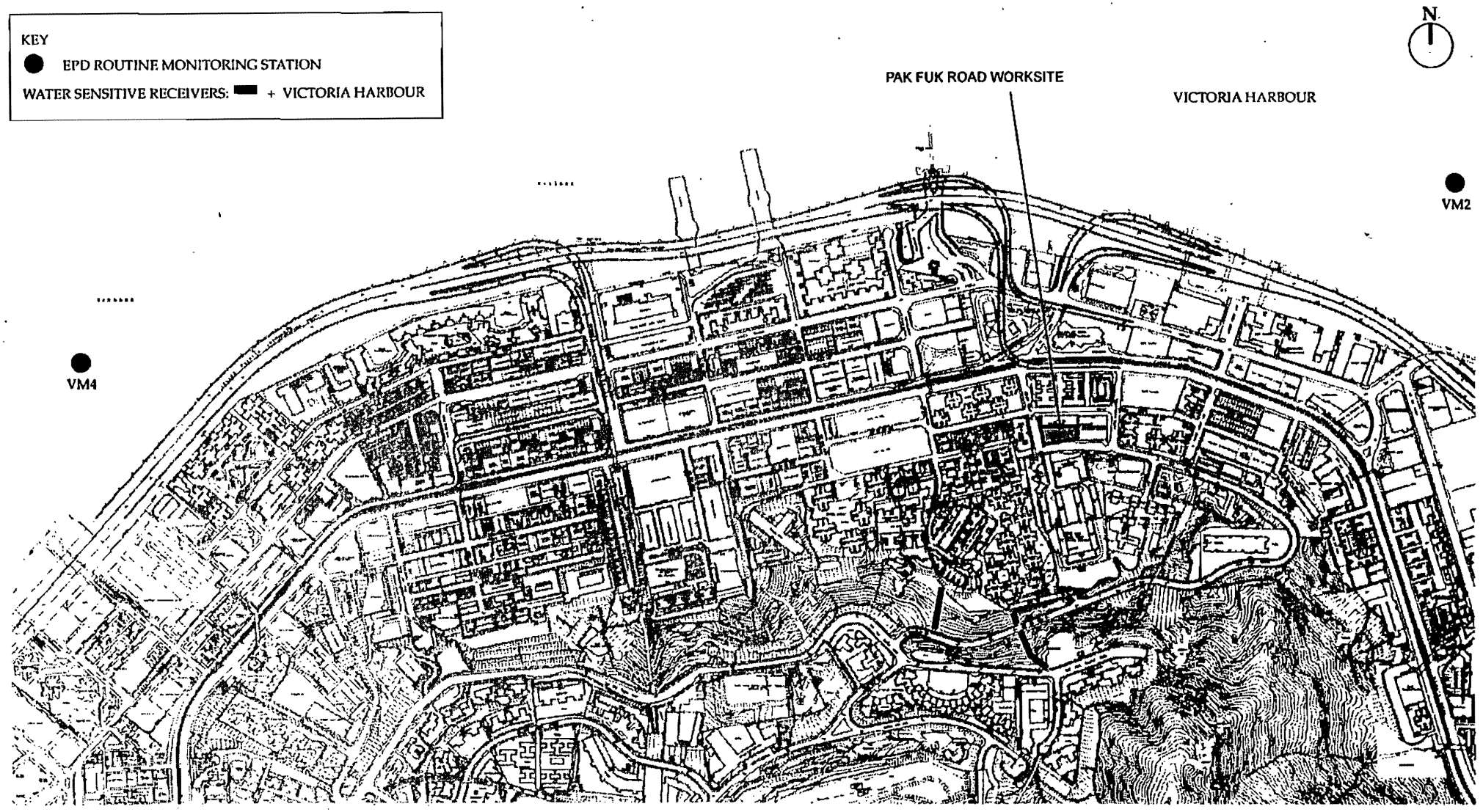
Tunnelling water will be generated by the combination of ground water inflows, seepage and wastewater used for dust suppression or in the excavation process itself and will contain increased loads of SS due to entrainment. Tunnelling water will be collected by the excavation of sumps in the floor of the tunnel and pumped in stages to the surface for disposal.

4.5 *PREDICTION OF IMPACTS*

Clearing and establishment works at the Pak Fuk Road work site will involve some small scale demolition of the existing road and car-park surfaces by sub-surface excavations to a depth of 5-15 m. Other general civil engineering works such as minor drainage and structural improvements will also be necessary to accommodate the new structures but are not considered to represent a significant source of water quality impacts.

The excavations will initially act to contain any water inflows during storm events and in this way, primary sedimentation will be achieved prior to the disposal of the water into sedimentation tanks. Potential water quality impacts are, therefore, expected to be limited.

In the vicinity of the new North Point station box, the vertical profile of the main



Location of Routine Water Quality Monitoring Stations and Water Sensitive Receivers

DATE: MAR 97

SCALE: NTS

MAUNSELL CONSULTANTS ASIA LTD

FIGURE No. 4.3a

Maunsell

line rail tunnels appears appropriate for a centralised collection point for tunnel water. Whether or not this is utilized as such, relies heavily on obtaining direct access to the surface and effective connection to and with other works. Due to the expected high volume of tunnel water likely to be discharged and the expected degree of SS loading, mitigation measures have been recommended.

It is expected that the Contractor will use a series of sumps to collect and transport tunnel water to the surface either through the access adit or vertically at a centralised location. The sumps constructed in the floor of the tunnel will act as primary sediment traps although further settlement will be required before discharge.

4.6 *EVALUATION OF IMPACTS*

The proposed site is located in the vicinity of small watercourses. However, the closest watercourse is at over 200 m distant and uphill from the site. In addition, the site is 250 m away from Victoria Harbour. Therefore, there is no direct drainage route to any WSR.

The primary concern is considered to be the impact of uncontrolled runoff on drainage systems within the site and the immediate vicinity. It is presently envisaged that approximately 100 construction workers will be stationed at Pak Fuk Road site. Owing to the lack of established guidelines on standard sewage flow rates for construction sites, the global unit flow factor for commercial/Institutional category specified in the *Sewerage Manual, Drainage Services Department, May 1995*, has been employed for the estimation of potential sewage arising from on-site workers at the proposed site. The daily volume of sewage is estimated to be 6 m^3.

Considering that the proposed site is situated within an urban area, sewage generated on-site may be directed to the established public sewer system via an appropriate connection. If connection to public sewerage is not available, it is considered feasible to use portable toilets. As such, no water quality impact is expected to arise from sewage generated by site staff.

Water quality impacts associated with the disposal of excavated materials will also be minimal. These materials will comprise both soft spoil and rock from tunnel and station excavation, which may be re-used or disposed to public dump as appropriate, with few associated water quality impacts as a result of the large particle size and the likely uncontaminated nature of the materials.

A noise enclosure will be erected to control potential noise impacts from the construction works at the proposed site. The presence of the noise enclosure will reduce the area of exposed surfaces and contribute positively to the minimisation of sediment transport. Nevertheless, effective provision to drain rainfall runoff from the surface of the noise enclosure to the nearest storm drainage system will still be required. Tunnel water will require treatment to remove SS before discharge. Appropriate mitigation measures for the minimisation of such impacts are recommended in *Section 4.7*.

Construction phase mitigation measures, in accordance with *Practice Note for Professional Persons on Construction Site Drainage, Professional Persons Environmental Consultative Committee, 1994 (ProPECC PN 1/94)* include the use of sediment traps, wheel washing facilities for vehicles leaving the site, adequate maintenance of drainage systems to prevent flooding and overflow, sewage collection and treatment, and comprehensive waste management (collection, handling, transportation, disposal) procedures.

At the start of site establishment, perimeter cut-off drains to direct off-site water around the site should be constructed and internal drainage works and erosion and sedimentation control facilities implemented. Channels, earth bunds or sand bag barriers should be provided on site to direct stormwater to such silt removal facilities. The design of efficient silt removal facilities should be based on the guidelines in *Appendix A1 of ProPECC PN 1/94*.

Construction works should be programmed to minimise surface excavation works during the rainy season (April to September). All exposed earth areas should be completed and revegetated as soon as possible after earthworks have been completed, or alternately, within 14 days of the cessation of earthworks. If excavation of soil cannot be avoided during the rainy season, or at any time of year when rainstorms are likely, exposed slope surfaces should be covered by tarpaulin or other means.

A sediment tank constructed from pre-formed individual cells of approximately 6-8 m^3 capacity is recommended as a general mitigation measure which can be used at all sites for settling wastewaters prior to disposal. The tanks are readily available and used primarily for recycling water for bored piling operations. The system capacity is flexible and able to handle multiple inputs from a variety of sources and particularly suited to applications where the influent is pumped. Various physical and chemical filters can be added should refinement of the sedimentation process be required.

Silt contained in ground water collected from tunnelling operations should be removed with properly designed silt removal facilities, such as the specified portable sedimentation tanks, such that TM standards are achieved prior to the discharge of waters into storm drains.

All drainage facilities and erosion and sediment control structures should be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms. Deposited silt and grit should be removed regularly.

Measures should be taken to minimise the ingress of rainwater into trenches. If the excavation of trenches in wet periods is necessary, they should be dug and backfilled in short sections. Rainwater pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities.

Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris entering the drainage system, and to direct storm runoff away from foul sewers. Discharge of surface runoff into foul sewers must always be prevented to avoid overloading the foul sewerage system.

Precautions to be taken at any time of year when rainstorms are likely, actions to

be taken when a rainstorm is imminent or forecast, and actions to be taken during or after rainstorms, are summarised in *Appendix A2 of ProPECC PN 1/94*. Particular attention should be paid to the control of silty surface runoff during storms event.

All vehicles and plant should be cleaned before leaving a construction site to ensure no earth, mud, debris and the like is deposited off site. An adequately designed and sited wheel washing bay should be provided at every site exit and wash-water should have sand and silt settled out and removed at least on a weekly basis to ensure the continued efficiency of the process. The section of access road leading to, and exiting from, the wheelwash bay to the public road should be paved with sufficient backfall toward the wheelwash bay to prevent vehicles tracking soil and silty water onto public roads.

It should also be noted that all discharges into any drainage or sewerage systems, or inland or coastal waters, or into the ground (e.g. from septic tanks) are controlled under the WPCO, except the discharge of domestic sewage into foul sewers or the discharge of unpolluted water into storm drains or into inland and marine waters of Hong Kong.

4.8 CONCLUSIONS

Based on the primarily underground nature of the works and the remote location from Victoria Harbour, it is considered that there will be no exceedances of the established water quality criteria associated with the construction works at the proposed site.

Whilst the protection of local storm drainage systems from potential blockage caused by the discharge of silt laden runoff from both surface and tunnel waters, has been identified as a concern, it is considered that any impacts can be readily controlled to within acceptable levels by adoption of the recommended mitigation measures and good site management techniques.

5 SOLID WASTE MANAGEMENT

5.1 INTRODUCTION

This Section identifies the potential waste arisings from the construction works at the proposed work site at Pak Fuk Road and assesses the potential environmental impacts resulting from these wastes.

The options for the minimisation, treatment, storage, collection, transport and disposal of waste arisings from the proposed site have been examined. Procedures for waste reduction and management are considered and mitigation measures for minimising the impacts of the wastes are recommended.

5.2 LEGISLATION

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

- Waste Disposal Ordinance (Cap 354);
- Waste Disposal (Chemical Waste) (General) Regulation (Cap 354);
- Crown Land Ordinance (Cap 28); and
- Public Health and Municipal Services Ordinance (Cap 132) - Public Cleansing and Prevention of Nuisances (Urban Council) and (Regional Council) By-laws.

Waste Disposal Ordinance

The *Waste Disposal Ordinance* (WDO) prohibits the unauthorised disposal of wastes, with waste defined as any substance or article which is abandoned. Construction waste is not directly defined in the WDO but is considered to fall within the category of "trade waste". Trade waste is defined as waste from any trade, manufacturer or business, or any waste building, or civil engineering materials, but does not include animal waste.

Under the WDO, wastes can only be disposed of at a licensed site. A breach of these regulations can lead to the imposition of a fine and/or a prison sentence. The WDO also provides for the issuing of licences for the collection and transport of wastes. Licences are not, however, currently required to be issued for the collection and transport of construction and/or trade waste.

Waste Disposal (Chemical Waste) (General) Regulation

Chemical wastes as defined under the *Waste Disposal (Chemical Waste) (General) Regulation* includes any substance being scrap material, or unwanted substances specified under Schedule 1 of the Regulations, if such substance or chemical occurs in such a form, quantity or concentration so as to cause pollution or constitute a danger to health or risk of pollution to the environment.

A person should not produce, or cause to be produced, chemical wastes unless he is registered with the EPD. Any person who contravenes this requirement commits an offence and is liable upon conviction, for a first offence, to a fine of up to HK$200,000 and to imprisonment for up to 6 months. The current fee for registration is HK$240.

Producers of chemical wastes must treat their wastes, utilising on-site plant licensed by the EPD, or have a licensed collector take the wastes to a licensed facility. For each consignment of wastes, the waste producer, collector and disposer of the wastes must sign all relevant parts of a computerised trip ticket. The transfer of wastes from cradle to grave can, therefore, be traced.

The Regulations prescribe the storage facilities to be provided on site including labelling and warning signs. To minimise the risks of pollution and danger to human health or life, the waste producer is required to prepare and make available written procedures to be observed in the case of emergencies due to spillage, leakage or accidents arising from the storage of chemical wastes. He must also provide employees training in such procedures.

Crown Land Ordinance

Construction wastes which are wholly inert may be taken to public dumps. Public dumps usually form part of land reclamation schemes and are operated by the CED. The *Crown Land Ordinance* requires that dumping licences are obtained by individuals or companies who deliver suitable construction wastes to public dumps. The licences are issued by the CED under delegated powers from the Director of Lands.

Individual licences and windscreen stickers are issued for each vehicle involved. Under the licence conditions public dumps will accept only inert building debris, soil, rock and broken concrete. There is no size limitation on the rock and broken concrete, and a small amount of timber mixed with other suitable material is permissible. The material should, however, be free from marine mud, household refuse, plastic, metal, industrial and chemical waste, animal and vegetable matter and any other material considered unsuitable by the dump supervisor.

Public Cleansing and Prevention of Nuisances

These Regulations provide a further control on the illegal tipping of wastes on unauthorised (unlicensed) sites. The illegal dumping of wastes can lead to fines of up to HK$10,000 and imprisonment for up to 6 months.

5.3 SENSITIVE RECEIVERS AND BASELINE CONDITIONS

Sensitive receivers in the direct vicinity of the Pak Fuk Road work site affected by:

- windblown dust and debris and vehicle exhaust are addressed in *Section 2*;
- noise from excavation, construction and transport activities and mechanical plant are addressed in *Section 3*; and
- contaminated or sediment-laden runoff from site surfaces are addressed in *Section 4*.

Thus, the sensitive receivers with respect to waste management, have been identified in *Sections 2, 3 and 4*. These receivers may be affected by the storage, handling, collection, transport and disposal of waste generated by the construction and operation of the QBR. Baseline conditions have also been described in the previous sections.

In addition, as a health and safety consideration, construction site personnel, and waste handling and transport personnel (other than specialist chemical waste/contaminated materials personnel), should be protected with respect to

chemical wastes and contaminated materials, as they do not possess the training, expertise and specialist equipment to deal with contaminated materials according to proper procedures.

The landfill, public dump or fill site at which waste is disposed, and its surrounding area, may be affected by waste disposal. For routine wastes, being general refuse, construction and demolition waste, and excavated inert materials, such disposal sites are not relevant to this study. This is because all are covered by their own EIA, EM&A and mitigation procedures; and appropriate disposal of the above routine waste types at these facilities is routine and legal. As such, neither the QBR contractors nor the MTRC have any responsibility for analysis or mitigation of impacts occurring at these disposal sites as a result of disposal of wastes generated at the proposed Pak Fuk Road site.

The proposed site is currently used as car park, land contamination is not anticipated. However, it should be noted that public dumps and fill sites will not accept chemical wastes or contaminated wastes, and none of the Strategic Landfills accept such wastes on a routine basis. In the case of chemical wastes and contaminated materials arising from the site, any handling, transportation and disposal require specialist procedures. The procedures for the transportation and disposal of chemical wastes or excavated contaminated materials, should be agreed in writing with the EPD prior to the removal of these materials from site.

5.4 *POTENTIAL SOURCES OF IMPACTS*

Construction activities will result in the generation of a variety of wastes which can be divided into distinct categories based on their constituents, as follows:

- excavated inert material;
- construction and demolition waste;
- chemical wastes; and
- general refuse

The definitions for each of these categories, and the nature of their arisings and potential impacts are discussed in detail below. The definitions of each waste type are provided for the purposes of this report, with the exception of chemical waste which is defined in the *Waste Disposal (Chemical Waste)(General) Regulation.*

Excavated Inert Material

Excavated inert material is defined as inert virgin material removed from the ground and sub-surface excluding any wastes or fill which may have been placed there previously. Excavated material will be generated from excavation of the ground and sub-surface of the proposed site and from the tunnel construction. Material from rock excavation will comprise volcanics or granite, with those portions from the surface and shallow sub-surface being partially or completely decomposed.

Some 180,000 m^3 of inert excavated material will be generated by the QBR construction. In addition to the proposed site at Pak Fuk Road, there will be five construction sites; one site in Quarry Bay, three at North Point and one at Fortress Hill, hence, it is anticipated that 30,000 m^3 of inert excavated material will be removed from the Pak Fuk Road work site.

Construction and Demolition Waste

Construction waste is defined as any unwanted materials generated during construction, including rejected structures and materials and materials used and discarded. Construction waste will arise from a number of different activities carried out by the Contractor during construction and maintenance activities; and may include:

- wood from formwork;
- equipment and vehicle maintenance parts, including materials used in tunnel boring;
- materials and equipment wrappings;
- unusable cement/grouting mixes; and
- damaged or contaminated construction materials.

The volume of construction waste generated at the Pak Fuk Road work site will be dependent on the operating procedure and site practices. At this stage, it is not possible to predict accurately the amount of construction waste that will be generated. However, a preliminary estimate can be made based upon previous projects. On the major construction sites employing about 100 workers, 20 m^3 per month of construction waste is estimated.

The proposed site is currently a car park and the volume of demolition waste will be very low. At completion of the works at each site, the noise enclosure will be dismantled, producing a small amount of demolition waste.

Chemical Waste

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

- scrap batteries or spent acid/alkali from their maintenance;
- used engine oils and hydraulic fluids, waste fuel;
- mechanical machining producing spent mineral oils/cleaning fluids including materials used in tunnel boring; and
- equipment cleaning activities producing spent solvents/solutions which may be halogenated.

At this stage, it is not possible to predict accurately the amount of chemical waste that will be generated. However, based upon similar projects, it is estimated that the proposed site will probably produce 450 l of waste fuel, oils and other liquid wastes each month.

General Refuse

General refuse will include any waste that does not fit into any of the categories previously described. The presence of a construction site will result in the generation of a variety of general refuse materials requiring disposal. General refuse may include food wastes and packaging, waste paper, etc. To quantify the amount of general refuse that will be generated, EPD's figure for domestic waste generation (1994) is used, being 1.04 kg $person^{-1}$ day^{-1}. As the site personnel are only present for the work day, a scale factor of 0.5 is used. Thus, the proposed

site will likely produce approximately 50 kg of general refuse per day.

5.5 ASSESSMENT METHODOLOGY

The assessment of environmental impacts from waste generation is based on three factors:

- the type of waste generated;
- the amount of principal waste types generated; and
- the proposed reuse, storage, transport, treatment and disposal methods, and the impacts of these methods.

5.6 PREDICTION AND EVALUATION OF IMPACTS

Excavated Inert Materials

There will be considerable volumes of excavated material generated by the QBR construction. Due to the nature of the works, the reuse of excavated materials on site will be minimal and therefore the majority of these materials will have to be disposed off-site. It is likely that the materials will be used as reclamation fill because of their suitability and the availability of reclamation fill sites. As explained in *Section* 5.3, potential impacts from excavated materials are covered in *Sections 2, 3 and 4.*

Construction and Demolition Waste

The storage, handling, transport and disposal of construction and demolition wastes have the potential to create similar visual, water, dust and associated traffic impacts as the storage and disposal of excavated materials.

The disposal of construction and demolition wastes is unlikely to raise any long term concerns because of the inert nature of most construction wastes. To conserve void space at landfill sites, construction waste must not be disposed of at a landfill site if it contains more than 20% inert material by volume. It is therefore good practice to segregate wastes at construction sites before disposing of inert materials at public dumps for reclamation works and putrescible materials at a controlled landfill site. However, the limited space on the work site may prevent effective sorting.

Chemical Waste

Chemical wastes may pose serious environmental and health and safety hazards if not stored and disposed of in an appropriate manner as outlined in the *Chemical Waste Regulations* and the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes.* These hazards include:

- toxic effects to workers;
- adverse effects on air, water and land from spills;
- fire hazards; and
- disruption of sewage treatment works where waste enters the sewage system.

Chemical wastes will arise principally as a result of maintenance activities. It is difficult to quantify the amount of chemical waste which will arise from the

construction activities since it will be highly dependent on the Contractor's on-site maintenance requirements and the numbers of plant and vehicles utilised.

General Refuse

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

The environmental impacts from the various waste types are summarised in *Table 5.6a*.

Table 5.6a ***Summary of Impacts from Waste Arisings***

Waste Type	General Evaluation
Excavated Inert Materials	An estimated 30,000 m^3 will be generated. The materials are not considered likely to generate adverse disposal related environmental impact because they will be used as reclamation fill. Significant air, water and noise impacts may occur as detailed in *Sections 2, 3 and 4.*
Construction and Demolition Waste	Estimated generation is 360 m^3 of construction waste. Due to the inert nature of most construction waste and the availability of public dump sites, disposal not likely to raise long term environmental concerns.
Chemical Waste	An estimated 8100 l of maintenance materials such as used lubricating oils will be produced. Storage, handling, transport and disposal must be in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes.* Provided that this occurs, and chemical wastes are disposed of at a licensed facility, the contractor and the MTRC should be in compliance with all relevant regulations.
General Refuse	Estimated generation is 23.6 te. If good practice is adhered to and all feasible avoidance and reuse opportunities are taken, non-compliances with the relevant regulations should not occur.

5.7 MITIGATION MEASURES

Storage, transportation and disposal measures to avoid or minimise potential adverse impacts associated with waste arisings from the construction of the facility are recommended as below.

Waste Management Hierarchy

Various options within waste management can be categorised in terms of preference from an environmental viewpoint. The options considered to be more preferable have the least impacts and are more sustainable in a long term context. Hence, the hierarchy is as follows:

- avoidance, ie not generating waste through changing or improving processes;
- reuse of materials, thus avoiding disposal; and
- disposal, according to relevant laws, guidelines and good practice. The

Waste Disposal Authority should be consulted by the Contractor on the final disposal of wastes.

This hierarchy should be used to evaluate waste management options, thus allowing maximum waste reduction and often reducing costs. For example, by reducing or eliminating over-ordering of construction materials, waste is avoided, eliminating the need for other, more complex management options, and purchasing costs are reduced.

Excavated Inert Materials

Excavated materials are not considered likely to cause adverse impacts, since they will be used as reclamation fill, which is considered a useful reuse of the material. As such, mitigation measures are not considered necessary. There are potentially significant impacts relating to air, water and noise which could result from the generation of excavated materials. As explained in *Section 5.3*, potential impacts due to excavated materials are covered in *Sections 2, 3 and 4.*

Any uncontaminated inert materials may be delivered to public dumps and fill sites, those public dumps and fill sites which will be in operation concurrently with the QBR excavation works, and their capacities, are listed in *Table 5.7a and 5.7b.*

Table 5.7a ***Public Dumps Operating Concurrent with the QBR Excavation Works***

Public Dump	Capacity during 1997-98 (m^3)
Tuen Mun Area 38 Reclamation	400000
Pak Shek Kok Reclamation	530000
Tseung Kwan O Area 137 Stage II	770000
Total Capacity	1700000

Source: *Civil Engineering Department, Port Works Division, April 1996.*
Predicted Total Arisings from the Pak Fuk Road work site (m^3) is 30360.

Table 5.7b ***Fill Sites Operating Concurrent with the QBR Excavation***

Fill Site Project Name	Start Date	End Date	Volume (m^3)
Shek Wu Hui Package 4	01/01/95	31/12/98	800000
River Trade Terminal in Tuen Mun Area 36	01/05/96	01/12/98	1810000
Yuen Long (SW) Extension Site Formation Rd & Drain Work	01/10/97	01/10/00	600000
Lantau Port Development	01/01/98	31/12/11	16390000
Total Capacity			19600000

Projected Total Rock and Soft Arisings from QBR Excavation (m^3) is 30000.

From *Tables 5.7a and 5.7b*, it can be seen that the public dump and fill sites have combined capacity of approximately 21.3 million m^3, greatly in excess of the inert

material arisings from QBR. As such, it is anticipated that no disposal difficulties will occur. The majority of the inert materials will most likely go to fill sites, with public dumps receiving materials in the event that fill sites are not available or the materials do not meet the requirements for fill sites.

Construction and Demolition Waste

It is not possible to predict accurately the likely generation rates at this time, although the volumes are estimated to be relatively low. Due to the inert nature of most construction waste and the availability of public dump sites, disposal is not likely to raise long term environmental concerns. However, minimisation measures should be taken, as described below.

Careful planning and good site management can minimise over ordering and waste of materials such as concrete, mortars and cement grouts. If feasible, the noise enclosure should be designed so that the materials are reusable after they have been dismantled and removed, thereby not generating demolition waste. The design of formwork could maximise the use of standard wooden panels so that high reuse levels can be achieved. Alternatives such as steel formwork or plastic facing could be considered to increase the potential for reuse.

In accordance with the *New Disposal Arrangements for Construction Waste, Environmental Protection Department and Civil Engineering Department, 1992,* disposal of construction waste can either be at a specified landfill, or a public dump, with the latter being the preferred option. Construction and demolition wastes currently occupy approximately 60-70% of the void in active landfills, and to extend landfill life, Government policy prohibits the disposal of construction waste at landfill if it contains more than 20% inert material by volume. Such inert wastes are directed to reclamation areas, where they have the added benefit of offsetting the need for removal of materials from terrestrial borrow areas.

If landfill disposal has to be used, the wastes will most likely be delivered to the SENT Landfill.

The requirements for the handling and disposal of bentonite slurries should follow the *Practice Note For Professional Persons - Construction Site Drainage, Professional Persons Consultative Committee, 1994* (ProPECC PN 1/94).

At the present time, Government is developing a charging policy for the disposal of waste to landfill, which will provide an additional incentive to reduce waste when implemented.

Chemical Waste

For those processes which generate chemical waste, it may be possible to find alternatives which generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste.

Chemical waste that is produced, as defined by *Schedule 1* of the *Waste Regulations (Chemical) 1992,* should be handled as follows.

Containers used for the storage of chemical wastes should:

- be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;

- have a capacity of less than 450 l unless the specifications have been approved by the EPD; and
- display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.

The storage area for chemical wastes should:

- be clearly labelled and used solely for the storage of chemical waste;
- be enclosed on at least 3 sides;
- have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest;
- have adequate ventilation;
- be covered to prevent rainfall entering (water collected within the bund must be tested and disposed as chemical waste if necessary); and
- be arranged such as to separate incompatible materials.

Disposal of chemical waste should:

- use a licensed waste collector; and
- be to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Facility (which offers both a chemical waste collection service and supply the necessary storage containers); or
- be to a reuser of the waste, under approval from the EPD. Note that the Centre for Environmental Technology operates a Waste Exchange Scheme which can assist in finding receivers or buyers.

General Refuse

General refuse generated on-site should be stored in enclosed bins or compaction units separate from construction and chemical wastes. A reputable waste haulier should be employed by the Contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily or every second day basis to minimise odour, pest and litter impacts. The burning of refuse on construction sites is prohibited by law.

General refuse is generated largely by food service activities on site, so reusable rather than disposable dishware should be used if feasible. Aluminium cans are often recovered from the waste stream by individual collectors if they are segregated or easily accessible, so separate, labelled bins should be provided if feasible.

Summary

This section describes waste management requirements and provides practical actions which can be taken to minimise the impacts arising as a result of the generation, storage, handling, transport and disposal of wastes. Waste reduction is best achieved at the planning and design stage, as well as by ensuring that

processes are run in the most efficient way. For unavoidable wastes, reuse, and optimal disposal are most practical when segregation occurs on the construction site, as follows:

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

The criteria for sorting solid waste is described in the *New Disposal Arrangements for Construction Waste*. Waste containing in excess of 20% by volume of inerts should be segregated from waste with a larger proportion of putrescible material.

Proper storage and site practices will minimise the damage or contamination of construction materials. If space permits, on site measures may be implemented which promote the proper disposal of wastes once off-site. For example having separate skips for inert (rubble, sand, stone, etc) and non-inert (wood, organics, etc) wastes would help ensure that the former are taken to public dumps, while the latter are properly disposed of at controlled landfills. Since waste brought to public dumps will not be charged, while those brought to landfill may be charged, separating waste may also help to reduce waste disposal costs.

Specifically, it is recommended that:

- wastes should be handled and stored in a manner which ensures that they are held securely without loss or leakage thereby minimising the potential for pollution;

- only reputable waste hauliers authorised to collect the specific category of waste concerned should be employed;

- removal of demolition wastes should coincide with the demolition work;

- appropriate measures should be employed to minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers;

- the necessary waste disposal permits should be obtained from the appropriate authorities, if they are required, in accordance with the *Waste Disposal Ordinance (Cap 354), Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)* and the *Crown Land Ordinance*;

- collection of general refuse should be carried out frequently, preferably daily;

- waste should only be disposed of at licensed sites and site staff and the civil engineering Contractor should develop procedures to ensure that illegal disposal of wastes does not occur;

- waste storage areas should be well maintained and cleaned regularly.

Training

Training and instruction of construction staff should be given at the site to increase awareness and draw attention to waste management issues and the need

to minimise waste generation.

5.8 CONCLUSIONS

Provided that the recommendations put forward in this report are conscientiously acted upon, no waste related regulatory non-compliances should occur as a result of the storage, handling, collection, transport, and disposal of wastes arising from the Pak Fuk Road work site for QBR construction.

The major area for concern will be the excavated material arisings, which amount to an estimated 30,000 m^3. The public dumps and reclamations operating concurrent with the proposed works have capacity well in excess of the arisings from the proposed work site. As such, excavated material arisings are not considered to be a problem from a waste management perspective as the materials will be used as reclamation fill.

6 LANDUSE AND VISUAL IMPACT

6.1 INTRODUCTION

The proposed Pak Fuk Road work site currently used as car-park. The landuses in the vicinity of the site are mainly high-rise residential uses, community facilities, roads and commercial complex. Although there are recreational parks to the east and south-east of the site, there is no evidence that they support species of conservation importance, the site is considered to be of low ecological value. Nevertheless, there is a row of trees along Pak Fuk Road and they should be maintained at good condition during the construction period. This Section focuses on the land use, landscape and visual impacts that may arise from the use of the construction sites identified for the proposed work site.

6.1 LEGISLATION

There is no legislation in Hong Kong that relates directly to the assessment of the landscape or visual impacts of construction sites. A degree of control is achieved through the requirement to address visual issues as part of an environmental review and assessment process. The EPD advice note *2/90 Application of the EIA Process to Major Private Sector Projects*, identifies visual impact as being an issue of concern to be addressed. In addition, HKPSG (Chapter 10-Landscape and Conservation), outlines those criteria which should be considered when planning in an urban environment.

Government legislation restricts developers from making changes to existing land levels and from felling trees. Government restrictions on the preservation and felling of trees in Hong Kong are detailed in *Government General Regulation 740.*

6.2 SENSITIVE RECEIVERS AND BASELINE CONDITIONS

The proposed site is located within an established part of the North Point district. The area consists of mainly residential and G/IC uses. Density of development is generally high within this area. The G/IC uses, including a health clinic, market building and teaching centre adjacent to the proposed site comprise of two to six storeys. The residential uses range from low-rise (6 storey) to high rise (30 storey).

The proposed site comprises a flat portion of land together with adjacent area of road-side slope behind Pak Fuk Road, it is currently occupied by a car park. The car park area and the road-side slope are currently zoned 'G/IC' on the North Point OZP (No. S/H8/5) and held under Government Lease. The lease conditions contain a provision that Government has full power to resume the piece of land for the improvement of Hong Kong or for any other public purpose whatsoever. In this case, the resumption of the car park for the MTR extension qualifies as a public purpose.

The site is over-looked by a number of residential properties including those located at Tsat Tsz Mui Road, Healthy Street West and those properties located at Tanner Road and Kai Yuen Terrace to the west of Healthy Street West. The Teaching Centre and Health Clinic will also have clear views of the site.

6.3 POTENTIAL SOURCES OF IMPACTS

The proposed use of the site for construction purposes is likely to pose various land-use, landscape and visual impacts on the surrounding areas and their populations during the construction stage. Land-use impacts would primarily be visual and noise disturbance to nearby uses as well as disruption to some existing pedestrian linkages and vehicular routes.

The elements of the proposed construction work that would have a visual impact on the surrounding areas and their population include storage of materials and machinery, fencing for site security, noise enclosure and temporary huts. In addition, there would be vehicular traffic associated with these construction works. Potential impacts on the physical landscape, namely temporary changes to the landform. All of the above land-use, visual and landscape impacts may be reduced to some extent at construction stage by the introduction of appropriate mitigation measures.

6.4 ASSESSMENT METHODOLOGY

A site visit was conducted on 10 January 1997 to gain an overview of the existing physical development of the proposed site and the characteristics and features of the surrounding developments. Information gathered from the site visit was used to assess the potential impacts of the proposed construction site on the landscape and on adjacent land uses.

Areas of the surrounding landscape where views of the proposed construction activities would be possible have been identified together with the populations that would be affected by those views. The affected populations have been categorised into groups of sensitive receivers. An assessment has been made of the significance of these views to those receiver groups. A series of mitigation measures has then been identified to help reduce the potential visual impacts.

6.5 PREDICTION OF IMPACTS

Given the tight street-block development in North Point, the adjoining land uses are in close proximity to the site and therefore are readily exposed to impacts from construction activities. Construction activities would also affect current pedestrian links and vehicular traffic in some areas given the high amount of traffic and pedestrian movements in this busy and congested part of North Point, especially Healthy Street Road West.

Stored materials and machinery, structures under construction, excavation works, temporary huts and security fencing may all be elements that would be visible outside the site at an early stage in the construction process. However, the site will be enclosed by the noise enclosure. This structure when completed will screen views of many of these elements. The noise enclosure structure itself will also be visible both during and after its construction. All the above features would create visual impacts on residents, users of surrounding properties and pedestrians.

6.6 EVALUATION OF IMPACTS

Given the high density development within the North Point area, there are many sensitive receivers located in the vicinity of the proposed construction sites. The proposed site is surrounded by high-density residential and G/IC facilities which would be adversely affected by construction activities. It is envisaged that the construction activities here would also affect the busy Healthy Street West and Tsat Tsz Mui Road due to frequent movement of trucks and construction vehicles. This would cause inconvenience to the surrounding residential areas.

Visual impact would be due to the generally unsightly appearance of any construction activities; erection of a noise enclosure, storage of materials, the movement of machinery and drainage alterations. However, low level visual impacts are predicted after the completion of the noise enclosure structure on all of the above viewers, except pedestrians using the adjacent footpath. Pedestrians would have clear views of the construction activities as these would be seen through the vehicular entrance to the noise enclosure.

In the context of the surrounding buildings, the presence of the noise enclosure structure itself would generally represent a low level visual impact. However, high level visual impacts would affect residents of the lower floors of the Nos. 1-11 Healthy Street West which overlooks the vehicle entrance to the enclosure. High level visual impacts would again be generated at a later stage in the project as the noise enclosure structure is dismantled.

6.7 MITIGATION MEASURES

Given that the construction sites are located amidst densely developed and populated areas of North Point, all require landuse impact mitigation measures to alleviate impacts on the adjacent sensitive receivers. The construction area should be effectively cordoned off and access to the site restricted. The row of trees along Pak Fuk Road should, if practicable, be retained and protected from adverse impacts from construction activities. In addition, consideration will have to be given to management of traffic within the area during the construction stage where there would be frequent movement of trucks and heavy vehicles into and out of the construction site.

6.8 CONCLUSIONS

The land use impacts of the proposed construction site are generally high during the construction stage as there are sensitive adjacent land uses. In addition, there will be traffic issues to be considered. Mitigation measures should be introduced to alleviate these problems. The construction site will be restored to its previous use which are generally compatible with the existing developments in the vicinity and the impacts are considered to be temporary.

For landscape and visual impacts, potential impacts are anticipated during the construction stage. However, many of the potential visual impacts and some of the potential landscape impacts may be reduced by the mitigation measures described above.

An additional work site for the Quarry Bay Relief Works (QBR) is proposed at Pak Fuk Road. The Site will only be required during the construction phase, after which it will be returned to its original use as a car park. There will, therefore, be no operational impacts associated with this site. Potential environmental impacts arising during the construction phase upon air quality, noise, water quality, waste and landuse and visual impacts have been assessed.

Fugitive dust has been identified as a potential air quality impact from the construction work at the proposed work site at Pak Fuk Road. However, the construction works will be small in scale and the predicted dust levels at all ASRs are within the identified criteria. Mitigation measures have, however, been recommended for good house-keeping.

Noise has been identified as the main impact arising from the construction work within the proposed work site at Pak Fuk Road. In the absence of any mitigation measures, noise levels that exceed the accepted voluntary daytime noise limits are predicted at the neighbouring NSRs. A noise enclosure is necessary to mitigate daytime construction noise during excavation and underground station construction which will last for 33 months. The use of the enclosure, plus other mitigation measures, including the use of moveable barriers, quiet plant and a reduction in the total number of plant in use at any one time, predicted noise exceedances at NSRs during the main construction period can be avoided.

During site preparation prior to the provision of the noise enclosure, exceedances of up to 13 dB(A) above the recommended noise criterion have been predicted during a 2-3 week period at the Anne Black Health Clinic. Similarly, during the final three months of the construction programme after the enclosure has been removed, residual exceedances of up to 8 dB(A) at the Anne Black Health Clinic and 3 dB(A) at the Teaching Centre are predicted. However, in view of the the fact that the works will enable the provision of the noise enclosure which will provide long term noise mitigation (29 months of a 33 month construction programme), the short duration of the exceedances, and that all practicable mitigation measures have been applied, these exceedances are considered acceptable within the context of the project.

The provision of the enclosure should enable the evening noise criterion to be met, so that working hours could be extended to at least 23.00. However, as a result of the dense residential development in the area, it is unlikely that the night-time noise limit of 40 dB(A) is achievable by available mitigation measures Any activities undertaken during restricted hours will only be allowed under the control of a CNP.

Based on the primarily underground nature of the works and the remote location from Victoria Harbour, it is considered that there will be no exceedances of the established water quality criteria associated with the construction works at the proposed site.

No waste related regulatory non-compliances should occur as a result of the storage, handling, collection, transport, and disposal of wastes arising from the Pak Fuk Road work site for QBR construction with the implementation of the recommended mitigation measures. The total amount of wastes, including excavated materials and general refuse waste from the proposed work site are

small in quantity. Public dumps and reclamations operating concurrently with the proposed works have capacity well in excess of the arisings from the proposed work site. As such, excavated material arisings are not considered to be a problem from a waste management perspective as the materials will be used as reclamation fill.

Potential landscape and visual impacts are anticipated during the construction stage. However, these can be controlled by the implementation of the proposed mitigation measures.

Annex A

Calculation of Sound Power Levels and Prediction of Noise Levels at NSRs

Predicted Noise Levels from Worksite at Pak Fuk Road									
worksite	Activity ref	period (months)	SWL	Ruby Court NSR1	Nos1-11 Healthy St W NSR2	Police Quarters NSR3	Teaching Centre NSR4	Library[1] NSR5	Health Clinic NSR6
Minimum distance to construction activities				43m	30m	42m	31m	30m	10m
Without mitigation measures									
	Site Prep (Initial)	0.5	123	85	88	85	88	78	98
	Site Prep (Final)	2.5	115	77	80	78	80	70	90
	Excavation (initial)	6	119	81	84	81	84	74	94
	Excavation (final)	9	118	80	83	80	83	73	93
	Station Constr	12	117	79	82	79	82	72	92
	Enclosure removal	2	117	79	82	79	82	72	92
	Enclosure foundationr	1	118	80	83	80	83	73	93
Mitigation 1 - Use of quiet plant									
	Site Prep (Initial)	0.5	122	85	88	85	87	78	97
	Site Prep (Final)	2.5	108	70	73	71	73	63	83
	Excavation (initial)	6	113	75	78	76	78	68	88
	Excavation (final)	9	115	77	80	78	80	70	90
	Station Constr	12	115	77	80	78	80	70	90
	Enclosure removal	2	108	70	73	71	73	63	83
	Enclosure foundationr	1	111	74	77	74	77	67	86
Mitigation 2 - Use of quiet plant + barrier									
	Site Prep (Initial)	0.5	113	75	78	76	78	68	88
	Site Prep (Final)	2.5	106	69	72	69	71	62	81
	Excavation (initial)	6	113	75	78	76	78	68	88
	Excavation (final)	9	115	77	80	78	80	70	90
	Station Constr	12	115	77	80	78	80	70	90
	Enclosure removal	2	106	69	72	69	71	62	81
	Enclosure foundationr	1	108	70	73	70	73	63	83
Mitigation 3 - Use of QP + barrier + reducing no. of plant									
	Site Prep (Initial)	0.5	113	75	78	76	78	68	88
	Site Prep (Final)	2.5	106	69	72	69	71	62	81
	Excavation (initial)	6	112	75	78	75	77	68	87
	Excavation (final)	9	114	76	79	76	79	69	89
	Station Constr	12	114	76	79	76	79	69	89
	Enclosure removal	2	106	69	72	69	71	62	81
	Enclosure foundationr	1	108	70	73	70	73	63	83
Mitigation 4 - Use of QP + barrier + reducing no. of plant + noise enclosure									
	Site Prep (Initial)	0.5	113	75	78	76	78	68	88
	Site Prep (Final)	2.5	106	69	72	69	71	62	81
	Excavation (initial)*	6	112	55	58	55	57	48	67
	Excavation (final)*	9	114	56	59	56	59	49	69
	Station Constr*	12	114	56	59	56	59	49	69

Note: [1] -10 dB attenuation included for Library where central air conditioning is provided

Table A1.1a Pak Fuk Road- No Mitigation					
	Noise Source	TM ref	Unit	SWL	Total - SWL
Site Preparation (Initial) (including construction of noise enclosure)	excavator mounted breaker	CNP027	1	122	122
	lorry	CNP141	1	112	112
	loader	CNP081	1	112	112
				PHASE TOTAL SWL	**123**
Site Preparation (Final) (including construction of noise enclosure)	lorry	CNP141	1	112	112
	loader	CNP081	1	112	112
				PHASE TOTAL SWL	**115**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	112	115
	mobile crane	CNP048	1	112	112
	compressor	CNP003	1	104	104
	excavator	CNP081	1	112	112
	hoist	CNP121	1	108	108
	water pump	CNP282	1	103	103
				PHASE TOTAL SWL	**119**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	112	115
	mobile crane	CNP048	1	112	112
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP282	1	103	103
				PHASE TOTAL SWL	**118**
Station Constr	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	2	109	112
	mobile crane	CNP048	1	112	112
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump	CNP282	1	103	103
				PHASE TOTAL SWL	**117**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry	CNP141	2	112	115
	mobile crane	CNP048	1	112	112
				PHASE TOTAL SWL	**117**
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor	CNP003	1	104	104
	loader	CNP081	1	112	112
	lorry	CNP141	2	112	115
	breaker	CNP024	1	108	108
				PHASE TOTAL SWL	**118**

Table A1.1b Pak Fuk Road - Use of Quiet Plant					
	Noise Source	TM ref	Unit	SWL	Total - SWL
Site Preparation (Initial) (including construction of noise enclosure)	excavator mounted breaker	CNP027	1	122	122
	lorry (QP)	CNP141	1	105	105
	loader (QP)	CNP081	1	105	105
				PHASE TOTAL SWL	**122**
Site Preparation (Final) (including construction of noise enclosure)	lorry (QP)	CNP141	1	105	105
	loader (QP)	CNP081	1	105	105
				PHASE TOTAL SWL	**108**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry (QP)	CNP141	2	105	108
	mobile crane (QP)	CNP048	1	105	105
	compressor (QP)	CNP003	1	100	100
	excavator (QP)	CNP081	1	105	105
	hoist	CNP121	1	108	108
	water pump (QP)	CNP281	1	88	88
				PHASE TOTAL SWL	**113**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	2	109	112
	mobile crane (QP)	CNP048	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump (QP)	CNP281	1	88	88
				PHASE TOTAL SWL	**115**
Station Constr	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	2	109	112
	mobile crane (QP)	CNP048	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump (QP)	CNP281	1	88	88
				PHASE TOTAL SWL	**115**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry (QP)	CNP141	1	105	105
	mobile crane (QP)	CNP048	1	105	105
				PHASE TOTAL SWL	**108**
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor (QP)	CNP003	1	100	100
	lorry (QP)	CNP141	1	105	105
	loader (QP)	CNP081	1	105	105
	breaker	CNP024	1	108	108
				PHASE TOTAL SWL	**111**

Table A1.1c Pak Fuk Road - Use of Quiet Plant + Movable Barriers					
	Noise Source	TM ref	Unit	SWL	Total - SWL
Site Preparation (Initial) (including construction of noise enclosure)	excavator mounted breaker (B)	CNP027	1	112	112
	lorry (QP)	CNP141	1	105	105
	loader (QP+B)	CNP081	1	100	100
				PHASE TOTAL SWL	**113**
Site Preparation (Final) (including construction of noise enclosure)	lorry (QP)	CNP141	1	105	105
	loader (QP+B)	CNP081	1	100	100
				PHASE TOTAL SWL	**106**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry (QP)	CNP141	2	105	108
	mobile crane (QP)	CNP048	1	105	105
	compressor (QP)	CNP003	1	100	100
	excavator (QP)	CNP081	1	105	105
	hoist	CNP121	1	108	108
	water pump (QP)	CNP281	1	88	88
				PHASE TOTAL SWL	**113**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	2	109	112
	mobile crane (QP)	CNP048	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump (QP)	CNP281	1	88	88
				PHASE TOTAL SWL	**115**
Station Constr	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	2	109	112
	mobile crane (QP)	CNP048	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump (QP)	CNP281	1	88	88
				PHASE TOTAL SWL	**115**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry (QP)	CNP141	1	105	105
	mobile crane (QP+B	CNP048	1	100	100
				PHASE TOTAL SWL	**106**
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor (QP+B)	CNP003	1	90	90
	lorry (QP)	CNP141	1	105	105
	loader (QP+B)	CNP081	1	100	100
	breaker (B)	CNP024	1	103	103
				PHASE TOTAL SWL	**108**

Table A1.1d Pak Fuk Road - Use of Quiet Plant + Barriers + Limiting No. of Plant Type ot One					
	Noise Source	TM ref	Unit	SWL	Total - SWL
Site Preparation (Initial) (including construction of noise enclosure)	excavator mounted breaker (B)	CNP027	1	112	112
	lorry (QP)	CNP141	1	105	105
	loader (QP+B)	CNP081	1	100	100
				PHASE TOTAL SWL	**113**
Site Preparation (Final) (including construction of noise enclosure)	lorry (QP)	CNP141	1	105	105
	loader (QP+B)	CNP081	1	100	100
				PHASE TOTAL SWL	**106**
Excavation (initial)	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry (QP)	CNP141	1	105	105
	mobile crane (QP)	CNP048	1	105	105
	compressor (QP)	CNP003	1	100	100
	excavator (QP)	CNP081	1	105	105
	hoist	CNP121	1	108	108
	water pump (QP)	CNP281	1	88	88
				PHASE TOTAL SWL	**112**
Excavation (final)	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	1	109	109
	mobile crane (QP)	CNP048	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump (QP)	CNP281	1	88	88
				PHASE TOTAL SWL	**114**
Station Constr	Noise Source	TM ref	Unit	SWL	Total - SWL
	concrete mixer lorry	CNP044	1	109	109
	mobile crane (QP)	CNP048	1	105	105
	vent fan	CNP241	1	108	108
	hoist	CNP121	1	108	108
	water pump (QP)	CNP281	1	88	88
				PHASE TOTAL SWL	**114**
Enclosure removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	lorry (QP)	CNP141	1	105	105
	mobile crane (QP+B)	CNP048	1	100	100
				PHASE TOTAL SWL	**106**
Enclosure foundation removal	Noise Source	TM ref	Unit	SWL	Total - SWL
	compressor (QP+B)	CNP003	1	90	90
	lorry (QP)	CNP141	1	105	105
	loader (QP+B)	CNP081	1	100	100
	breaker (B)	CNP024	1	103	103
				PHASE TOTAL SWL	**108**

Annex B

Responses to Comments

C1365/TKO/QBE/JKC/56067
26 February 1997

Responses to Comments
TKE/QBR Pak Fuk Road Working Paper

No.	Department	Reference	Comments	Consultants' Response
1	Highways Dept/ Stephen W M Chan/ 26 February 1997	HH 81/140	Further to your above letter to EPD enclosing the EIA for the proposed worksite at Pak Fuk Road. The proposed worksite is a public carpark under the maintenance jurisdiction of this Region. It is not clear from the paper whether the entire carpark is needed to be closed down and for how long it will be occupied. MTRC should seek comments from Transport Department and Lands D concerning the possibility of a short term tenancy if necessary. I have no comments on the environmental aspects of the proposal.	Noted. Noted.
2	Buildings Dept/ C K Lo/ 27 February 1997	BD P&R/83/95c Pt.II	I have no comment on the Working Paper attached to the letter. In the 19th line of page 32, 'Director of Bldgs. and Lands' should be amended to 'Director of Lands'.	The text will be amended as advised.
3	AFD/K W Cheung/1 March 1997	(45) in AF DVL 01/116/2	I refer to your letter of 13 February 1997 to the Environmental Protection Department and copied to this Department. As the Working Paper on the captioned subject enclosed in your letter does not involve ecological issues, I have no comment.	Noted.
4	WSD/Dennis C K Tai/5 March 1997	(3) in WSD(HK) 3095/62/95 Pt. 4	I refer to your letter dated 13.2.97 of the above reference and would advise that I have no comment to your enclosed Working Paper QBR DEIA - Additional Worksite at Pak Fuk Road.	Noted.
5	USD/Ernest Lam/4 March 1997	(23) in USDP 14/402/96 III	Regarding Chapter 6 of your Working Paper, I strongly recommend that the row of trees along Pak Fuk Road be maintained at good condition during the construction period. If these trees will be affected, comments from the relevant government departments should be sought in due course.	Noted. A recommendation to this effect will be included in *Section 6.7.*

No.	Department	Reference	Comments	Consultants' Response
6	TD/Simon O/ 28 February 1997	HR 106/193-10	I have no comment from traffic engineering aspect.	Noted.
7	EPD/Alex Tang/ 10 March 1997	An(5) to EP1/G/72 VI	I refer to your above referenced letter dated 13.2.97 and have the following comments on the captioned working paper: (A) <u>Air Quality</u> (1) On page 6, the 2nd sentence of the para under "24-hour TSP levels" is unclear, please elaborate on how you estimate the 24-hour TSP levels.	Text will be amended.
			(B) <u>Water Quality</u> (2) Section 4.3, fig. 4.3a was missing.	Figure 4.3a will be added.
			(3) Section 4.4, 2nd last para - the report should highlight that marine disposal of excavated material should only be regarded as the last resort after the feasibility of reuse and land-based disposal options (eg. public dump, landfills) have already been fully explored. Depending on the nature, quantity and other factors relating to the excavated materials, any proposal for marine disposal may have to be subject to further assessment.	Noted and "Marine disposal of excavated material should only be regarded as the last resort after the feasibility of reuse and land-based disposal options (eg. public dump, landfills) have already been fully explored." will be added.
			(C) <u>Noise</u> (4) Section 3.2, 1st para - for clarity, please add "for residential dwellings" following"(ProPECC PN2/93)" in the 2nd sentence.	Noted and text will be amended.
			(5) Section 3.2, 3rd para - according to the Noise Control (Air Compressor) Regulation, the maximum permissible noise level for air compressors is 104 dB(A).	Noted and text will be amended.

No.	Department	Reference	Comments	Consultants' Response
			(6) Section 3.2, 8th para - the Technical Memorandum on Noise from Construction Work in Designated Areas already came into operation in 1996. To avoid confusion, revise the 1st and 2nd sentences to read "...in Designated Areas (TM3) is applicable during restricted hours,..."	Noted and text will be amended.
			(7) Section 3.2, 10th para - in the 1st sentence, "TM1" should read "TM2".	Text will be amended.
			(8) Section 3.2, 11th para - in the 3rd sentence, "TM1" should read "TM2/TM3". Also, "Table 3.2c and 3.2c below" should read "Table 3.2c and 3.2d below".	Text will be amended.
			(9) Section 3.3, 1st para - there is no Figure 3.3a provided in the report. Clarification is required.	Figure 3.3a should read Figure 1.1a.
			(10) Section 3.3, 2nd para - for NSRs not affected by the Influence Factor (i.e. King's Road), an ASR of "B" should be employed for construction noise assessment. In addition, "TM1" should read "TM2/TM3".	Classification is based on the methodology adopted in the previous QBR studies. The proposed worksite is located within urban area and King's Road is considered as influence factor which indirectly affects the noise background at the study area, therefore, ASR of the NSRs are classified as "C".
			(11) Section 3.4 - there are a no. of high-rise residential developments located further away from the representative NSRs and these residential developments are likely be affected by the construction activities too. You should take these developments into account in the assessment, especially when determining the appropriate noise mitigation measures (e.g. noise barriers could provide adequate protection to the low-rise representative NSRs but the barriers may not be effective in protecting the high-rise NSRs behind).	All the NSRs adjacent to the proposed worksite have been identified, including Ruby Court which marginally overlooks the western side of the worksite. High rise buildings further away, including Healthy Village are screened by the nearest NSRs, namely the clinic and market building, therefore, they are not the worst affected NSRs from these works.
			(12) Section 3.4 - it is understood that NSR5 (Library) is provided with a central air conditioning system. Verification on the validity of the assumption that the representative NSRs have central air conditioning systems is required.	A noise reduction of 10 dB will be considered for the Library (NSR5) as there is central air conditioning system. Although individual air conditioners are provided at Teaching Centre and the Clinic, openable windows were noted during the site visit and no additional noise reduction has been considered.

No.	Department	Reference	Comments	Consultants' Response
			(13) Section 3.4 - the distances between the notional source positions and the NSRs shown in Table 3.4a are found incorrect. You are required to review the distances and revise the assessment results, mitigation requirements and conclusions accordingly.	The distances between NSRs and the worksite have been revised and the relevant sections will be amended accordingly.
			(14) Section 3.5, 2nd bullet - whilst construction period for excavation work shown here is 15 months, the total excavation period indicated in Table 3.7a and Annex A is 21 months (6 months for initial excavation & 15 months for final excavation). Clarification is required.	The durations for initial and final excavation will be 6 and 9 months respectively, giving the total duration of 15 months. The spreadsheet will be revised.
			(15) Section 3.6 - "TM" and "TM1" in this section should read "TM2".	Text will be amended.
			(16) Section 3.6 - where the assessment of noise from the use of SPME/PCW during restricted hours and percussive piling is required, the methodologies based on TM3 and TM1 respectively should be employed.	No percussive piling is anticipated and therefore, assessment is not required. For the potential noise impact from SPME/PCW, assessment methodology based on TM2/TM3 will be employed.
			(17) Section 3.6 - for clarity, revise the 1st sentence in the 2nd para. to read "... are 75 dB(A) and 70 dB(A) (65 dB(A) during examination) respectively."	Text will be revised.
			(18) Section 3.7, 1st para - detailed noise assessment on the operation of ventilation fans during the night-time should be provided.	Insufficient information is currently available for a detailed assessment, however, any night time activities will be required to meet the appropriate standards for the necessary CNP.
			(19) Section 3.7, Table 3.7a - see comments (13) above.	see response (13)
			(20) Section 3.9, "Selecting Quiet Plant and Working Methods" -	
			(i) "TM1" should read "TM2".	Text will be amended.
			(ii) Meaning of "SOLS" is not clear.	"SOLS" should read "SWLs".
			(iii) A schedule of quite plant together with the SWLs employed in this EIA should be provided.	A schedule of quiet plant has been included in the main DEIA report.

No.	Department	Reference	Comments	Consultants' Response
			(21) Section 3.9, "Movable Noise Barriers" - "TM1" should read "TM2".	Text will be amended.
			(22) Section 3.9, "Noise Enclosure" - it is agreed that a less effective noise reduction will be achieved for those NSRs facing the opening of the enclosure. Confirmation on whether this adverse effect has been considered in the noise calculations presented in Annex A is required.	In the working paper, it has been specified that careful design of this opening is required to avoid direct line of sight to the NSRs; additionally, doors should remain closed between vehicle movements to achieve the best practicable noise reduction.
			(23) Section 3.9, "Station construction" - the acceptable noise level for Designated Areas for NSRs with an ASR of "B" during evening is 50 dB(A).	see response (10).
			(24) Section 3.9, Figure 3.9a - the construction period does not agree with that described in Section 3.5 or Annex A. Clarification is needed. Also, see comments (13) above.	see response (13).
			(25) Section 3.10 - the conclusions that the noise exceedances at NSRs will be avoided and are considered acceptable through the provision of the recommended noise mitigation measures are questionable. The amounts of noise exceedance warrant a further detailed investigation, and it is apparent that the use of alternative mitigation measures/quiet construction technology such as non-explosive chemical agent has not been considered in the report. It is premature to draw the above mentioned conclusions without exhausting all available mitigation measures. The consultants is therefore required to explore additional measures to further ameliorate the noise impact.	Noise mitigation measures recommended in the report have been developed throughout the QBR study with the engineering team and considered to be the most practicable available. Alternative measures have been discussed in detail with the EPD and other SMG members when considering NP1 and the same conclusions apply.
			(26) Section 3.10 - the possibility of extending the construction hours to the evening is subject to further evaluation, comments (10), (13), (18) and (23) refer.	Predicted noise levels have been calculated with revised distances and the predicted noise levels at residential uses are 1-4 dB(A) above the evening noise criterion for designated area. It has been suggested that noise enclosure should be designed in the way that noise levels at NSRs should be below the noise criterion, otherwise, construction works should be limited to underground works.

No.	Department	Reference	Comments	Consultants' Response
			(27) Section 7 - see comments (25) and (26) above.	The conclusion will be revised with the incorporation of comments (25) and (26).
			(28) Annex A, "Table on Predicted Noise Levels from Worksite at Pak Fuk Road" - (i) see comments (13) above. (ii) it is not clear how the noise levels at the NSRs are obtained. Sample calculations for NSR2 for each mitigation option should be provided to demonstrate the calculated results.	Distances in the Table in Annex A will be revised. A sample calculation for NSR2 during station construction is attached.
			(29) Annex A, "Tables A1.1a to A1.1d" - (i) Table for "Use of Quiet Plant + Barriers + Limiting No, of Plant Type to One" should be numbered as Table A1.1d.	Text will be amended as advised.
			(ii) To avoid confusion, calculation of SWLs for "enclosure removal" and "enclosure foundation removal" should be shown separately as these two construction activities are not related to the calculations presented in Tables A1.1a to A1.1d.	The assessment methodology for all construction activities is the same, therefore, all activities are included in *Tables A1.1 a-d.*
			(30) Annex A, "Table A1.1a" - ID Code CNP026 under Site Preparation and CNP141 under Station Construction do not agree with the PME shown in the table. Also SWL for CNP001 is 100 dB(A).	Text will be revised.
			(31) Annex A, "Table A1.1b" - ID Code CNP044 under Excavation (final) does not agree with the PME shown in the table. Similar comments on Table A1.1c.	Text will be revised.

No.	Department	Reference	Comments	Consultants' Response
8	CED/CT Lau/ 14 March 1997	(10) in DVK 0300.13 IX	I refer to your letter dated 13.2.97 enclosing a copy of the Working Paper for the captioned EIA. Please be advised that we have no comment on the Working Paper. The following typing mistakes are observed:- i) "Section 4.6" in the last sentence of Section 4.6 on page 27 should read "Section 4.7"; and ii) "TM standars" in the 5th paragraph of Section 4.7 should read "TM standards".	 Text will be amended accordingly. Text will be amended accordingly.

C1365/RTC/JKC/59060
17 April 1997

Response to Comments
QBR Works DEIA - Revision to Volume IV

No.	Department	Reference	Comments	Consultants' Response
1.	EPD/Terence Tsang/ 12 April 1997	()in Annex (5) to EP1/G/72	My comments on the revisions to Vol. IV of the report are as follows: (c) Para. 1.1.4 of Vol. I, II and IV. The statement "... the endorsement of the original DEIA..." is not suitable since according to the SMG meeting minutes in July 1996 (copy attached), the report was not endorsed. I suppose we should retain the original wordings in this respect.	Noted, the text will be amended as advised.
			(d) As discussed yesterday, you will revise some of the texts in Vol. IV - working paper on Pak Fuk Road site. In particular, you would insert your judgement on the ASR for the nearby receivers, reiterating the fact that the Authority will determine the ASR by the time the contractor applies for a CNP, and the conclusion that even with ASR "B", the noise can still be effectively mitigated with practicable measures.	Noted, the text will be amended as advised.
			<u>Volume IV - Supplementary Working Papers</u> Work Site NP2: Construction Noise Impact Assessment - Section 4, 6th para., "84 dB(A)" should read "87 dB(A)".	Noted, the text will be amended as advised.
2.	EPD/Alex Tang/ 16 April 1997	An(5) to EP1/G/72 VII	I refer to your three facsimiles dated 15 & 16 April 1997 enclosing the further amendments to Vol. I, II & IV of the DEIA reports and have no main problem on the amendments except the following some detailed comments:	
			<u>Vol. IV - Pak Fuk Road WP</u> (e) Section 3.10, please delete "well above the ProPECC guidelines" in the 2nd sentence of the 3rd para.	Noted, the text will be amended as advised.