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Highways Department
The Government of the Hong Kong Special Administrative Region

Agreement No. CE 61/95

Design and Construction of Justice Drive Extension

Environmental Impact Assessment Report

Mouchel Asia Limited

September 1997

Highways Department
The Government of the Hong Kong Special Administrative Region

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Design and Construction of Justice Drive Extension

Environmental Impact Assessment Report

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Section 1
Introduction

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1 INTRODUCTION

1.1 Background

1.1.1 On the 31st May 1996, the Highways Department of the Hong Kong Government appointed Mouchel Asia Limited, under Agreement No. CE 61/95, to provide professional services in respect of the design and construction supervision of Justice Drive Extension (hereinafter referred to as the Project).

1.1.2 As part of this Assignment, an Environmental Impact Assessment (EIA) is required to provide an assessment of the potential noise and air quality impacts associated with the Project's construction and operation and to determine how the Project can be constructed and operated in an environmentally acceptable manner. The EIA has been carried out by Mouchel Asia Environmental.

1.2 Previous Studies

1.2.1 A preliminary Environmental Impact Assessment (EIA) was carried out by Maunsell Consultants Asia Ltd "Final Report on the North South Links Investigation (Justice Drive Extension - Preliminary Design)", 1991. The EIA identified the potential for impacts to air quality during Project construction and noise impacts during both construction and operation. The EIA provided general mitigation measures for reducing the level of environmental impacts.

1.2.2 The Environmental Protection Department (EPD) subsequently conducted an Environmental Review (ER) of the Project in February 1995 based on the findings of the Maunsell EIA study. The ER identified the need for a EIA to provide a detailed assessment of construction and operational noise and air quality impacts based on the following:

(i) the most updated traffic data;

(ii) the existing and committed future noise sensitive receivers (NSR) in the area;

(iii) the existing and committed future air quality sensitive receivers in the area, including vent shaft areas;

(iv) air quality impacts from proposed mitigation measures such as noise enclosures or barriers; and

(v) construction related impacts.

1.3 Report Structure

1.3.1 In meeting the objectives set out above, the rest of this report is organised as follows:

- Section 2 describes the Project;

- Section 3 describes the environmental standards and guidelines;
- Section 4 assesses the noise impacts likely to occur during the construction and operation of the Project and recommends appropriate mitigation measures;
- Section 5 assesses the air pollution impacts likely to occur during the construction and operation of the Project together with appropriate recommendations for their mitigation;
- Section 6 summarises the EM&A Manual; and
- Section 7 summarises the conclusions and recommendations of the Project.

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Section 2
Project Description

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2 PROJECT DESCRIPTION

2.1 Project Location

2.1.1 The Project is located between the Central and Wan Chai Districts. The site location of the Project area is shown on Figure 2.1, the Project works are shown on Figure 2.2 and the Sensitive Receivers are shown on Figure 2.3.

2.2 Project Objectives

2.2.1 The objective of the Assignment is to design and construct the Justice Drive Extension and associated works which include:

(i) the construction of a single 2 to 3-lane elevated carriageway of about 420m in length, extending from Justice Drive Flyover to Central Reclamation Phase III;

(ii) the construction of a 2 to 3-lane at-grade carriageway of about 80m in length, linking the elevated carriageway with the proposed Road D10 on the reclamation;

(iii) the reconstruction of the Queensway interchange with links to and from Queensway eastbound and Justice Drive Extension;

(iv) the reconstruction of the existing suspended span over Queensway; and

(v) the construction of associated footpaths, drainage and landscaping works.

2.2.2 The Project is to be completed and opened for use by early 2002.

2.3 EIA Objectives

2.3.1 The EIA Study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the Project. This information will contribute to decisions on:

(i) the overall acceptability of any adverse environmental impacts that are likely to arise as a result of the Project;

(ii) the conditions and requirements for the design and construction of the Project; and

(iii) the acceptability of any residual impacts after the proposed mitigation measures are implemented.

2.3.2 The objectives of the EIA are defined in Section 17.2 of the Guidance Notes to the Study Brief, as follows:

(i) to describe the Project and associated works together with the requirements for

carrying out the Project;

(ii) to identify and describe the elements of the community and environment likely to be affected by the noise and air quality impacts from the Project;

(iii) to identify and quantify noise and dust emission sources and determine the significance of impacts on sensitive receivers and potential affected users;

(iv) to propose the provision of mitigation measures including direct/indirecttechnical remedies in accordance with the prevailing Government policy set down in the ExCo directive XCC(89)(157) so as to minimise traffic noise impacts from new roads;

(v) to identify, predict and evaluate the noise and air quality impacts and their cumulative effects expected to arise during the construction, operation phases of the Project in relation to the sensitive receivers and potential affected users;

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

(vii) to design, screen, scope and specify the noise and air quality monitoring and audit requirements necessary to ensure the implementation and the effectiveness of the noise and air quality pollution control measures adopted;

(viii) to investigate the extent of side-effects of proposed mitigation measures including direct/indirect technical remedies that may lead to other forms of impacts; and

(ix) to identify constraints associated with the mitigation measures including direct and indirect technical remedies recommended in the Study.

2.4 Construction Activities

2.4.1 The main construction activities of Justice Drive Extension comprise:

- Demolition Work. This will include demolition of the existing main span over Queensway and the north approach ramp abutment and spans.

- Foundation Construction. This will include construction of the large diameter bored piles, pile caps, bridge piers and abutment structures. It will also include service diversions, and modification/strengtheningworks to the underground car park structure where the bridge piers are located over the car park.

- Bridge Deck Construction. This will include construction/erection of the main supporting elements, and construction of the deck slab, parapets and noise mitigation measures (if required).

- Pavement Construction. This will include construction of the at-grade pavement on Queensway and on the new reclamation to tie the bridgeworks into the road network. It will also include construction of the drainage works, and the surfacing on the bridge deck.

2.4.2 The preliminary construction programme for the Project shows that construction will start in 1999 and the construction contract will cover a total period of three years. The construction activities are expected to be 12 hour working and are likely to be between 07:00 to 19:00. It is not expected that there will be any working in the evenings, at night or on Sundays or public holidays, except for some demolition work and some activities related to the construction of the bridge deck.

2.4.3 The schedules of equipment for the construction activities are shown in Table 2.1, with the activities that may have to be carried out at night time or in the evening shown separately.

Table 2.1: Sound Power Levels of the Equipment Associated with Various Construction Activities

Activity	Noise Source	TM Identification Code	Number	Sound Power Level (dB(A))
Demolition Work	Air Compressor, air flow ≤10 m^3/min	CNP 001	2	100
	Breaker, hand-held, mass >10kg and <20kg	CNP 024	4	108
	Breaker, excavator mounted (pneumatic)	CNP 027	2	122
	Bulldozer	CNP 030	1	115
	Crane, mobile/barge mounted (diesel)	CNP 048	1	112
	Drill, percussive, hand-held (electric)	CNP 064	2	103
	Dumper	CNP 066	1	106
	Dump truck	CNP 067	1	117
	Excavator/loader, wheeled/tracked	CNP 081	1	112
	Generator, super silenced, 70 dB(A) at 7 m	CNP 103	1	95
	Lorry	CNP 141	1	112
Foundation Construction	Air Compressor, air flow ≤10 m^3/min	CNP 001	2	100
	Bar bender and cutter (electric)	CNP 021	2	90
	Breaker, hand-held, mass >10kg and <20kg	CNP 024	4	108
	Bulldozer	CNP 030	1	115
	Chipper, hand-held (pneumatic)	CNP 043	4	112
	Concrete lory mixer	CNP 044	2	109
	Concrete pump, stationary/lorry mounted	CNP 047	2	109
	Crane, mobile/barge mounted (diesel)	CNP 048	2	112
	Compactor, vibratory	CNP 050	2	105
	Dumper	CNP 066	2	106
	Dump truck	CNP 067	2	117
	Excavator/loader, wheeled/tracked	CNP 081	2	112
	Generator, super silenced, 70 dB(A) at 7 m	CNP 103	1	95
	Lorry	CNP 141	2	112
	Piling, large diameter bored, grab and chisel	CNP 164	2	115
	Poker, vibratory, hand held	CNP 170	4	113
	Planer, wood, hand-held (electric)	CNP 171	2	117
	Saw, circular, wood	CNP 201	2	108
	Water pump, submersible (electric)	CNP 283	2	85

Activity	Noise Source	TM Identification Code	Number	Sound Power Level (dB(A))
Bridge Deck Construction	Air Compressor, air flow ≤10 m^3/min	CNP 001	2	100
	Bar bender and cutter (electric)	CNP 021	2	90
	Chipper, hand-held (pneumatic)	CNP 043	4	112
	Concrete lory mixer	CNP 044	2	109
	Concrete pump, stationary/lorry mounted	CNP 047	2	109
	Crane, mobile/barge mounted (diesel)	CNP 048	2	112
	Lorry	CNP 141	2	112
	Poker, vibratory, hand held	CNP 170	4	113
	Planer, wood, hand-held (electric)	CNP 171	2	117
	Saw, circular, wood	CNP 201	2	108
Pavement Construction	Air Compressor, air flow ≤ 10 m^3/min	CNP 001	2	100
	Asphalt paver	CNP 004	1	109
	Breaker, hand-held, mass >10kg and <20kg	CNP 024	4	108
	Concrete lorry mixer	CNP 044	2	109
	Concrete mixer (petrol)	CNP 046	2	96
	Compactor, vibratory	CNP 050	2	105
	Dumper	CNP 066	2	106
	Dump truck	CNP 067	2	117
	Excavator/loader, wheeled/tracked	CNP 081	2	112
	Lorry	CNP 141	2	112
	Paint line marker	CNP 161	1	90
	Road roller	CNP 185	1	108
	Roller, vibratory	CNP 186	1	108
	Saw/groover, concrete (petrol)	CNP 203	1	115
Night-time Demolition Work	Air Compressor, air flow ≤10 m^3/min	CNP 001	1	100
	Breaker, hand-held, mass >10kg and <20kg	CNP 024	2	108
	Crane, mobile/barge mounted (diesel)	CNP 048	1	112
	Drill, percussive, hand-held (electric)	CNP 064	2	103
	Generator, super silenced, 70 dB(A) at 7 m	CNP 103	1	95
	Lorry	CNP 141	1	112
Night-time Bridge Deck Construction	Air Compressor, air flow ≤10 m^3/min	CNP 001	1	100
	Concrete lorry mixer	CNP 044	1	109
	Concrete pump, stationary/lorry mounted	CNP 047	1	109
	Crane, mobile/barge mounted (diesel)	CNP 048	1	112
	Lorry	CNP 141	1	112
	Poker, vibratory, hand held	CNP 170	2	113

2.5 Traffic Estimates

Models Used

2.5.1 The forecast traffic flows are based on the forecast methodology from the report "Design and Construction of Justice Drive Extension - Working Paper 1 - Traffic Forecasts".

Existing Traffic Conditions

2.5.2 The existing traffic conditions are described in the report "Design and Construction of Justice Drive Extension - Working Paper 1 - Traffic Forecasts".

Future Year Traffic Volume

2.5.3 The future year traffic volumes are forecast based on the methodology from the report "Design and Construction of Justice Drive Extension - Working Paper 1 - Traffic Forecasts".

2.5.4 All the traffic figures are shown in Appendix A.

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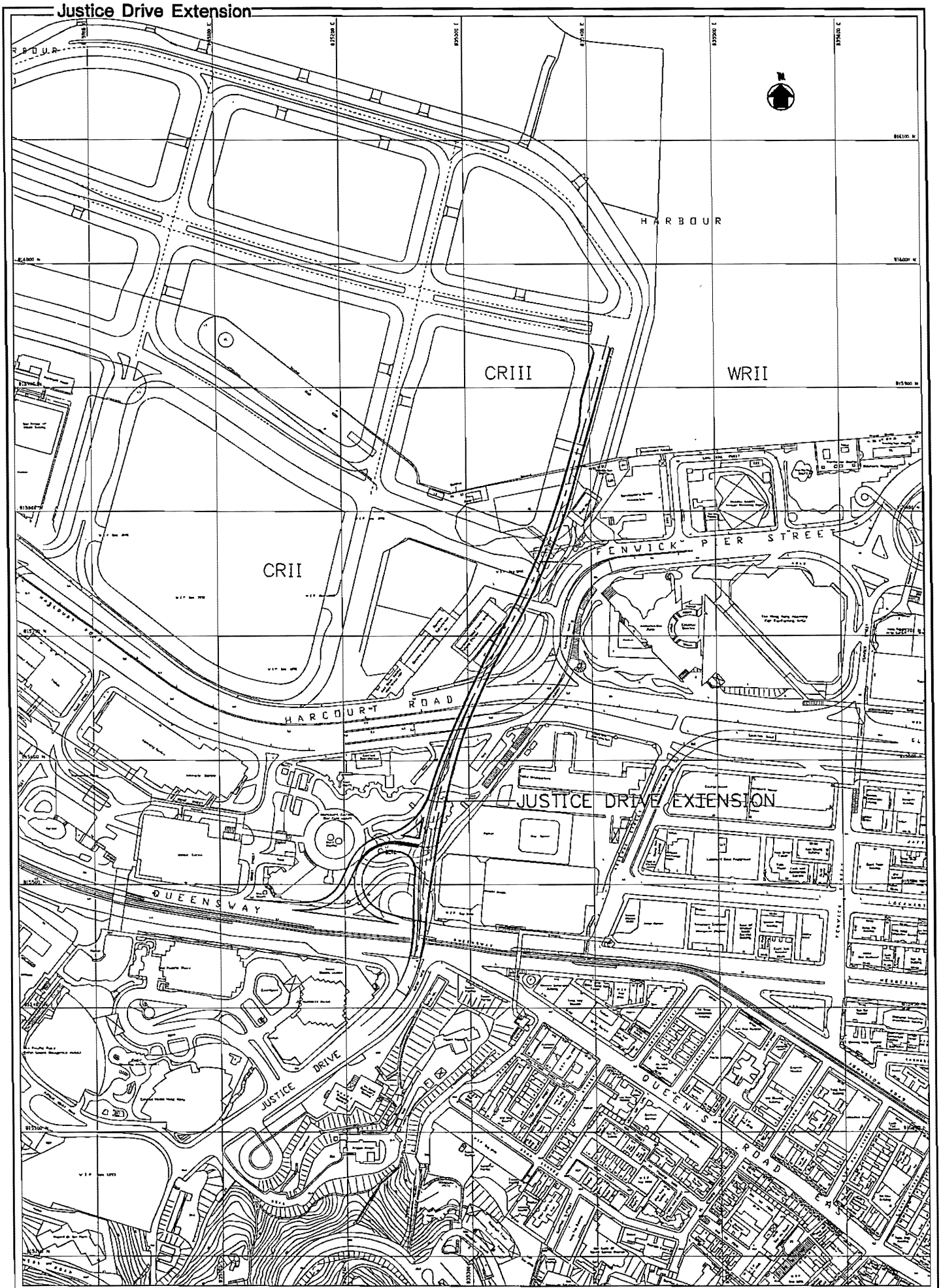

Site Location Plan

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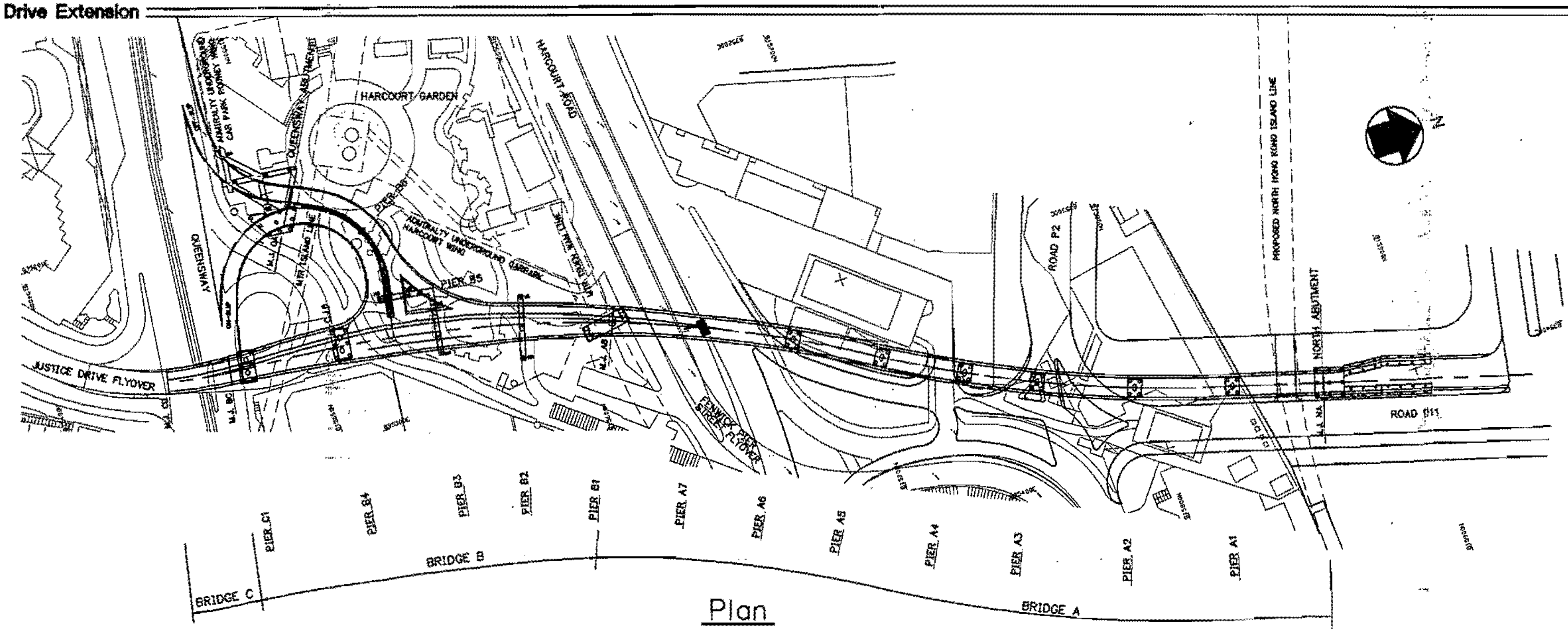
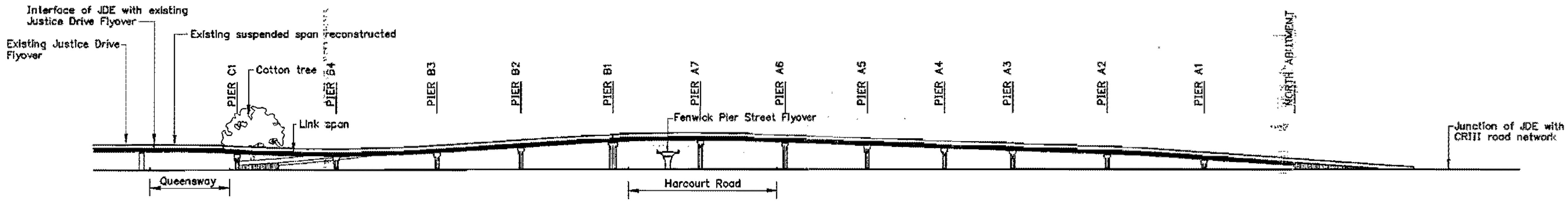
Figure No. 2.1

Cad File: C:\F90558\EIA\FIG-21

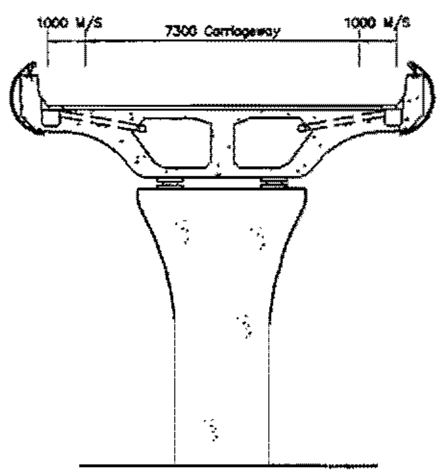
Justice Drive Extension



Plan
(Scale 1 : 2000)



Elevation
(Scale 1 : 2000)



Indicative Cross Section through Deck
(Scale 1 : 200)

Note : Structural form of bridge deck to be confirmed.

Project Works

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Figure No. 2.2

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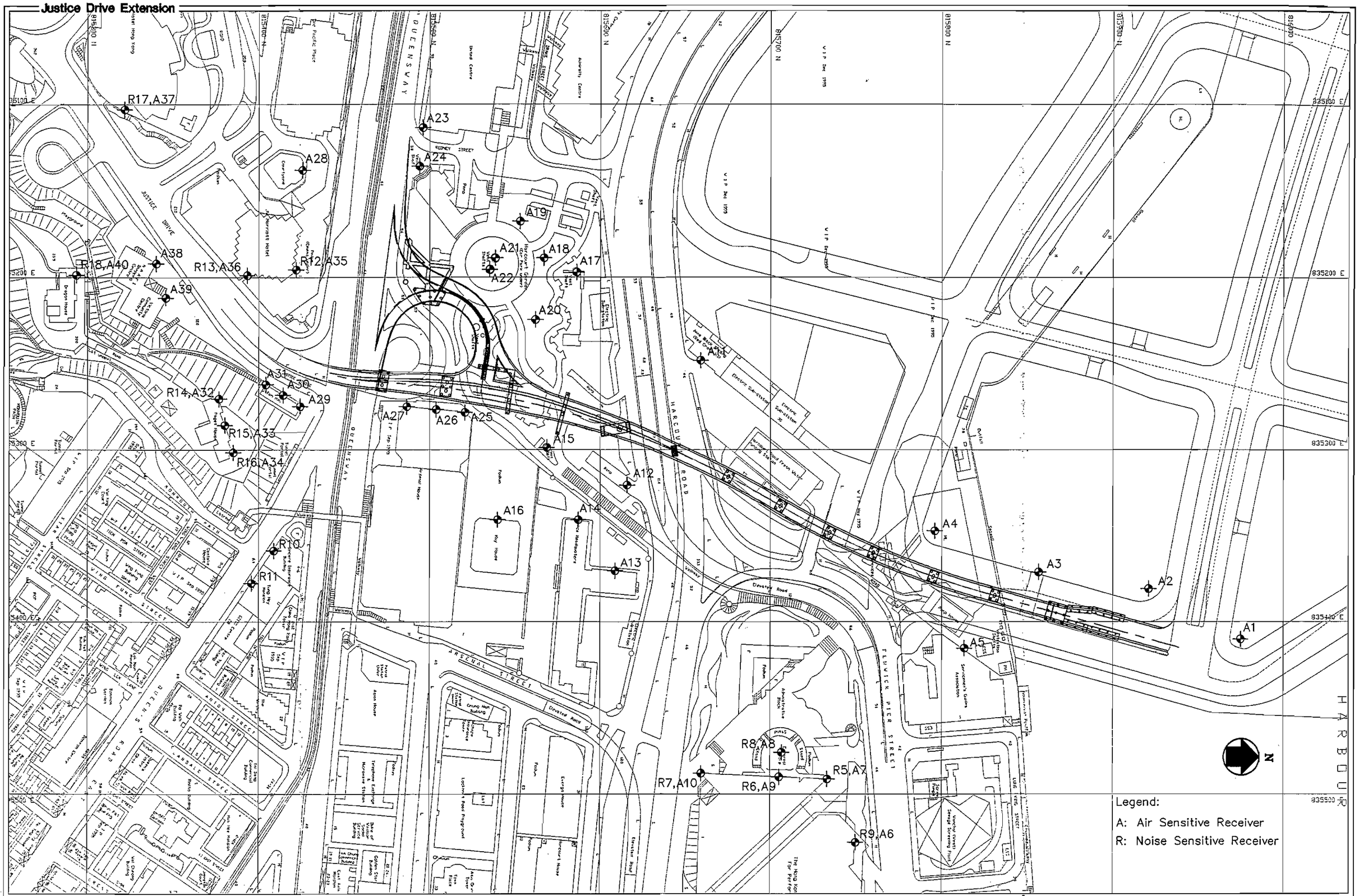
Justice Drive Extension



Location of Sensitive Receivers

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Figure No. 2.3

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Section 3
Environmental Standards and Guidelines

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3 ENVIRONMENTAL STANDARDS AND GUIDELINES

3.1 Noise

Non-restricted Hours

3.1.1 The noise generated by the construction of the Project during the non-restricted daytime hours (07.00-19.00) has been assessed with reference to the EPD recommended criteria in the Practice Note for Professional Persons No. ProPECC PN 2/93, as shown in Table 3.1.

Table 3.1: Recommended Construction Noise Levels (Non-Restricted Hours)

Noise Sensitive Receiver	Noise Level L_{eq} (30 min) dB(A)
Dwelling	75
School	70 (Normal school hours) 65 (During examination)

Restricted Hours

3.1.2 For construction activities carried out during restricted hours (19.00-07.00), requirements stipulated by the *Technical Memorandum on Noise from Construction Work other than Percussive Piling* and the *Technical Memorandum on Noise from Construction Work in Designated Areas* under the NCO. NCO construction noise limits are determined with reference to the type of area within which the Noise Sensitive Receiver (NSR) is located. NSRs in the Study Area can generally be assigned an Area Sensitivity Rating (ASR) of "A", "B", or "C", reflecting that the receivers are situated in a rural or low density residential area, affected (directly/indirectly) or not affected by major road(s). The Basic Noise Levels from the *Technical Memorandum on Noise from Construction Work other than Percussive Piling* are outlined below in Table 3.2.

Table 3.2: Basic Noise Levels (Restricted Hours), Technical Memorandum on Noise from Construction Work other than Percussive Piling

Time Period	Acceptable Noise Level L_{eq} (5 min) dB(A)		
	ASR = A	ASR = B	ASR = C
All days during the evening (19.00-23.00) and general holidays (including Sundays) during the daytime and evening (07.00-23.00)	60	65	70
All days during the night-time (23.00-07.00)	45	50	55

3.1.3 The Basic Noise Levels from the *Technical Memorandum on Noise from Construction Work in Designated Areas* are outlined below in Table 3.3.

Table 3.3: Basic Noise Levels (Restricted Hours), Technical Memorandum on Noise from Construction Work in Designated Areas

Time Period	Acceptable Noise Level L_{eq} (5 min) dB(A)		
	ASR = A	ASR = B	ASR = C
All days during the evening (19.00-23.00) and general holidays (including Sundays) during the daytime and evening (07.00-23.00)	45	50	55
All days during the night-time (23.00-07.00)	30	35	40

Percussive Piling

3.1.4 No percussive piling is anticipated during the construction phase and therefore the criteria stipulated in the *Technical Memorandum on Noise from Percussive Piling* under the NCO are not applicable to the Project.

Road Traffic Noise

3.1.5 The impact of operational noise has been assessed with reference to the HKPSG which stipulate maximum L_{10} (1 hour) road traffic noise levels at sensitive facades of various NSRs (Table 3.4).

Table 3.4: Acceptable Road Traffic Noise Levels

Noise Sensitive Receivers	Road traffic Noise L_{10} (1 hour) dB(A)
Domestic Premises	70
Places of Public Worship	65
Educational Institutions	65
Hospitals, Clinics, Homes for the Aged (wards & diagnostic rooms)	55

3.1.6 In case where no practical direct technical remedies can be applied, the Exco directive *Equitable Redress for Persons Exposed to Increased Noise Resulting from the Use of New Roads* will be referenced to identify which NSRs may qualify for indirect technical remedies.

3.2 Noise Impacts at the Academy for Performing Arts

3.2.1 The Academy of Performing Arts is within the potential zone of impact for the new road must be considered as a sensitive receiver. There are two functions of the Academy that must be considered:

- the main building
- the outdoor theatre

3.2.2 We have inspected both of these facilities and held discussions with the management of the Academy to determine their uses and sensitivity to noise.

3.2.3 A noise survey was carried out to measure the existing noise levels. The results of the noise monitoring are shown in Appendix F and are discussed further in Section 4 of this report.

3.3 Air Quality

3.3.1 Air quality is regulated through the Air Pollution Control Ordinance, 1983 Cap. 311, which provides, *inter alia*, statutory Air Quality Objectives for each Air Control Zone. Air Control Zones have been declared for the whole of the Territory, and the associated Air Quality Objectives are provided in Table 3.5.

Table 3.5: Hong Kong Air Quality Objectives

Pollutant	Concentration $\mu g/m^3$ (i) Averaging Time				
	1 Hour (ii)	8 Hours (iii)	24 Hours (iii)	3 Months (iv)	1 Year (iv)
Sulphur Dioxide	800		350		80
Total Suspended Particulates			260		80
Respirable Suspended Particulates (v)			180		55
Nitrogen Dioxide	300		150		80
Carbon Monoxide	30000	10000			
Photochemical Oxidants (as ozone (vi))	240				
Lead				1.5	

(i) Measured at 298°K (25°C) and 101.325 KPa (one atmosphere).
(ii) Not to be exceeded more than three times per year.
(iii) Not to be exceeded more than once per year.
(iv) Arithmetic means.
(v) Respirable Suspended Particulates means suspended particulates in air with a nominal aerodynamic diameter of 10 micrometers and smaller.
(vi) Photochemical oxidants are determined by measurements of ozone only.

Source : Air Pollution Control Ordinance

3.3.2 In addition to the Air Quality Objectives, Environmental Protection Department also recommended that a maximum hourly level of 500 $\mu g/m^3$ Total Suspended Particulates should not be exceeded at any air sensitive receivers.

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Section 4
Noise Impact Assessment

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4 NOISE IMPACT ASSESSMENT

4.1 Noise Sensitive Receivers

4.1.1 Noise Sensitive Receivers (NSRs), have been identified as defined by Hong Kong Planning Standards and Guidelines (HKPSG) and the Noise Control Ordinance (NCO). These are listed in Table 4.1 and shown on Figure 2.3.

Table 4.1: Locations of Noise Sensitive Receivers

Receiver No.	Location	Area Sensitivity Ratings (ASR) from (1)	Recommended Construction Noise Standards (Non-Restricted Hours), L_{eq} (30 min), dBA, from (2)	HKPSG Traffic Noise Standards L_{10} (1hr) dBA
R5 to R7, R9	Facade of main building of Academy for Performing Arts	C	70 (normal school hours) 65 (during exams)	65
R8	External theatre of Academy for Performing Arts	C	- ditto -	(3)
R10	Facade of Sincere Insurance Building (domestic premises)	C	75	70
R11	Facade of Tung Hey Mansion (domestic premises)	C	75	70
R14, R15, R16	Paget House (domestic premises)	C	75	70
R18	Dragon House (domestic premises)	C	75	70

Notes (1) See Tables 3.2 and 3.3 (2) See Table 3.1 (3) See Section 3.2.4

4.1.2 The Planning Department has commissioned a study of the reclamation area and according to the Hong Kong Island West Development Statement, Outline Master Development Plan of July 1997, the proposed areas closest to the development have been designated local open space and commercial. Thus, the HKPSG noise sensitivity criteria do not apply as the commercial developments are assumed not to rely on openable windows for ventilation and these areas are not considered to be affected by operational or construction noise impacts as a result of the Justice Drive Extension.

4.1.3 NSRs R12, R13 and R17, the Marriott and Conrad Hotels, have been included in the assessment but since these buildings are equipped with high quality glazing and central air conditioning, the noise sensitivity criteria stipulated in the HKPSG are not considered to apply and these buildings will not be considered to be affected by the project.

4.2 The Existing Noise Environment

4.2.1 The existing noise environment in the area of the Project site is dominated by the traffic noise from Queensway Road, Queen's Road East, Harcourt Road and Fenwick Pier Street. Road noise is currently the major contributor to the overall noise environment in the Project area. Noise monitoring at representative noise sensitive receivers were carried out to define the existing noise environment and are shown in Appendix F. The daytime (07:00 - 19:00) noise measurement results are summarised in Table 4.2.

Table 4.2: Results of Background Noise Monitoring

Noise Sensitive Receivers	Locations	Periods	Average Noise Levels (1 hour), dBA		
			L_{10}	L_{90}	L_{eq}
NAAFI Building	2/F	3-4/97	81.4	76.5	79.7
Paget House	G/F	3/97	70.9	64.8	68.3
Sincere Insurance Building	14/F	3/97	77.7	68.7	74.3
Hong Kong Academy for Performing Arts	Roof	3/97	74.3	70.4	72.6

4.3 Impacts During Construction

4.3.1 The main construction activities which have been identified to generate potential impacts at nearby NSRs fall into following main categories:

- Demolition Work
- Foundation Construction
- Bridge Deck Construction
- Pavement Construction
- Night-time Demolition Work
- Night-time Bridge Deck Construction

4.3.2 No percussive piling is expected. All other activities will be of small scale or suitably screened such that they will not contribute more noise than the activities which have been chosen for assessment. The plant inventory and sound power levels (SWL) associated with each activity have been summarized previously in Table 2.1.

4.3.3 The construction noise at the Noise Sensitive Receivers (NSRs) was assessed according to the methodology quoted in the *Technical Memorandum on Noise from Construction Work other than Percussive Piling* and *Technical Memorandum on Noise from Construction Work in Designated Areas*. The predicted day and night time noise levels at all relevant NSRs are given in Table 4.3. The noise criteria to be employed during day time construction works will be 75 dB(A) for all NSRs except for the Hong Kong Academy where the standards applicable to schools will be applied.

4.3.4 Only one activity will be carried out in a construction area at any one time. Combinations of noise impacts on the nearest NSRs by more than one activity is therefore not anticipated. The total predicted noise levels associated with each activity at all NSRs have also been calculated and are shown in Table 4.3 taking into account the distance attenuation and screening effect due to topographical features.

Table 4.3: Predicted Noise Levels During Construction Assuming No Mitigation

Noise Sensitive Receivers	Predicted Noise Levels, dB(A)						Noise Criteria		
	Demolition Work	Foundation Construction	Bridge Deck Construction	Pavement Construction	Evening-time and Night-time Demolition	Evening-time and Night-time Bridge Deck Construction	Recommended Construction Noise Standards (Non-Restricted Hours), L_{eq} (30 min), dBA, from (1)	Noise Control Ordinance Standards (Restricted Periods), L_{eq} (30 min), dBA, from (2)	
								Period 1[3] TM1/TM2*	Period 2[4] TM1/TM2*
R5	80	81	78	77	70	72	70/65 (normal/exam)	70/55	55/40
R6	79	80	78	77	69	72	- ditto -	- ditto -	- ditto -
R7	78	79	77	76	68	71	- ditto -	- ditto -	- ditto -
R8	80	81	79	77	70	73	- ditto -	- ditto -	- ditto -
R9	78	79	76	75	68	70	- ditto -	- ditto -	- ditto -
R10	82	83	80	79	72	74	75	- ditto -	- ditto -
R11	80	81	78	77	70	72	75	- ditto -	- ditto -
R14	88	89	86	85	78	80	75	- ditto -	- ditto -
R15	87	88	86	84	77	80	75	- ditto -	- ditto -
R16	86	87	84	83	76	78	75	- ditto -	- ditto -
R18	79	80	77	76	69	71	75	- ditto -	- ditto -

Notes : (1) See Table 3.1
(2) See Tables 3.2 and 3.3
(3) All days during the evening (19.00 - 23.00) and general holidays (including Sundays) during the daytime and evening (07.00 - 23.00)
(4) All days during the night-time (23.00 - 07.00)
* TM1 = Technical Memorandum on Noise from Construction Work other than Percussive Piling
TM2 = Technical Memorandum on Noise from Construction Work in Designated Areas

4.4 Mitigation Measures During Construction

4.4.1 It can be seen from the above that construction noise has the potential for significant daytime and night-time noise impacts at the NSRs. Therefore, mitigation measures are required, and the following forms of mitigation are recommended and should be incorporated into the Contract Specifications:

(i) good site practice to limit noise emissions at source;

(ii) avoidance of simultaneous noisy activities;

(iii) selection of quiet plant and working methods;

(iv) silencers should be installed at the exhaust pipes of the dump trucks, air compressors, mobile cranes, excavators, lorries;

(v) mufflers should be installed on pneumatic breakers;

(vi) acoustic enclosures should be installed for pumps; and

(vii) reduction in the numbers of plant operating in critical areas close to NSRs.

4.4.2 Mitigation in the form of noise enclosures around the noisy activities has been considered during the evening and night time working. The design of the temporary noise enclosures will be the responsibility of the Contractor who will be required to submit his design to the Engineer for approval before carrying out the work. The design will also have to be submitted to DEP, as the Authority under the Noise Control Ordinance, with the Contractor's application for a Construction Noise Permit.

4.4.3 Table 4.4 shows the predicted noise levels after the above noise mitigation measures have been applied. All the noise calculations and results of mitigation measures are provided in Appendix B.

4.4.4 Table 4.4 shows that noise impacts will be within the standards at all sensitive receivers. However, it is the responsibility of the Contractor to comply with the NCO and relevant Technical Memorandums if there is any construction work during the restricted hours. The Contractors should submit CNP applications if required, the conditions of which should be strictly followed. The assessment with respect to construction noise for restricted hours in this study serves to avoid late focus on this issue.

4.4.5 The samples of the construction noise calculations are shown in Appendix B. The mitigation afforded to the specific PME given in Appendix B during the assessment and the subsequent level of attenuation achieved is summarised in Table 4.5 below.

Table 4.4: Predicted Noise Levels During Construction After Noise Mitigation Measures Have Been Applied

Noise Sensitive Receivers	Predicted Noise Levels, dB(A)								Noise Criteria		
	Demolition Work	Foundation Construction	Bridge Deck Construction	Pavement Construction	Evening-time and Night-time Demolition	Evening-time and Night-time Bridge Deck Construction	Evening-time and Night-time Demolition (SPME)	Evening-time and Night-time Bridge Deck Construction (SPME)	Recommended Construction Noise Standards (Non-Restricted Hours), L_{eq} (30 min), dBA, from (1)	Noise Control Ordinance Standards (Restricted Periods), L_{eq} (30 min), dBA, from (2)	
										Period 1[3] TM1/TM2*	Period 2[4] TM1/TM2*
R5	62	62	60	62	40	36	32	32	70/65(normal/exam)	70/55	55/40
R6	62	62	59	61	40	36	31	32	- ditto -	- ditto -	- ditto -
R7	61	61	58	60	39	35	30	31	- ditto -	- ditto -	- ditto -
R8	62	62	60	62	40	37	32	33	- ditto -	- ditto -	- ditto -
R9	60	60	58	60	38	34	30	30	- ditto -	- ditto -	- ditto -
R10	64	64	62	64	42	38	34	34	75	- ditto -	- ditto -
R11	62	62	60	62	40	36	32	32	75	- ditto -	- ditto -
R14	70	70	67	70	48	44	40	40	75	- ditto -	- ditto -
R15	69	69	67	69	47	44	39	39	75	- ditto -	- ditto -
R16	68	68	66	68	46	42	38	38	75	- ditto -	- ditto -
R18	61	61	59	61	39	35	31	31	75	- ditto -	- ditto -

Notes : (1) See Table 3.1
(2) See Tables 3.2 and 3.3
(3) All days during the evening (19.00 - 23.00) and general holidays (including Sundays) during the daytime and evening (07.00 - 23.00)
(4) All days during the night-time (23.00 - 07.00)
* TM1 = Technical Memorandum on Noise from Construction Work other than Percussive Piling
TM2 = Technical Memorandum on Noise from Construction Work in Designated Areas

Table 4.5: Mitigation of Powered Mechanical Equipment

Powered Mechanical Equipment	Mitigation	Attenuation dB(A)	Relevant Construction Activity
Air Compressor	Muffler	-5	D, F, BD, P, N-D, N-BD
Breaker, hand held, mass >10kg < 20kg	Muffler	-8	D, F, P, N-D
Breaker, excavator mounted (pneumatic)	Muffler	-8	D
Bulldozer	Quiet bulldozer with silencer	-10	D, F
Chipper, hand held (pneumatic)	Muffler	-8	F, BD
Concrete lorry mixer	Silencer for the exhaust pipes plus semi-acoustic enclosure for the engine, acoustic panels along the running track, reduce the running speed of the engine, etc.	-10	F, BD, P, N-BD
Concrete pump, stationary/lorry mounted	Acoustic enclosure, silencer for the exhaust pipes, acoustic panels along the running track, reduce the running speed of the engine, etc.	-10	F, N-BD
Crane, mobile (diesel)	Silencer for the exhaust pipes plus semi-acoustic enclosure for the engine, acoustic panels along the running track, reduce the running speed of the engine, etc.	-10	D, F BD, N-D, N-BD
Compactor, vibratory	Muffler	-8	F, P
Dump Truck	Silencer for the exhaust pipes plus semi-acoustic enclosure for the engine, acoustic panels along the running track, reduce the running speed of the engine, etc.	-10	D, F, P
Excavator/loader, wheeled/tracked	Silencer plus acoustic enclosure	-10	D, F, P
Lorry	Silencer for the exhaust pipes plus semi-acoustic enclosure for the engine, acoustic panels along the running track, reduce the running speed of the engine, etc.	-10	D, F, BD, P, N-D, N-BD
Piling, large diameter	Silencers, acoustic panels around the working area	-10	F
Poker vibratory, hand held	Silencers, acoustic panels around the working area	-10	F, BD, N-BD
Planer, wood, hand-held	Quiet electrical planer	-10	F, BD

Note: D = demolition work, F = foundation construction, BD = bridge deck construction, P = pavement construction , N-D = night-time demolition work, N-BD = night-time bridge deck construction

4.5 Impacts During Operation

4.5.1 Operation noise on this Project will be attributable solely to road traffic. The impact of road noise arising from the Project and other roads in the area has been calculated at the facades of the representative Noise Sensitive Receivers (NSRs) in terms of L_{10} (1 hour) in dBA using the SoundPlan package. The calculation methodology was based on the "Calculation of Road Traffic Noise", UK Department of Transport, 1988. Noise levels for receivers at several heights in the tower blocks were simulated to obtain a profile of noise impacts over the height of the building. The noise sensitive receivers are the same as those used in the construction noise assessment as shown in Table 4.1.

4.5.2 The following assumptions have been made for the modelling:

(i) peak hour traffic flows and vehicle mix in the year 2017 (which is the worst case scenario within 15 years after the opening of the roads) and in the year 1999 were obtained from the transportation modelling studies and input into the SoundPlan package for noise modelling. The traffic data are shown in Appendix A;

(ii) in view of the close proximity of the Noise Sensitive Receivers (NSRs) to the noise sources, effects due to the absorption by air have not been allowed for;

(iii) meteorological conditions have not been allowed for as the receivers are close to the source; and

(iv) speed limits of the roads were used;

4.5.3 The results of the assessment of operation impacts (unmitigated) are summarised in Table 4.6 and Table 4.7.

Table 4.6: The Maximum Noise Levels, L_{10} (1 hour), dBA, at the Noise Sensitive Receivers During Operation in the Year 2017

Sensitive Receivers	Predicted Maximum L_{10} Noise Levels (1 hour)
R5	78
R6	77
R7	77
R8	75
R9	82
R10	82
R11	83
R14	73
R15	78
R16	78
R18	74

4.5.4 The Academy building of the Hong Kong Academy for Performing Arts (HKAPA), NSRs R5 to R7 and R9, is well insulated against noise with sealed facades on all sides. All the performing and practice areas are in the central part of the building with non-sensitive uses such as corridors around the outside. Therefore, the traffic noise impacts on the above said areas are not a concern, although the maximum L_{10} (1 hour) noise level

is 78 dBA at 1m from the external facade of the main building. We have therefore concluded that the main building of the Academy should not be affected by the traffic noise unless there is a very dramatic increase in noise due to the new road, such that there could be an impact at the practice and performance rooms in the central core of the building. The noise modelling has included impacts at the facade of the main building to confirm that there will not be a large increase in noise from the new road.

4.5.5 The outdoor theatre of the HKAPA, NSR R8, is already subject to noise impacts from existing roads, even though there is a noise barrier on the adjacent flyover and some noise baffles around the theatre itself. In view of the fact that the theatre can be, and sometimes is, used for practice or performances, the traffic noise impacts on this amenity are assessed in this study. This Project should be designed such that the contribution to the noise at the theatre from the new road will be nil or negligible. The overall traffic noise with the Project will be no more than 1 dBA than the noise without the Project. This assessment criterion will be applied to operational noise impacts on the outdoor theatre.

4.5.6 The maximum predicted L_{10} (1 hour) noise level at the Hong Kong Academy for Performing Arts (HKAPA) outdoor theatre in the year 2017 is 75dBA, 74.6dBA (without Justice Drive Extension) and 74.1dBA in the year 1999. The noise monitoring results show that the existing average L_{10} (1 hour) noise level is 74.3dBA at the roof of the HKAPA in March 1997. It shows that the noise contribution from the Justice Drive Extension (new road) will be negligible.

4.5.7 We have carried out a test using a road network comprising Justice Drive, Fenwick Pier Street, Harcourt Road and Gloucester Road for the year 2002 to demonstrate the noise impacts at the HKAPA outdoor theatre on commencement of the operation of Justice Drive Extension. Details are provided in Appendix A. The L_{10} noise levels are 73 (72.98) dBA (overall) and 73 (72.97) dBA (without Justice Drive Extension). The differences are therefore less than 1 dBA and the above criteria is met.

4.5.8 The number of dwellings which will be exposed to traffic noise above HKPSG limits is 531 but these are affected by other roads not the proposed Justice Drive Extension.

4.6 Residual Impacts

4.6.1 The noise modelling results have concluded that the traffic noise levels at all the noise sensitive receivers in the year 2017 will exceed the standards of the Hong Kong Planning Standards and Guidelines. However, the dominant factor in the environment is the traffic noise from the existing roads, e.g. Queensway Road, Queen's Road East, Harcourt Road, Fenwick Pier Street, etc., which are very busy and have a high percentage of heavy vehicles and high traffic flows. The noise impact from the existing roads is clearly reflected in the noise modelling results for the year 1999, that is the last year before the construction of the Justice Drive Extension. The traffic noise contribution from the Project is in general 10 dBA below the existing road networks in accordance with the predicted noise levels for the Year 2017 in Table 4.7 below. Therefore, it would not be effective to provide direct mitigation measures on the Project to address the traffic noise impacts. We have also carried out an assessment on the eligibility of noise insulation work based on the following three criteria:

(i) the predicted overall noise level from the new road together with other traffic noise in the vicinity must be above the specified noise level (L_{10} (1 hour) 70dB(A) and 65dB(A) for residential dwellings and education institutions respectively);

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

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

Table 4.7: The Three Eligibility Criteria Test for the Maximum Noise Levels, L_{10} (1 hour), dBA, at the Noise Sensitive Receivers During Operation in the Year 2017

Sensitive Receivers	Year 2017 Existing Roads	Year 2017 New Roads	Year 2017 Predicted Total Noise Levels L_{10} (1 hr) dBA	Year 1999 Prevailing Traffic Noise Level	Condition 1	Condition 2	Condition 3
R5	78.1	55.9	78 (78.2)	76.9	Yes	Yes	No
R6	77.2	55.9	77 (77.3)	76.6	Yes	No	No
R7	76.8	48.9	77 (76.8)	77.5	Yes	No	No
R8	74.6	53.6	75 (74.7)	74.1	Yes	No	No
R9	82.2	48.8	82 (82.2)	80.5	Yes	Yes	No
R10	82.4	56.9	83 (82.5)	82.3	Yes	No	No
R11	82.9	55.5	83 (82.9)	82.7	Yes	No	No
R14	72.5	61.4	73 (72.8)	72.7	Yes	No	No
R15	77.6	64.8	78 (77.9)	77.9	Yes	No	No
R16	77.8	64.0	78 (78.0)	78.0	Yes	No	No
R18	74.3	59.7	75 (74.5)	74.2	Yes	No	No

4.6.2 Table 4.7 shows the application of this test to this Project and concludes that none of the properties are eligible for indirect noise mitigation. The results of the test show that it is not necessary to carry out any indirect mitigation measures at any of the noise sensitive receivers. The results of the test are presented in Appendix C.

4.6.3 The test against the three eligibility criteria for indirect noise mitigation has concluded that none of the existing properties will be eligible. There are thus considered to be no residual impacts.

Justice Drive Extension

Justice Drive Extension

Justice Drive Extension

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Section 5
Air Impact Assessment

Mouchel Asia Limited

5. AIR IMPACT ASSESSMENT

5.1 Air Sensitive Receivers

5.1.1 Representative Air Sensitive Receivers (ASRs) have been identified according to the criteria set out in the Hong Kong Planning Standards and Guidelines (HKPSG) and the Air Pollution Control Ordinance (APCO), through site inspections and review of land use plans of the Study Area. The locations of the ASRs are shown in Figure 2.3. The names of the Air Sensitive Receivers are shown in Table 5.1. The modelling has used the ASRs which are closest to the new road so for example, the two 30-storey residential towers at No. 9 Star Street and the proposed Wan Chai Park are not defined specifically in the modelling as they are not the worst case for the assessment.

Table 5.1: Locations of Air Sensitive Receivers

Receiver No.	Location
A1 to A4	Representative receivers on new development (it has been confirmed that these are planned as commercial)
A5	Servicemen's Guides Association
A6, A7, A9, A10	Facade of main building of Academy for Performing Arts
A8	External theatre of Academy for Performing Arts
A11	Anne Black Building (Red Cross HQ)
A12	Ramp of Harcourt Garden
A13, A14, A16	Police Headquarters
A15, A17, A21, A22, A24	Vent shafts for Car Park under Harcourt Garden
A18, A19, A20	Harcourt Garden
A23	United Centre
A25, A26, A27	Arsenal House
A28	Courtyard
A29, A30, A31	Oxfam H.K.
A32, A33, A34	Paget House
A35, A36	Not used (Marriott Hotel) This is not applicable as an ASR as the building is fully sealed and air conditioned.
A37	Note used (Conrad Hotel) This is not applicable as an ASR as the building is fully sealed and air conditioned.
A38	NAAFI Shopping Centre
A39	Victoria Community Centre
A40	Dragon House

5.2 The Existing Air Pollution Environment

5.2.1 The existing air pollution environment in the area of the Project site is dominated by the vehicular air emissions. There are no long term air monitoring stations in the vicinity of the study area and an air pollution monitoring survey was therefore carried out to measure the ambient conditions. The air monitoring results are shown in Appendix F and the background conditions are summarised in Table 5.2.

Table 5.2: Results of Background Air Monitoring

Monitoring Location	Locations	Periods	Average Concentrations of Air Pollutants ($\mu g/m^3$)			
Hong Kong Academy for Performing Arts	Roof	3-4/97	TSP (1 hour)	TSP (24 hour)	RSP (24 hour)	NO_2 (1 hour)
			100	95	61	54*
Standards of Air Quality Objectives			500	260	180	300

Note: * The background concentration was based on long-term monitoring at EPD's Central/Western Monitoring Station.

5.3 Impacts During Construction

5.3.1 The likely air quality impact arising from the construction of Justice Drive Extension is related to dust nuisance, and gaseous emissions from construction plant and vehicles.

5.3.2 SO_2 and NO_2 will be emitted from the diesel-powered equipment used. However, since the number of such plant required on-site will be limited, their gaseous emissions will be minor. It is therefore not expected that the Air Quality Objectives for these gases will be exceeded as a result of the construction of the Project.

5.3.3 Potential dust nuisance will be the major concern from the construction of the Project. The major sources of dust on site have been assumed based on the preliminary programme discussed in Chapter 2 of this report.

5.3.4 The Fugitive Dust Model (FDM) has been used to predict the likely dust impacts at the Air Sensitive Receivers (ASRs). Particulate emission rates for the dust sources were determined based on the USEPA publication *Compilation of Air Pollution Emission Factors (AP-42)(USEPA, 4th & 5th edition, 1985 & 1995).* It was assumed that 80% of particulates are of size equal to 30 μm and the remaining 20% are respirable with size of 10 μm. The silt content was assumed to be 4.8% and the moisture content was assumed to be 4%. These figure have been used in previous studies on similar projects and are based on the emission information for different activities listed in AP42. The emission factors are shown in Appendix D. Average dust density of 2500 kg/m^3 was assumed in this study. The background concentrations used in the impact assessment are :

TSP(1 hour): 100 $\mu g/m^3$
TSP(24 hour): 95 $\mu g/m^3$

5.3.5 Meterological data of 1995 at Central Station has been supplied by the Hong Kong Royal Observatory. Mixing height information for 1995 was supplied at King's Park weather station. 1-hour, 24-hour TSP concentrations at the Air Sensitive Receivers were calculated.

5.3.6 The four construction activities, Demolition, Deck Construction, Foundation Construction, Pavement Construction, will not take place concurrently and the results of the modelling have therefore been shown for these individual groups of activities.

5.4 Mitigation Measures During Construction

5.4.1 The construction work could cause dust impacts on some of the air sensitive receivers up to about 550 $\mu g/m^3$ (1-hour TSP) unless mitigation is applied. The following dust control measures are recommended to reduce these dust impacts to acceptable levels. These mitigation measures should be incorporated in the Contract Specification:

(i) watering of unpaved roads, which results in road dust suppression by forming moisture cohesive films among the discrete grains of road surface material. An effective watering programme, i.e. twice daily watering with complete coverage, is estimated to reduce erosion and unpaved roads by 50%;

(ii) watering of open areas at every 1.5 hours. This is estimated to reduce dust emissions by 70%;

(iii) watering should be implemented to control dust where breaking of oversize rock/concrete is required. Water spray should be used during the handling of fill material at the site and at active cuts, excavation and fill sites where dust is likely to be created;

(iv) dropping heights for excavated materials should be controlled to a practical height to minimize the fugitive dust arising from unloading;

(v) materials being transported by truck should not be loaded to a level higher than the side and tail boards, and should be dampened or covered before transport;

(vi) all stockpiles of aggregate or spoil should be enclosed or covered and water applied in dry or windy condition; and

(vii) effective water sprays should be used on the site at potential dust emission sources.

5.4.2 The FDM model has been run to estimate the dust impacts with these mitigation measures in place. The background air quality has been added to the FDM model results. The maximum concentrations of dust impacts at the nearest Air Sensitive Receivers from the alignment during construction with these general control requirements are shown in Table 5.3, 5.4, 5.5 and 5.6.

Table 5.3: Concentrations of Dust Impacts at the Air Sensitive Receivers During Construction With General Control Requirements

Demolition Work

Air Sensitive Receivers	Concentration of Total Suspended particulates ($\mu g/m^3$)	
	1 Hour	24 Hour
A5	218	116
A6	167	106
A7	182	108
A8	161	107
A9	160	105
A10	146	105
A11	177	112
A12	223	119
A13	208	111
A14	227	112
A15	136	98
A16	199	112
A17	120	99
A18	223	118
A19	231	128
A20	195	118
A21	124	99
A22	126	99
A23	226	136
A24	120	99
A25	235	122
A26	223	118
A27	206	114
A28	112	96
A29	229	125
A30	259	125
A31	274	128
A32	108	95
A33	107	96
A34	105	96
A35*	114	96
A36*	113	96
A37*	109	95
A38	114	96
A39	115	96
A40	107	95

Note: Background dust concentrations were included in the results.
Air Quality Objectives Standards:- (i) TSP (1 hour) : $500\mu g/m^3$
(ii) TSP (24 hours) : $260\mu g/m^3$

* Supplied for information only

Table 5.4: Concentrations of Dust Impacts at the Air Sensitive Receivers During Construction With General Control Requirements

Bridge Deck Construction

Air Sensitive Receivers	Concentration of Total Suspended particulates ($\mu g/m^3$)	
	1 Hour	24 Hour
A5	218	116
A6	167	106
A7	182	108
A8	161	107
A9	160	105
A10	146	105
A11	177	112
A12	223	119
A13	208	111
A14	227	112
A15	136	98
A16	199	112
A17	120	99
A18	223	118
A19	231	128
A20	195	118
A21	124	99
A22	126	99
A23	226	136
A24	120	99
A25	235	122
A26	223	118
A27	206	114
A28	112	96
A29	229	125
A30	259	125
A31	274	128
A32	108	95
A33	107	96
A34	105	96
A35*	114	96
A36*	113	96
A37*	109	95
A38	114	96
A39	115	96
A40	107	95

Note: Background dust concentrations were included in the results.
Air Quality Objectives Standards:- (i) TSP (1 hour) : $500\mu g/m^3$
(ii) TSP (24 hours) : $260\mu g/m^3$
* Supplied for information only

Table 5.5: Concentrations of Dust Impacts at the Air Sensitive Receivers During Construction With General Control Requirements

Foundation Construction

Air Sensitive Receivers	Concentration of Total Suspended particulates ($\mu g/m^3$)	
	1 Hour	24 Hour
A5	271	126
A6	197	111
A7	219	115
A8	189	112
A9	187	110
A10	166	109
A11	212	119
A12	279	130
A13	257	119
A14	285	120
A15	152	100
A16	244	120
A17	129	101
A18	279	129
A19	291	143
A20	238	129
A21	135	101
A22	138	101
A23	283	155
A24	129	101
A25	296	134
A26	278	129
A27	255	123
A28	117	96
A29	288	139
A30	332	139
A31	354	144
A32	111	96
A33	110	96
A34	108	96
A35*	121	97
A36*	119	97
A37*	113	96
A38	120	97
A39	123	96
A40	110	95

Note: Background dust concentrations were included in the results.
Air Quality Objectives Standards:- (i) TSP (1 hour) : $500\mu g/m^3$
(ii) TSP (24 hours) : $260\mu g/m^3$

* Supplied for information only

Table 5.6: Concentrations of Dust Impacts at the Air Sensitive Receivers During Construction With General Control Requirements

Pavement Construction

Air Sensitive Receivers	Concentration of Total Suspended particulates ($\mu g/m^3$)	
	1 Hour	24 Hour
A5	274	126
A6	198	112
A7	221	115
A8	190	112
A9	189	111
A10	167	110
A11	214	119
A12	282	130
A13	259	119
A14	287	120
A15	153	100
A16	245	121
A17	129	101
A18	281	129
A19	293	143
A20	239	129
A21	136	101
A22	138	101
A23	285	156
A24	130	101
A25	298	135
A26	280	129
A27	256	123
A28	117	96
A29	290	139
A30	334	140
A31	357	144
A32	111	96
A33	110	96
A34	108	96
A35*	121	97
A36*	119	97
A37*	113	96
A38	120	97
A39	123	96
A40	110	95

Note: Background dust concentrations were included in the results.
Air Quality Objectives Standards:- (i) TSP (1 hour) : $500\mu g/m^3$
(ii) TSP (24 hours) : $260\mu g/m^3$

* Supplied for information only

5.4.3 Contour lines for the TSP concentration have been plotted at 1m above ground level and these are shown in Figures 5.1, 5.2, 5.3 and 5.4.

5.4.4 It can be seen that the dust impacts at ASRs are all well within the standards of the Air Quality Objectives.

5.5 Impacts During Operation

5.5.1 Impacts on air quality during operation of the Justice Drive Extension and the existing roads are due to vehicular emissions.

5.5.2 The background concentrations used in the impact assessment are :

PM(24 hour):	61 $\mu g/m^3$	
NO_2(1 hour):	54 $\mu g/m^3$	(recorded data at EPD's Central/Western Monitoring Station)

5.5.3 Peak hour traffic flows and vehicle mix in the year 2011 and year 2002 were obtained from the transportation modelling studies for all roads within 500m of the new road. The year 2011 has been used for the assessment as this will be the worst case. Vehicular emission factors of NO_x, PM, CO for each vehicle type in the year 2011 and year 2002 were based on data supplied by EPD. NO_2 was assumed to be 20% of total NO$_x$ emissions. The traffic emissions were modelled using the traffic pollution model CALINE4. The worst case is in the year 2011 and is clearly shown in Appendix E.

5.5.4 It is not possible to obtain a 24-hour averaging period results from CALINE4 as it is only a screening model. However, maximum concentrations for 24 hour periods can be calculated by multiplying the maximum 1-hour concentration with the multiplication factors of 0.4 (+/-0.2). The factor is generally used to convert short term concentrations estimated by screening models to long term concentrations. The factor is accepted by regulatory agencies in the U.S.A.[1]

5.5.5 As the peak hour traffic occurs during daytime, neutral meterological conditions were assumed. Typical input parameters for the CALINE4 model are listed below:

Wind Speed:	1 metre per second
Wind Direction:	worst case for each receiver
Standard Deviation:	24 Degrees
Stability Class:	D
Mixing Height:	1000 metres
Temperature:	25 Deg. C
Surface Roughness:	300 cm

[1] (i) "Practical Guide to Atmospheric Dispersion Modelling", Trinity Consultants, Inc., U.S.A. Table 10-5, p.10-16.

(ii) Brode, R.W., 1988: Screening Procedures for Estimating the Air Quality Impact of Stationary Sources. EPA-450/4-88-010, U.S. Environmental Protection Agency, Research Triangle Park, N.C., U.S.A., p.4-17.

5.5.6 The Traffic Emission Factors are shown in Appendix E.

5.5.7 The detailed results of the modelling are shown in Table 5.7 and Table 5.8. The ambient air quality has been included in the results, except CO modelling results. It can be shown that the CO concentration results are far below the standards, therefore, we are confident that the cumulative results would not exceed the standards.

5.5.8 It can be seen that the air impacts are all within the standards of the Air Quality Objectives and no further mitigation will be required.

5.5.9 Contour lines for the operation phase in the year 2011 were plotted at 1m above ground level with identified air sensitive receivers and are shown in Figure 5.5.

5.6 Mitigation Measures During Operation

5.6.1 Mitigation measures during operation are not required.

5.7 Residual Impacts

5.7.1 The results indicate that the air pollutants will be within acceptable levels over the entire study area.

Table 5.7: Concentrations of the Air Pollutants at the Air Sensitive Receivers During Operation in the Year 2002

Air Sensitive Receivers	Concentration ($\mu g/m^3$)		
	CO (1 hour)	RSP (24 hour)	NO_2 (1 hour)
A1	1149	78	154
A2	1182	79	161
A3	1421	84	184
A4	1624	88	207
A5	1663	88	212
A6	1822	86	198
A7	1496	84	189
A8	1558	88	209
A9	1559	88	208
A10	2782	111	287
A11	2451	103	293
A12	2505	106	297
A13	2509	108	299
A14	2291	103	286
A15	2348	103	283
A16	1661	90	218
A17	2246	101	279
A18	2230	102	283
A19	2056	99	268
A20	2199	100	273
A21	2197	102	285
A22	2231	102	287
A23	2037	103	289
A24	2123	104	291
A25	2172	98	257
A26	1992	96	246
A27	1975	98	253
A28	988	77	153
A29	2180	101	281
A30	2332	103	293
A31	2309	103	288
A32	679	71	121
A33	654	71	119
A34	631	71	118
A35*	1072	79	161
A36*	1093	79	163
A37*	968	77	152
A38	1134	79	165
A39	1168	80	168
A40	738	72	125

Note : Background air pollutant concentrations are included in the results, except CO concentrations.

Air Quality Objectives Standards:- (i) CO (1 hour) : $30000\mu g/m^3$
(ii) RSP (24 hours) : $180\mu g/m^3$
(iii) NO_2 (1 hour) : $300\mu g/m^3$

* Supplied for information only

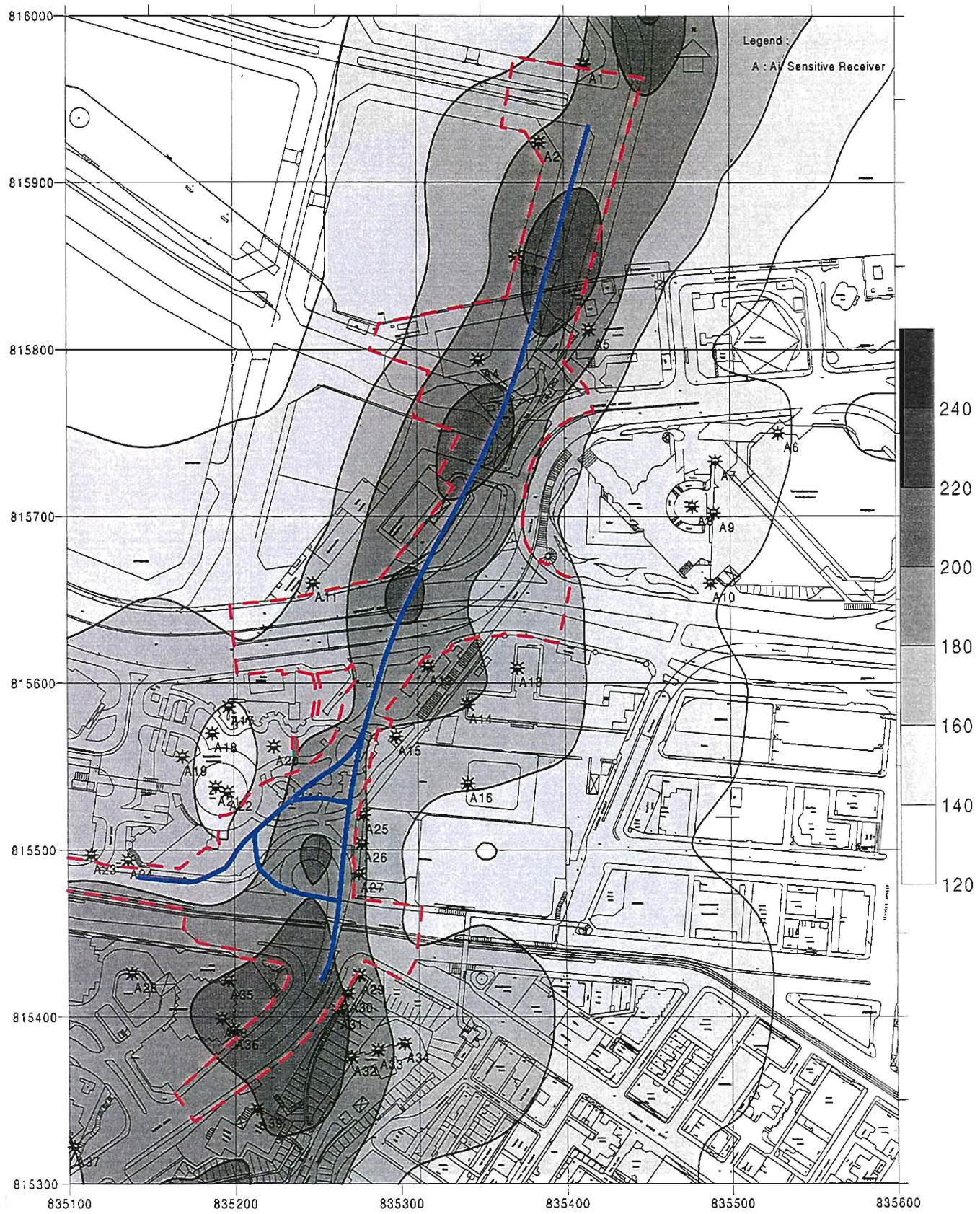
Table 5.8: Concentrations of the Air Pollutants at the Air Sensitive Receivers During Operation in the Year 2011

Air Sensitive Receivers	Concentration ($\mu g/m^3$)		
	CO (1 hour)	PM (24 hour)	NO_2 (1 hour)
A1	1419	77	161
A2	1456	78	166
A3	1757	82	190
A4	2346	86	210
A5	2138	87	218
A6	2271	86	216
A7	1868	81	186
A8	1693	82	195
A9	1645	82	190
A10	2310	88	222
A11	2951	98	293
A12	2875	99	291
A13	2734	98	281
A14	2533	95	271
A15	2691	97	276
A16	1893	86	212
A17	2882	98	295
A18	2827	98	294
A19	2583	96	276
A20	2712	96	281
A21	2734	98	292
A22	2760	98	293
A23	2079	92	245
A24	2274	94	258
A25	2590	95	259
A26	2409	93	249
A27	2448	95	255
A28	1195	76	154
A29	2666	97	283
A30	2847	99	296
A31	2820	99	292
A32	883	71	127
A33	850	71	125
A34	822	71	124
A35*	1349	78	167
A36*	1360	78	169
A37*	1129	75	151
A38	1362	78	166
A39	1421	78	171
A40	909	71	128

Note : Background air pollutant concentrations are included in the results, except CO concentrations.

Air Quality Objectives Standards:-
(i) CO (1 hour) : $30000\mu g/m^3$
(ii) RSP (24 hours) : $180\mu g/m^3$
(iii) NO_2 (1 hour) : $300\mu g/m^3$.

* Supplied for information only

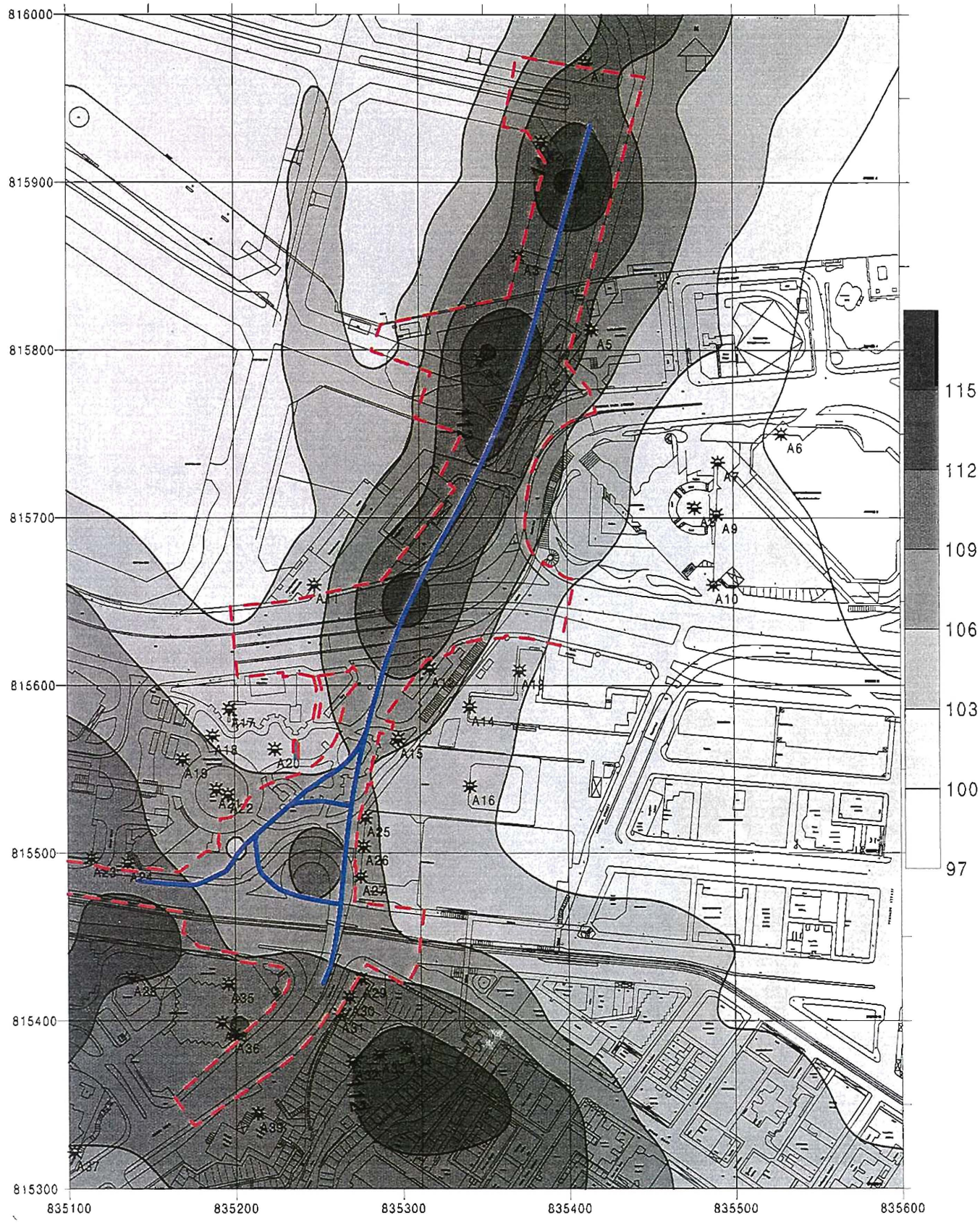


TSP concentration (ug/m3, 1-hour) contour lines

TSP Concentration Contour for Demolition

Mouchel

Figure No. 5.1a



TSP concentration (ug/m3, 24-hour) contour lines

TSP Concentration Contour for Demolition

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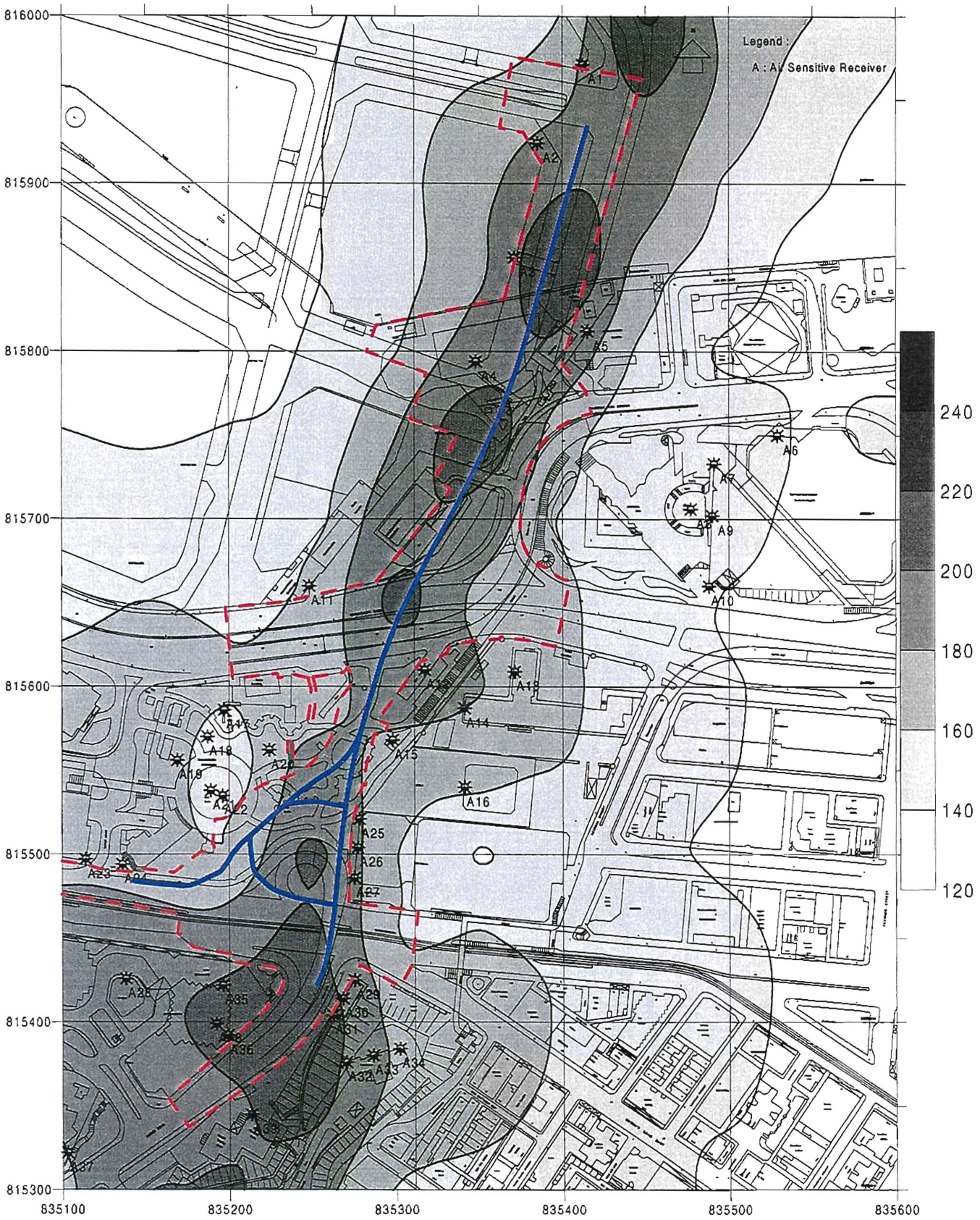
Figure No. 5.1b



TSP concentration (ug/m3, 1-hour) contour lines

TSP Concentration Contour for Deck Construction

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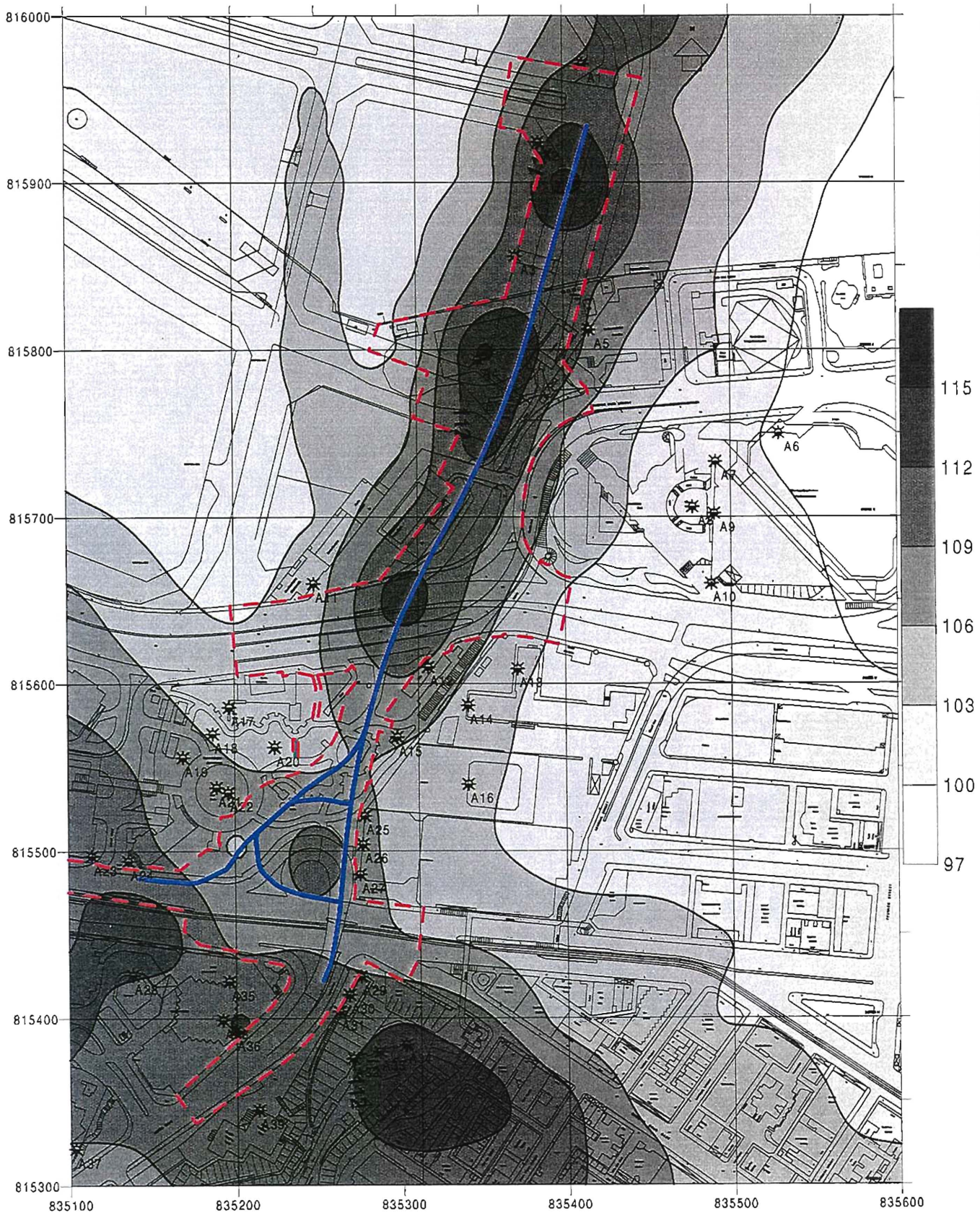
Figure No. 5.2a



TSP concentration (ug/m3, 24-hour) contour lines

TSP Concentration Contour for Deck Construction

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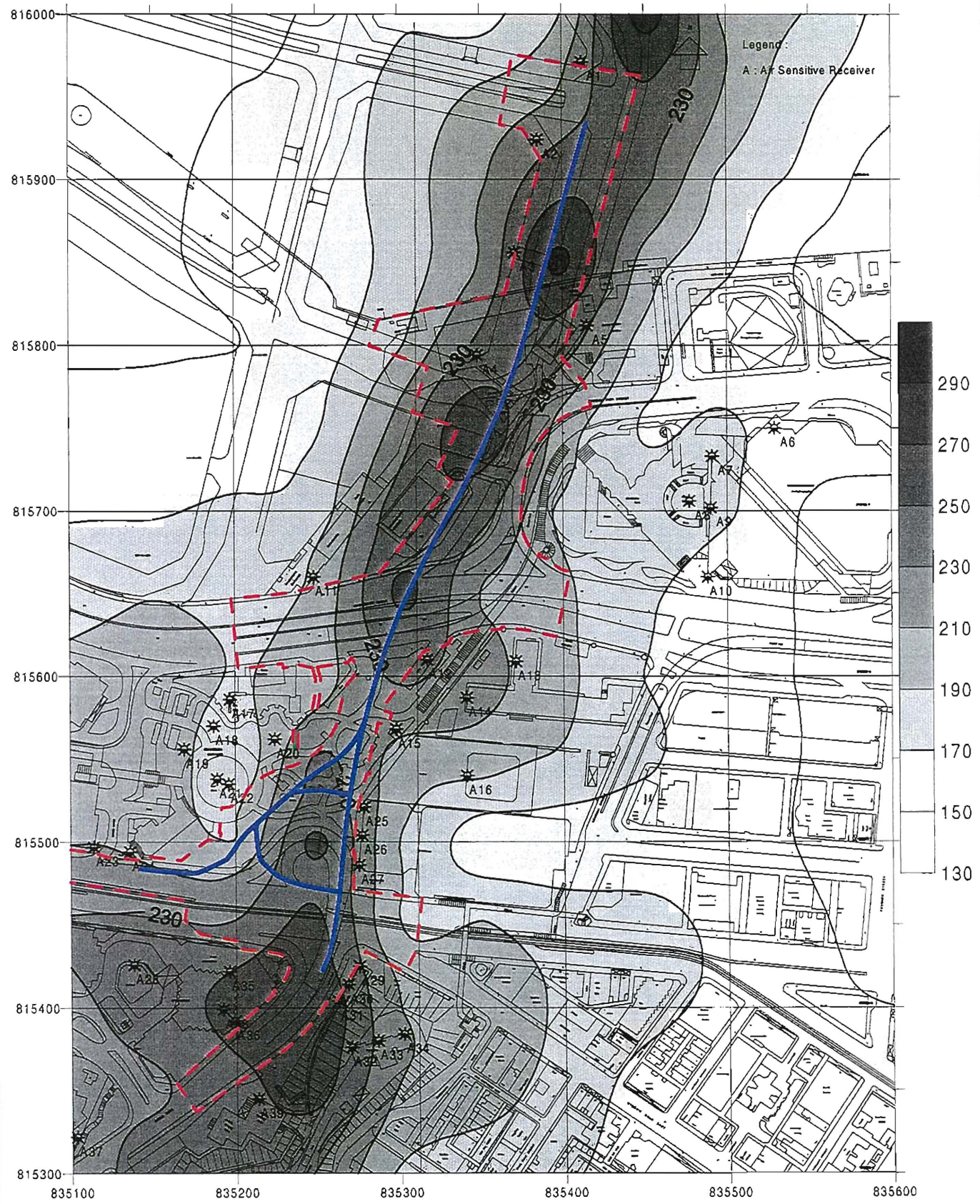
Figure No. 5.2b



TSP concentration (ug/m3, 1-hour) contour lines

TSP Concentration Contour for Pavement Construction

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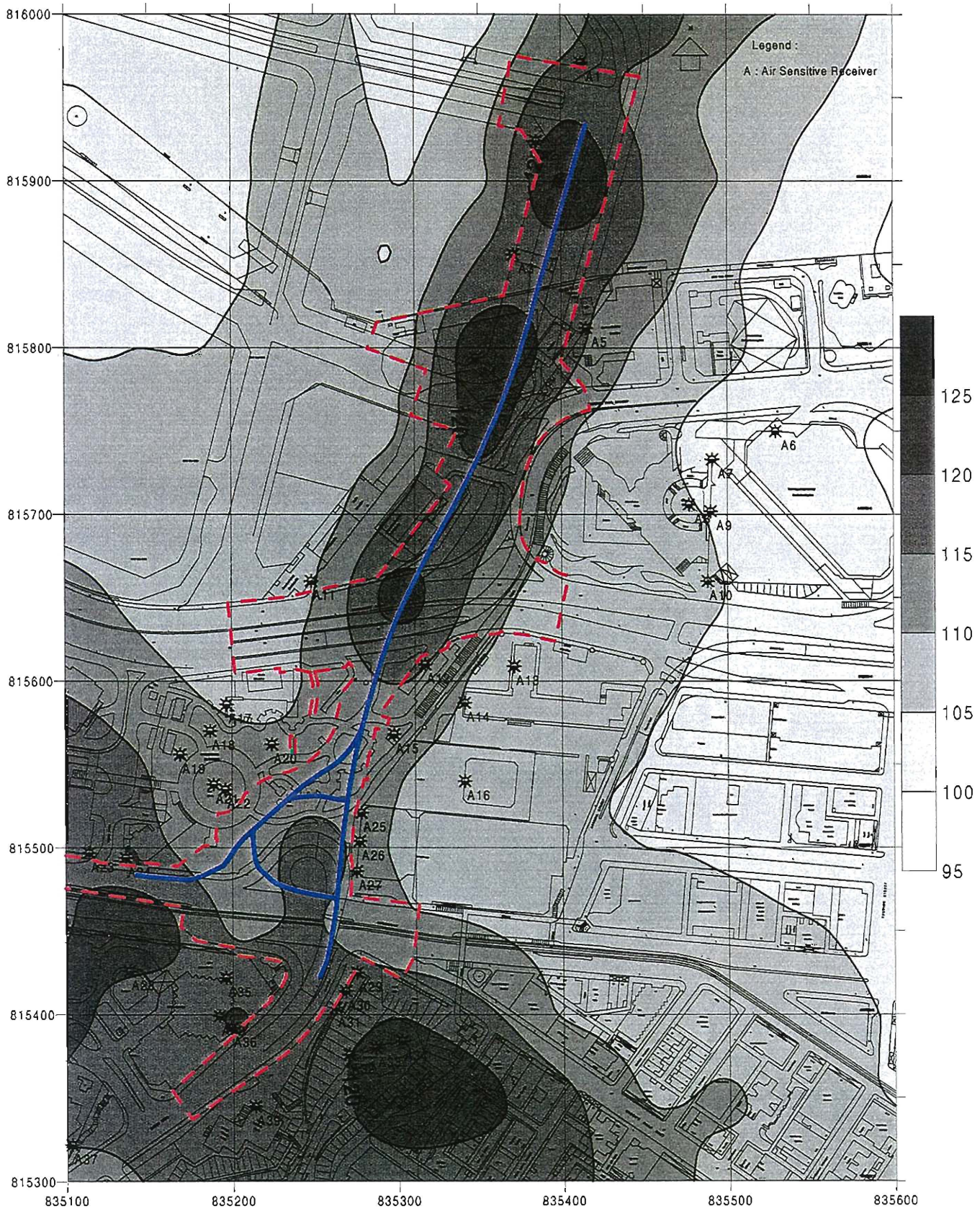
Figure No. 5.3a



TSP concentration (ug/m3, 24-hour) contour lines

TSP Concentration Contour for Pavement Construction

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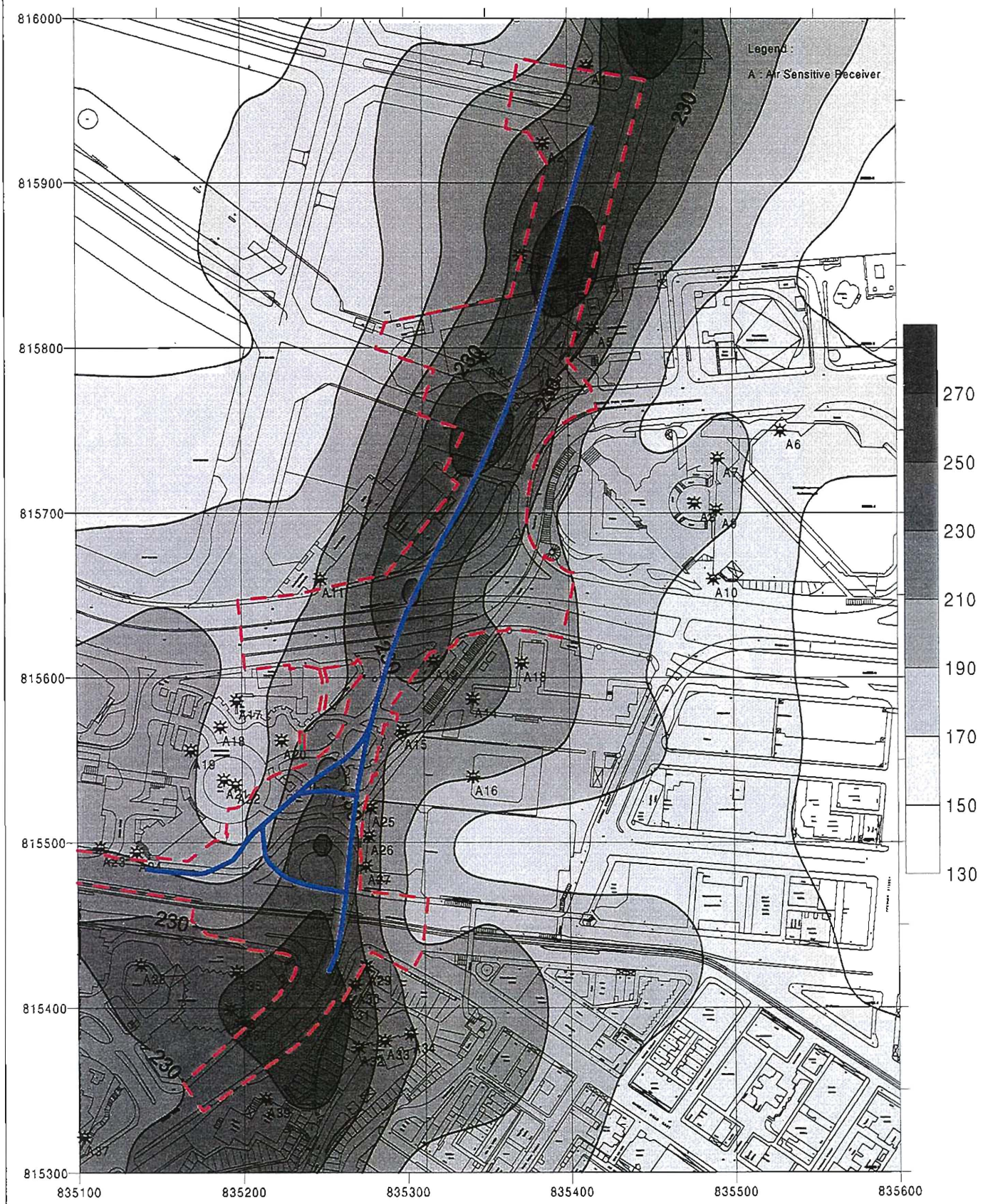
Figure No. 5.3b



TSP concentration (ug/m3, 1-hour) contour lines

TSP Concentration Contour for Foundation Construction

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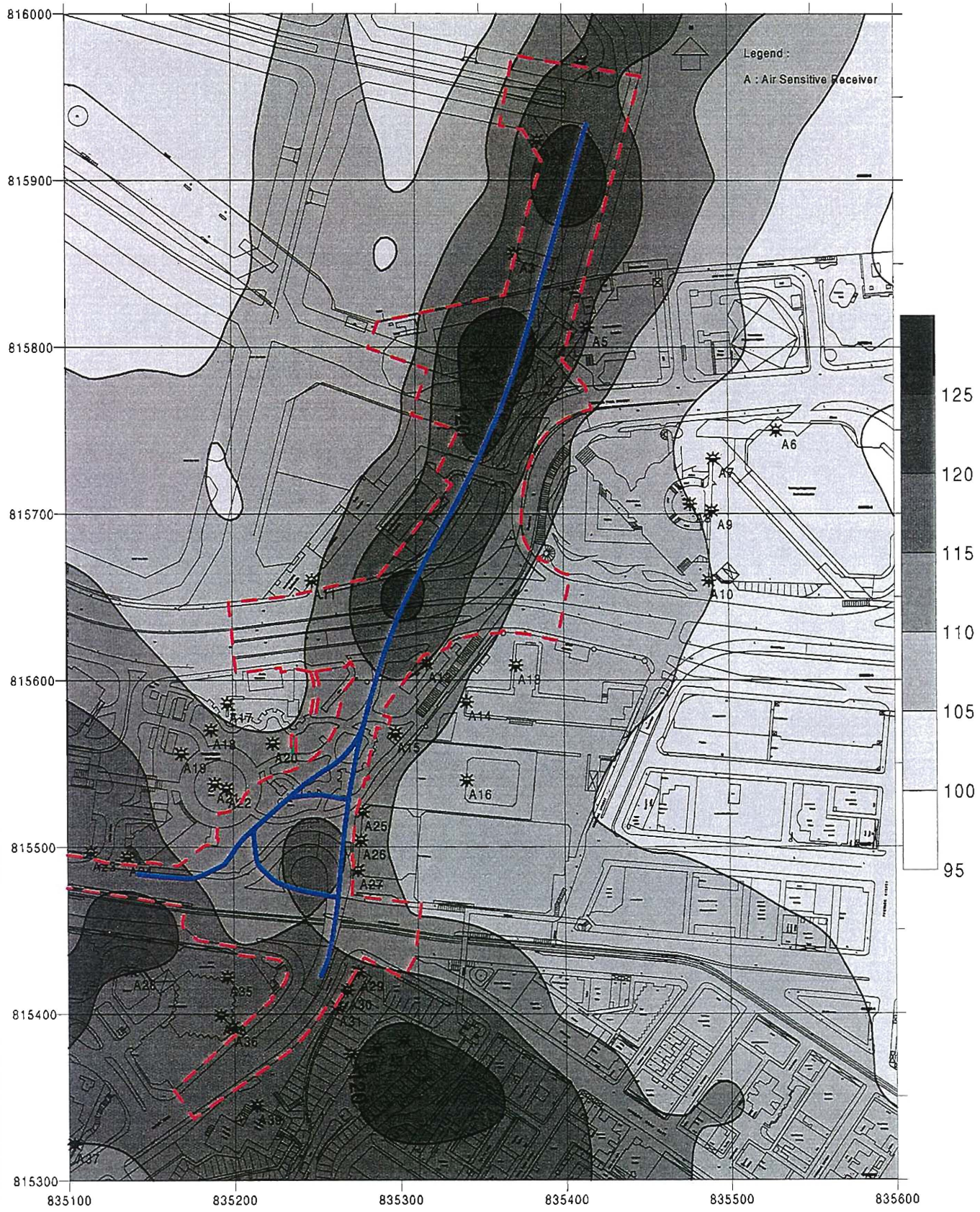
Figure No. 5.4a



TSP concentration (ug/m3, 24-hour) contour lines

TSP Concentration Contour for Foundation Construction

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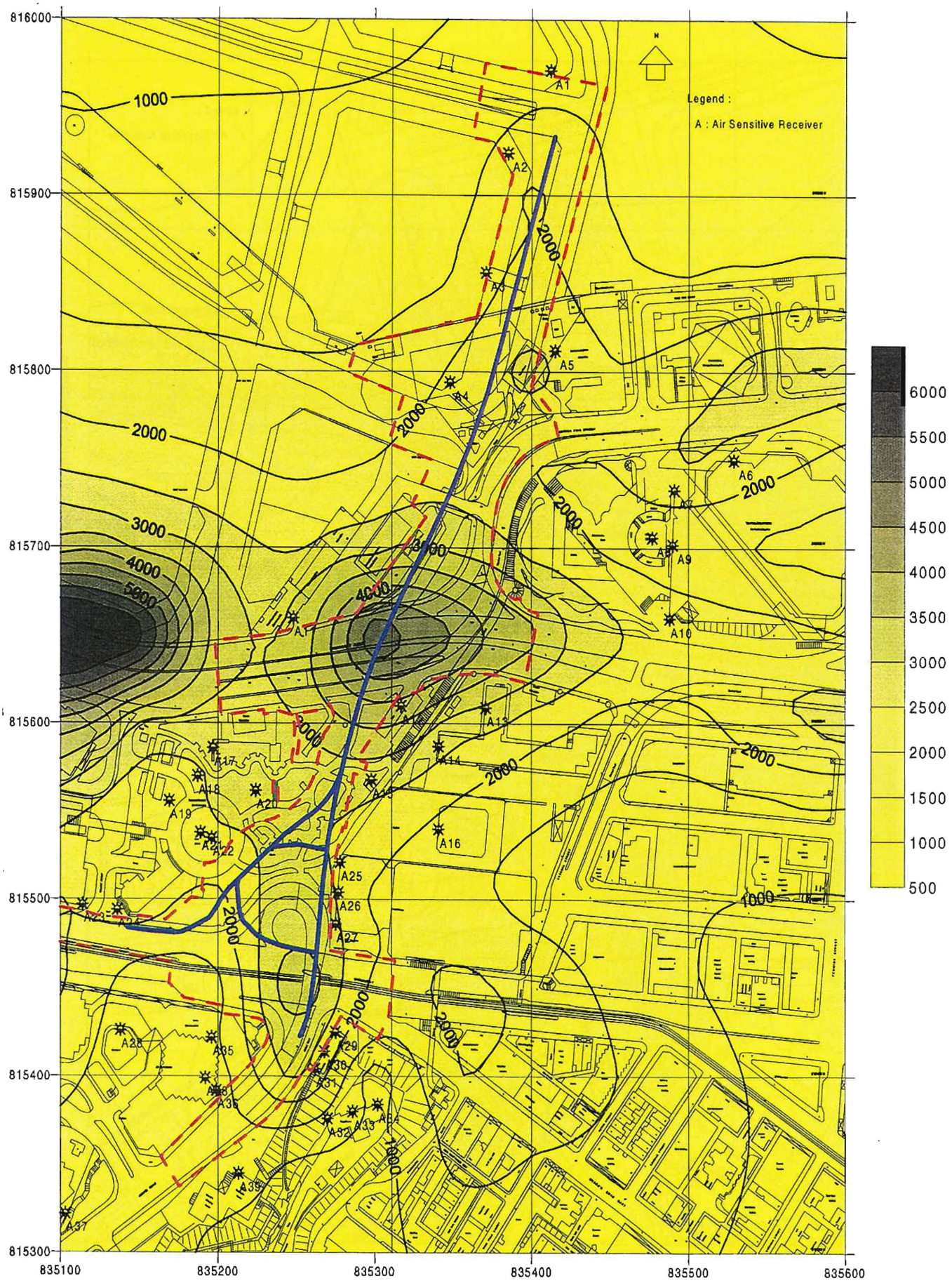
Figure No. 5.4b

Juctice Drive Extension



CO concentration (ug/m3, 1 hour) contour lines

Pollution Concentration Contour during Operation

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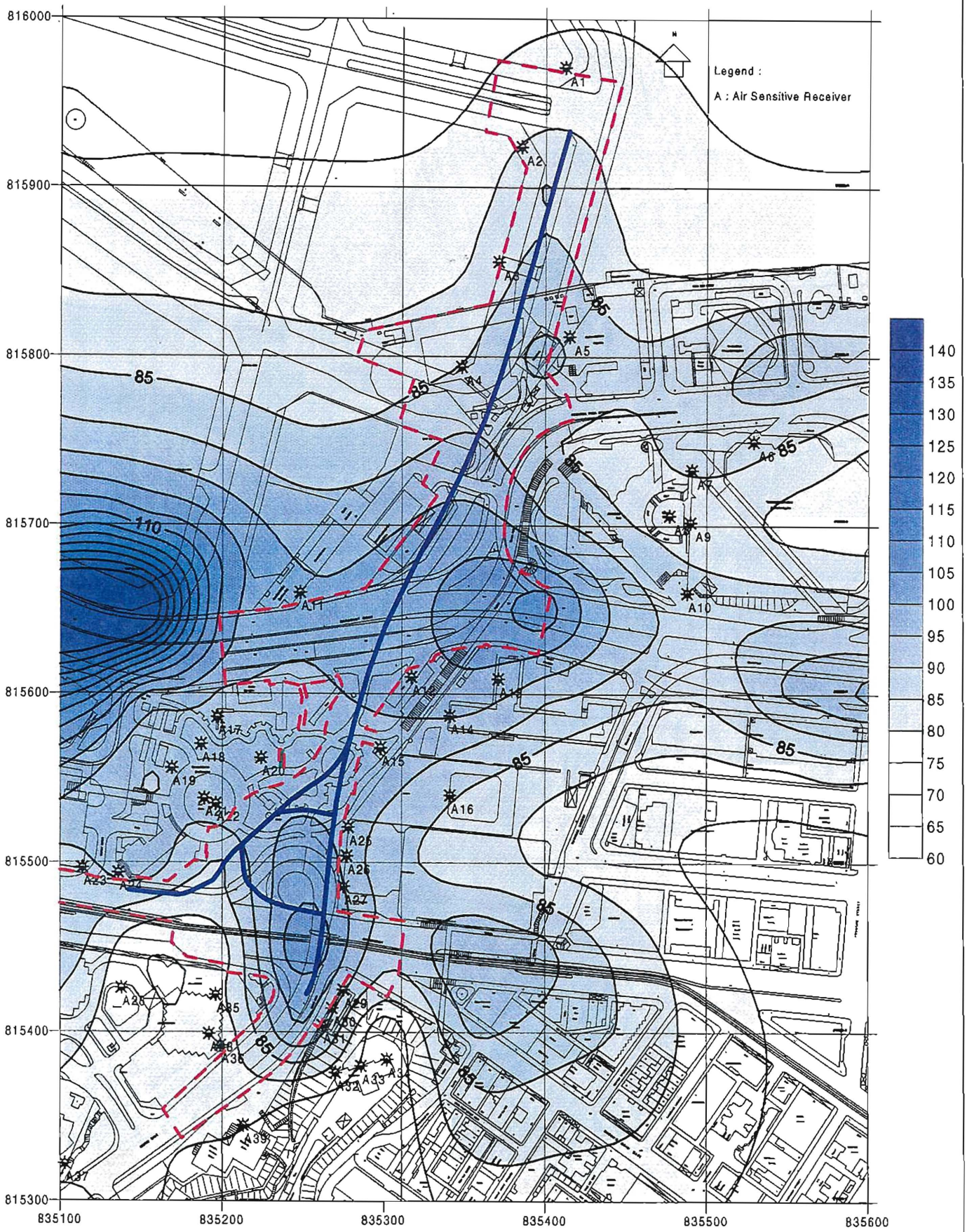
Figure No. 5.5a



PM concentration (ug/m3, 1-hour) contour lines

Pollution Concentration Contour during Operation

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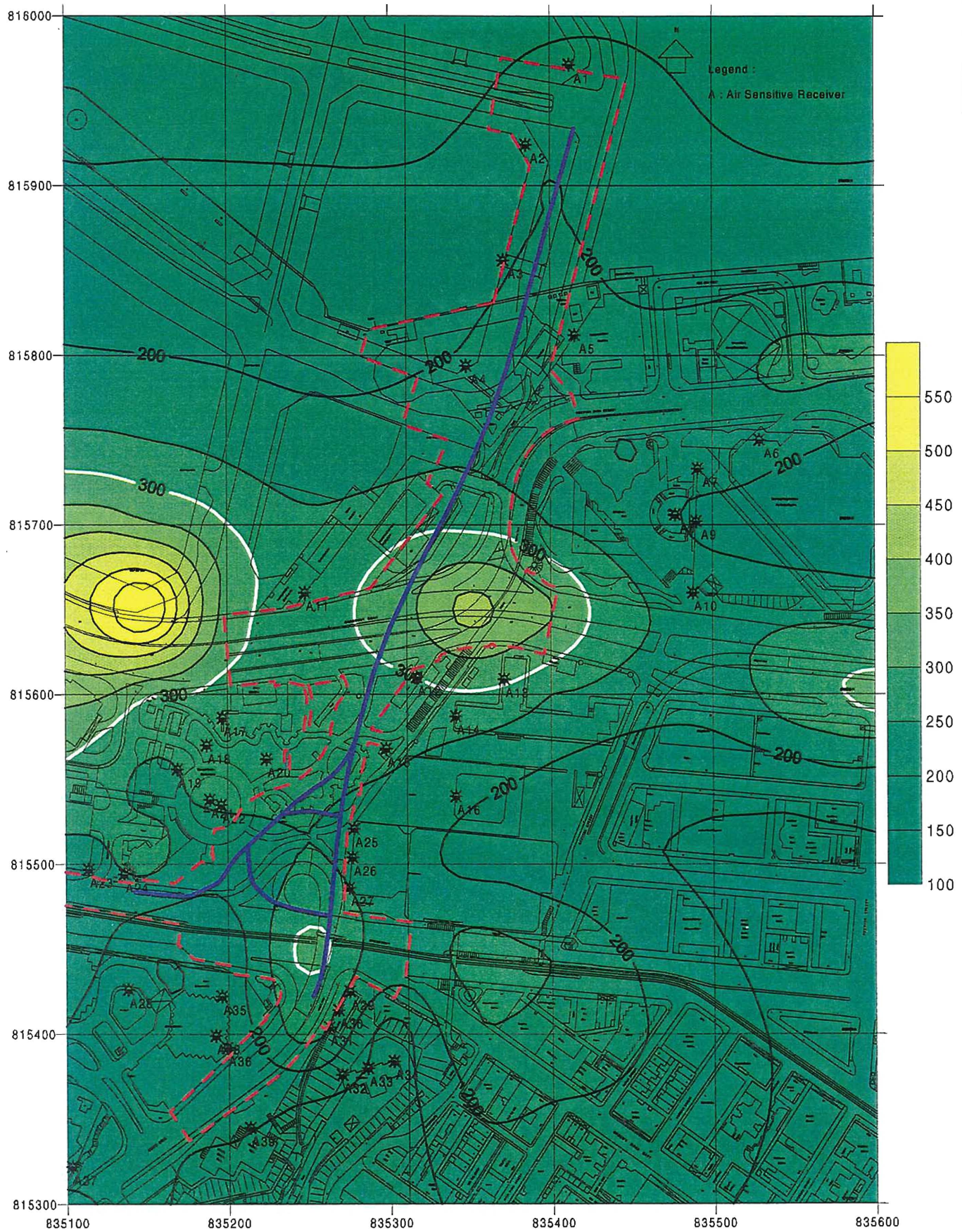
Figure No. 5.5b



NO2 concentration (ug/m3, 1-hour) contour lines

Pollution Concentration Contour during Operation

Mouchel

Figure No. 5.5c

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Section 6 Environmental Monitoring and Audit

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6 ENVIRONMENTAL MONITORING AND AUDIT

6.1 Introduction

6.1.1 The following Environmental Monitoring and Audit (EM&A) Section provides summary of the EM&A requirements for this Project. Specific details of the EM&A Programme are provided in the EM&A Manual.

6.1.2 The purpose of the EM&A programme is to assess the environmental performance of the Justice Drive Extension and provide a method for assessing the effectiveness of the mitigation measures that are proposed in this report to determine the need for any additional mitigation measures or remedial action to be taken for reducing impacts generated from the Project.

6.1.3 The Government of the Hong Kong Special Administrative Region's applicable environmental regulations for noise and air quality, EPD's Generic EM&A Manual, the Hong Kong Planning Standards and Guidelines, and recommendations in this EIA study have served as guidance documents in the preparation of EM&A Programme.

6.2 Parties Involved

6.2.1 As part of the resident site staff, an Environmental Specialist is to be employed along with required support staff for carrying out the environmental monitoring including field measurements, sampling, laboratory testing, analysis of monitoring work results, reporting and auditing. The Environmental Specialist shall be approved by the Engineer's Representative and the Director of the Environmental Protection Department (DEP).

6.3 EIA Mitigation Measures

6.3.1 The previous Sections of this EIA identify existing and proposed sensitive receivers within the study area. The EIA has recommended specific mitigation measures to be implemented to reduce the potential for dust and noise impacts. These measures will be carried out prior to and during Project construction works.

6.4 Baseline Monitoring

6.4.1 Baseline Monitoring is the measurement of parameters at representative receivers prior to construction works to establish existing conditions. Baseline Monitoring will be carried out for both dust and noise.

6.4.2 Baseline monitoring for dust will be carried out at six representative locations for 14 consecutive days prior to the start of the construction works to obtain daily 24-hr TSP samples. 1-hr sampling will also be carried out at least 3 times per day during the same period. The monitoring will be carried out within a three week period prior to the commencement of construction activities.

6.4.3 Baseline Monitoring for noise will be taken at representative monitoring locations prior to the commencement of the construction work over a 24 hour period. The baseline monitoring will be carried out daily for a period of at least two weeks and will be taken no earlier than three weeks prior to construction works being carried out.

6.5 Impact Monitoring

6.5.1 Impact Monitoring is defined as the measurement of parameters during Project construction and implementation so as to detect changes that can be attributed to the Project. Impact Monitoring will be carried out for both air quality and noise.

6.5.2 Air quality Impact Monitoring will be carried out at a frequency of at least once every week at four of the designated monitoring station for 24-hr TSP monitoring. For 1-hr TSP monitoring, the sampling frequency of at least three times every week will be carried out at the four locations when the highest dust impact occurs. The stations to be monitored will be selected based on the prevailing wind direction and their proximity to the active construction works.

6.5.3 Noise Impact Monitoring will be carried out at designated monitoring stations once construction has commenced on a twice a week basis. The construction noise level to be monitored will be measured in terms of the A-weighted equivalent continuous sound pressure level (Leq). Leq (30 min) for the time period between 0700-1900 hours on normal weekdays.

6.6 Action and Limit Levels

6.6.1 For the noise and air quality impact monitoring and audit, the criteria with which impacts are assessed are described as the Action Level and Limit Level.

(i) Action Level is the level beyond which there is an indication of deteriorating ambient level for which a typical response could be an increase in the monitoring frequency.

(ii) Limit Level is the level beyond the appropriate remedial pollution control ordinances, noise and air quality impact objectives or Hong Kong Planning Standards and Guidelines established by EPD for a particular Project, such that the works should not proceed without appropriate remedial action, including a critical review of plant and work methods.

6.6.2 The baseline monitoring results will form the basis for determining the air quality criteria for the impact monitoring. The air quality criteria (Action and Limit levels) will be as given in Table 6.1

Table 6.1: Action and Limit Levels for Air Quality

Parameters	Action	Limit
24 Hour TSP Level in $\mu g/m^3$	For baseline level < 108 $\mu g/m^3$, Action level = average of baseline level plus 30% and Limit level For baseline level > 108 $\mu g/m^3$ and baseline level < 154 $\mu g/m^3$, Action level = 200 $\mu g/m^3$ For baseline level > 154 $\mu g/m^3$, Action level = 130% of baseline level	260
1 Hour TSP Level in $\mu g/m^3$	For baseline level < 154 $\mu g/m^3$, Action level = average of baseline level plus 30% and Limit level For baseline level > 154 $\mu g/m^3$ and baseline level < 269 $\mu g/m^3$, Action level = 350 $\mu g/m^3$ For baseline level > 269 $\mu g/m^3$, Action level = 130% of baseline level	500

6.6.3 The Action and Limit levels for construction noise are given in Table 6.2.

Table 6.2: Action and Limit Levels for Construction Noise

Time Period	Action	Limit
0700-1900 hrs on normal weekdays	When one documented complaint is received	75* dB(A)
0700-2300 hrs on holidays; and 1900-2300 hrs on all other days		60/65/70** dB(A)
2300-0700 hrs of next day		45/50/55** dB(A)

* reduce to 70 dB(A) for schools and 65 dB(A) during school examination periods.

** to be selected based on Area Sensitivity Rating.

6.6.4 In the event of non-compliance with the air or noise criteria, more frequent monitoring will be undertaken and actions will be required (specified in the EM&A Manual) until the excessive noise or dust emission or the deterioration in noise or air quality is rectified or proved not to be generated from Project works.

6.7 Compliance Audit

6.7.1 Compliance Auditing is the process for verifying that parameters measured during the impact monitoring programme are in compliance with regulatory requirements and internal policies and standards and also to determine the degree and scope of any necessary measures in the event of exceedance of compliance.

6.7.2 Compliance Auditing will be carried out during the Project by review and checking of monitoring data, comparing data against the action and limit levels, reviewing the actions taken in the event of complaint or exceedance of levels, by carrying out routine and ad hoc site inspections and by checking that the works are in compliance with legal and contractual requirements.

6.8 Environmental Complaints

6.8.1 Complaints received will be addressed by a set of established complaint investigation procedures which are described in the EM&A Manual.

6.9 Reporting/Data Keeping

6.9.1 The monitoring and auditing results will be fully documented throughout the Project. Prior to construction works, a report of Baseline Monitoring results will be prepared providing detailed information on the monitoring results, influencing factors, the determination of the action and limit levels and statistical analysis of the results.

6.9.2 During construction activities, a monthly EM&A Report will be prepared which will include but not be limited to the results and finings of the EM&A work and description of all environmental issues and actions. A quarterly summary report will also be provided which will include, but not be limited to, general Project works and a synopsis of the EM&A activities and findings.

6.9.3 All site documents such as the monitoring field records, laboratory analysis records, site inspection forms, etc. which will be ready for inspection upon request. The monitoring data will be recorded in magnetic media form.

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Section 7
Conclusions and Recommendations

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7 CONCLUSIONS AND RECOMMENDATIONS

7.0.1 This Environmental Impact Assessment Report assesses the potential air and noise environmental impacts associated with the construction and operation of the proposed Justice Drive Extension.

7.0.2 Noise and dust mitigation measures have been incorporated into the construction stage to reduce potential environmental impacts.

7.1 Noise

Construction Stage

7.1.1 The modelling results during construction stage indicate that the noise levels at the noise sensitive receivers will comply with the relevant standards with the recommended mitigation measures.

Operation Stage

7.1.2 The noise modelling results for the year 2017 and the year 1999 have concluded that the noise impact from the Justice Drive Extension is very small even though the cumulative noise will be high. We have tested the potential for implementing direct mitigation measures and have concluded that this will not be acoustically effective and therefore no direct mitigation measures are recommended. We have also carried out a test according to the three Eligibility Criteria for indirect technical remedies in the form of acoustic insulation. The test concludes that none of the properties are eligible for indirect noise mitigation.

7.1.3 Based on our detailed analysis as mentioned in Section 4.6, it is concluded that neither direct nor indirect noise mitigation measures will be necessary.

7.2 Air

Construction Stage

7.2.1 The FDM modelling results during construction indicate that the dust levels at the air sensitive receivers will comply with the relevant standards with the recommended mitigation measures mentioned in Section 5.4.

Operation Stage

7.2.2 Mitigation measures during operation are not required.

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Appendix A
Traffic Figures

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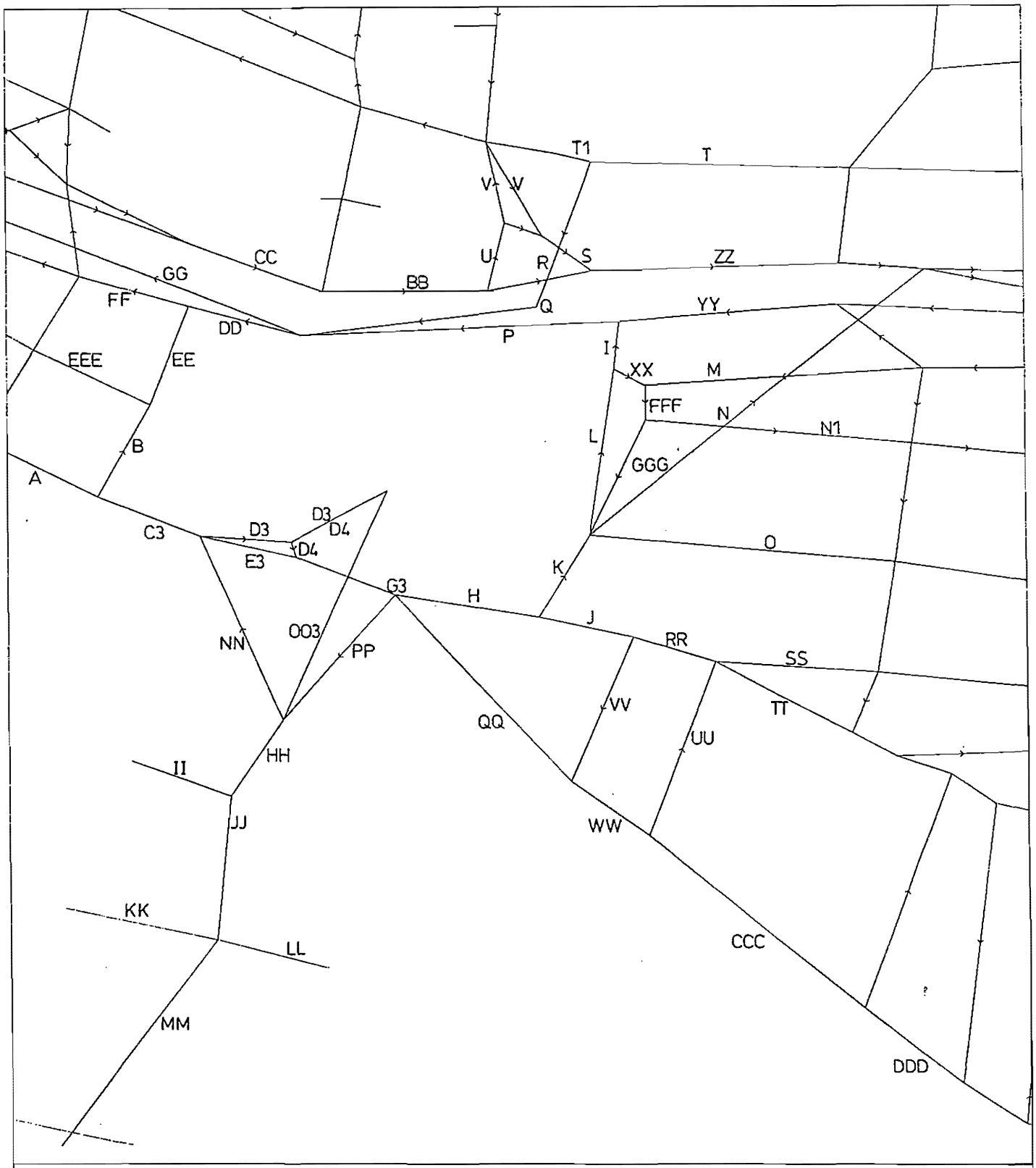
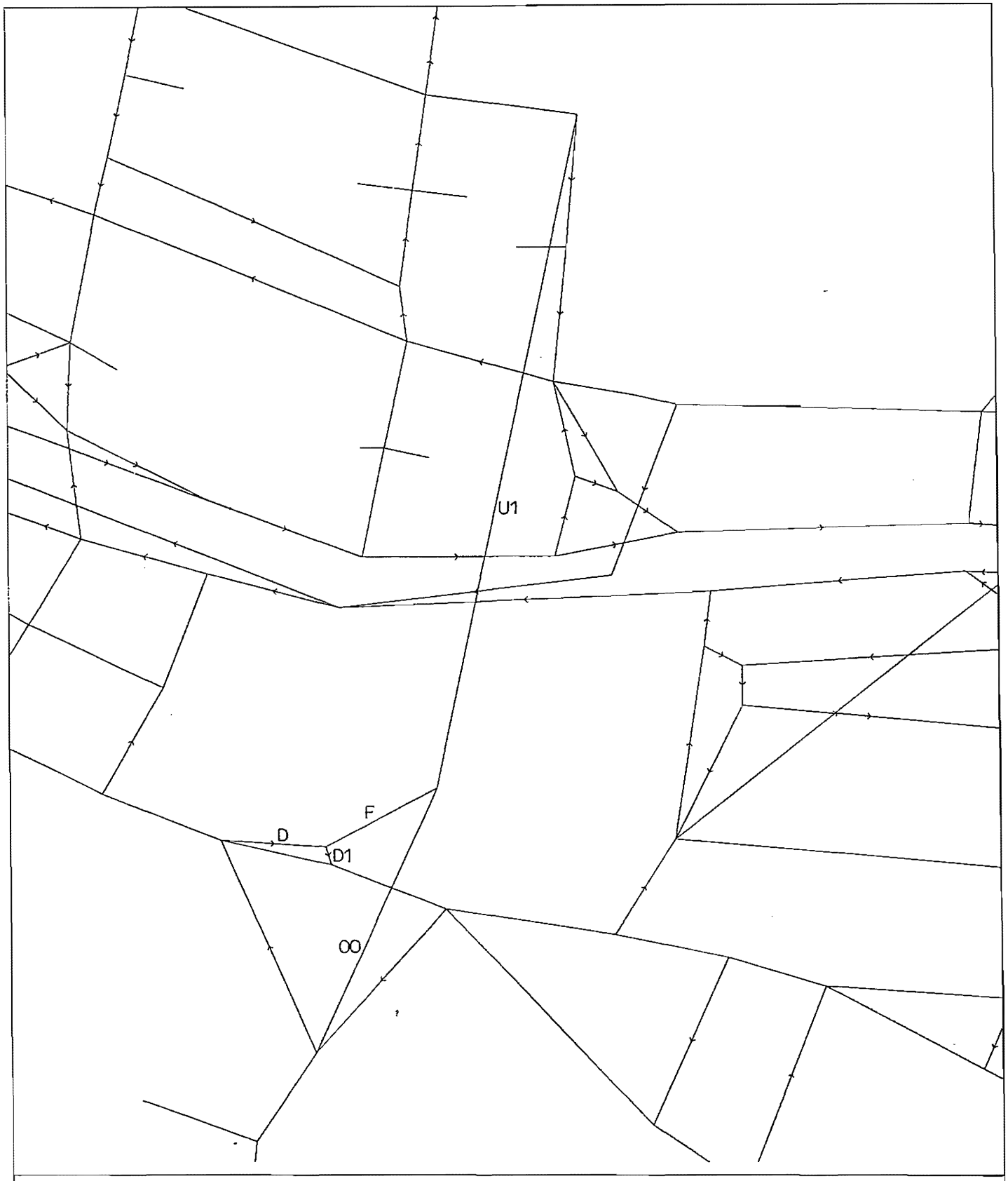
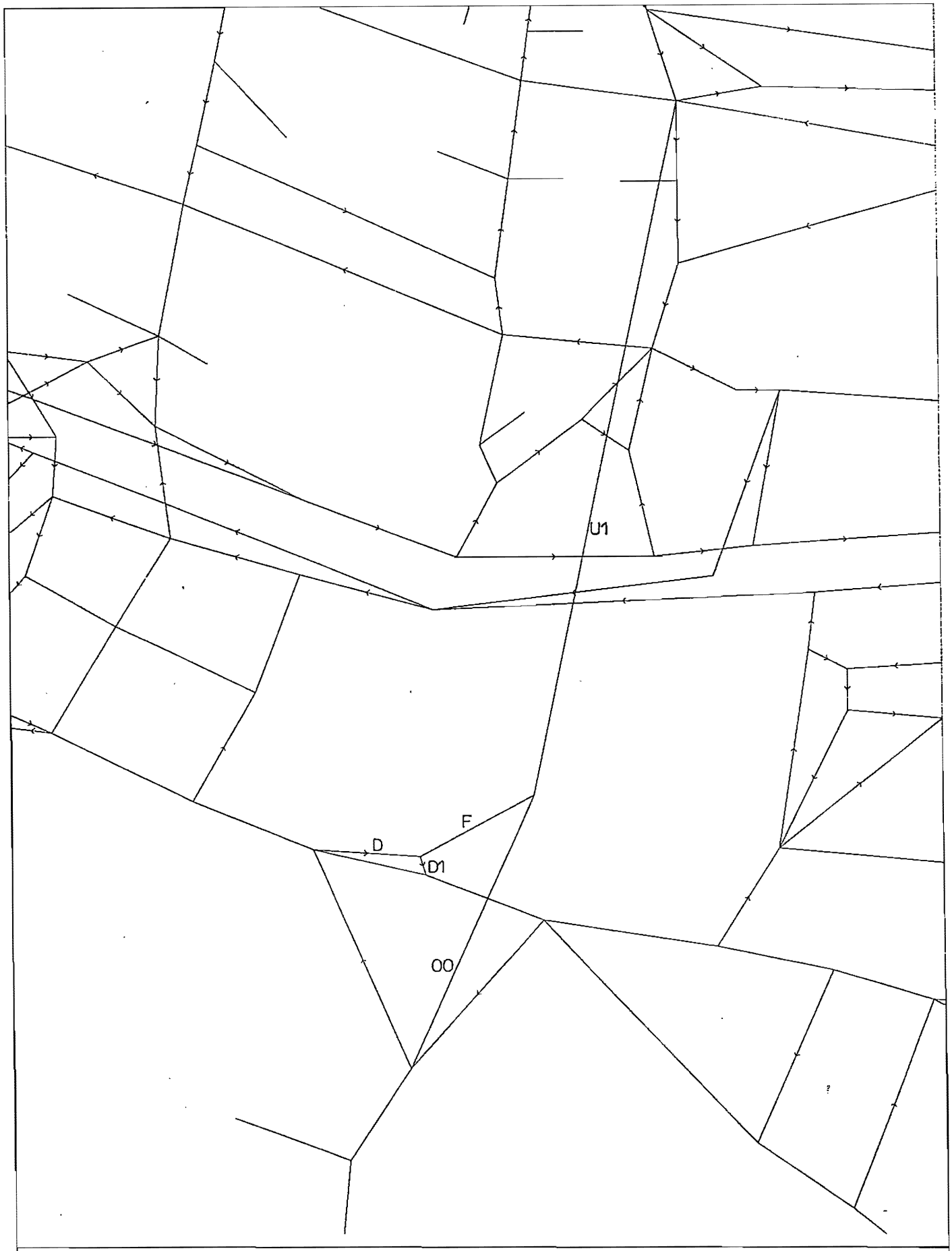


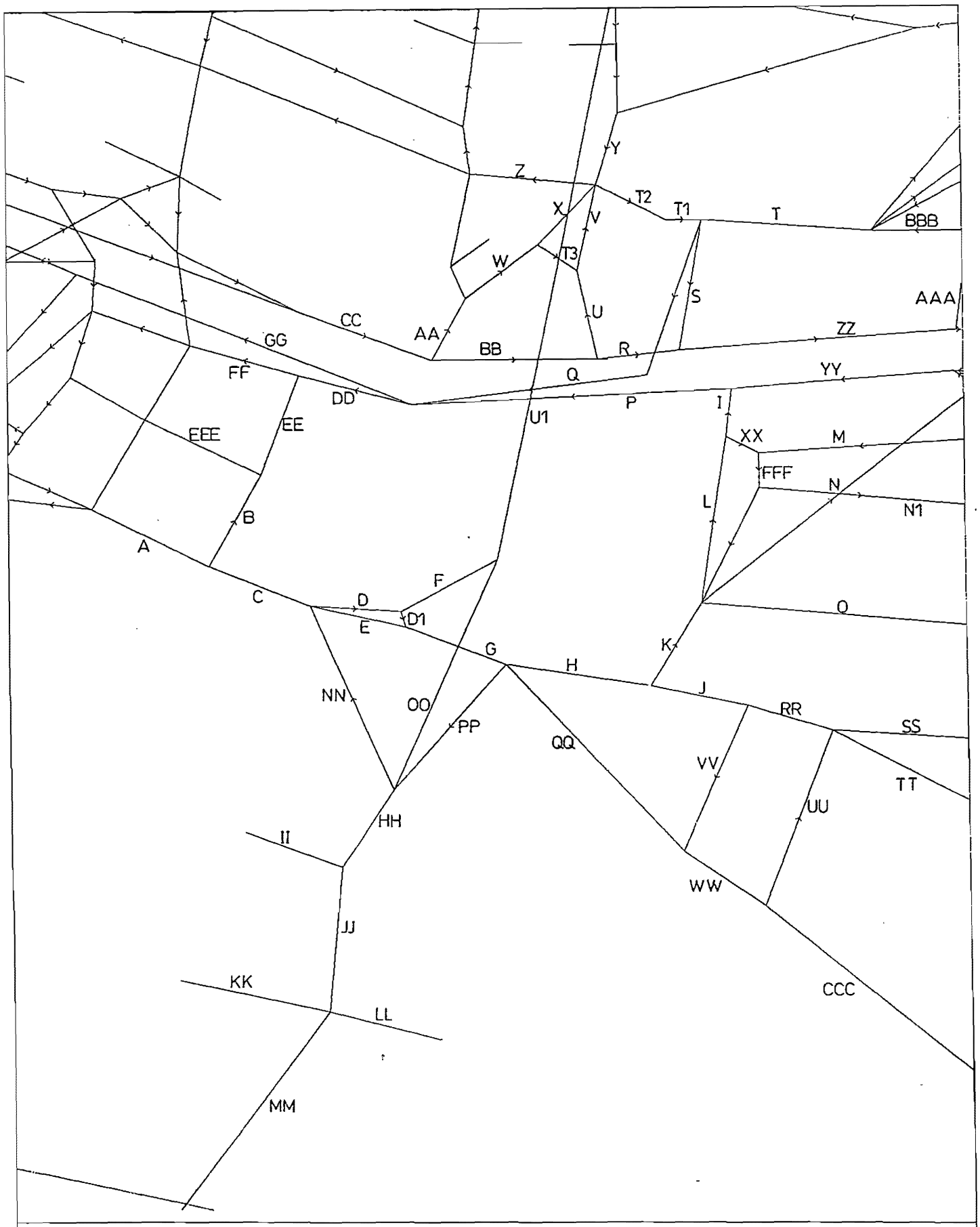
The Traffic Network Of The Justice Drive Extension In The Year 1999



The Traffic Network Of The Justice Drive Extension in 2002



The Traffic Network Of The Justice Drive Extension in 2011



The Traffic Network Of The Justice Drive Extension in 2017

YEAR 1999 PM PEAK TRAFFIC FLOW

Alignment	Total no. of veh.	Car	Taxi	Goods Vehicles	Bus	% heavy vehicles	Car & Taxi	Goods veh. & bus	Bus	Total (excl. buses)
A	6148	2816	1839	601	892	24.28	4655	1493	892	5256
B	99	13	8	1	77	78.79	21	78	77	22
C3	6048	2803	1831	601	814	23.40	4634	1415	814	5234
D3	993	565	369	59	0	5.94	934	59	0	993
D4	563	298	195	70	0	12.43	493	70	0	563
E3	4031	1643	1073	499	817	32.65	2716	1316	817	3214
G3	4518	1910	1247	559	803	30.15	3157	1362	803	3715
003	1556	863	564	129	0	8.29	1427	129	0	1556
H	3188	1277	834	386	691	33.78	2111	1077	691	2497
I	38	7	5	8	18	68.42	12	26	18	20
J	2254	790	516	294	654	42.06	1306	948	654	1600
K	935	488	318	92	37	13.80	806	129	37	898
L	393	203	133	40	17	14.50	336	57	17	376
M	93	41	26	25	0	26.88	67	25	0	93
N	787	362	237	107	80	23.76	599	187	80	707
N1	411	212	138	62	0	15.09	350	62	0	411
O	826	367	239	102	118	26.63	606	220	118	708
P	4971	2108	1376	1200	287	29.91	3484	1487	287	4684
Q	1732	976	637	116	3	6.87	1613	119	3	1729
R	3709	1947	1271	484	7	13.24	3218	491	7	3702
T	4520	2376	1552	588	3	13.08	3928	591	3	4517
T1	2785	1394	910	435	46	17.27	2304	481	46	2739
U	1563	797	520	246	0	15.74	1317	246	0	1563
V	1563	797	520	246	0	15.74	1317	246	0	1563
BB	5271	2743	1791	730	7	13.98	4534	737	7	5264
CC	6808	3584	2340	858	25	12.97	5924	883	25	6783
DD	1461	679	443	178	160	23.13	1122	338	160	1301
EE	721	339	222	105	56	22.33	561	161	56	665
FF	1501	714	466	135	186	21.39	1180	321	186	1315
GG	5251	2423	1582	1119	127	23.73	4005	1246	127	5124
HH	3170	1781	1163	225	0	7.10	2944	225	0	3170
II	1514	843	550	120	0	7.93	1393	120	0	1514
JJ	2012	1143	747	122	0	6.06	1890	122	0	2012
LL	94	52	34	8	0	8.51	86	8	0	94
MM	1270	735	480	55	0	4.33	1215	55	0	1270
NN	1019	590	386	44	0	4.32	976	44	0	1019
PP	594	327	214	53	0	8.92	541	53	0	594
QQ	1977	975	637	234	132	18.51	1612	366	132	1845
RR	2388	860	561	313	654	40.49	1421	967	654	1734
SS	2791	1070	699	369	653	36.62	1769	1022	653	2138
TT	286	167	109	9	0	3.15	276	9	0	286
UU	23	13	8	2	0	8.70	21	2	0	23
VV	134	70	45	19	0	14.18	115	19	0	134
WW	1860	915	597	216	132	18.71	1512	348	132	1728
XX	380	209	136	35	0	9.21	345	35	0	380
YY	4938	2102	1373	1194	269	29.63	3475	1463	269	4669
ZZ	3703	1947	1271	484	1	13.10	3218	485	1	3702
CCC	1933	952	622	223	137	18.62	1574	360	137	1796
DDD	1871	915	597	204	155	19.19	1512	359	155	1716
EEE	206	27	17	4	157	78.16	44	161	157	49
FFF	473	249	163	60	0	12.68	412	60	0	473

a

YEAR 2002 PM PEAK TRAFFIC FLOW

Types of vehicle	Car	Taxi	Goods Vehicles	Bus
Emission Factor (PM) (g/Km/Veh.)	0.041	0.239	0.976	1.333
Emission Factor (NOx) (g/Km/Veh.)	1.403	0.779	9.04	11.139
Emission Factor (CO) (g/Km/Veh.)	13.752	0.911	8.385	9.064

Alignment	Total no. of veh.	Car	Taxi	Goods Vehicles	Bus	% heavy vehicles	Car & Taxi	Goods veh. & bus	Bus	Total (excl buses)	Ave. emiss. factors (g/Km/veh)			Ave. emiss. factors (g/ml/veh)		
											PM	NOx	CO	PM	NOx	CO
D	534	302	197	35	0	6.55	499	35	0	534	0.175378	1.673191	8.659742	0.282868	2.698696	13.96733
D1	527	277	181	69	0	13.09	458	69	0	527	0.2314	2.188669	8.640517	0.373226	3.530111	13.93632
F	1061	579	378	104	0	9.80	957	104	0	1061	0.203204	1.92923	8.650193	0.327749	3.111661	13.95192
U1	1359	786	514	60	0	4.42	1300	60	0	1359	0.157137	1.505391	8.672418	0.253446	2.428049	13.98777
OO	2142	1211	791	140	0	6.54	2002	140	0	2142	0.175221	1.671744	8.659796	0.282614	2.696361	13.96741

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YEAR 2011 PM PEAK TRAFFIC FLOW

Types of vehicle	Car	Taxi	Goods Vehicles	Bus
Emission Factor (PM) (g/Km/Veh.)	0.041	0.238	0.568	0.894
Emission Factor (NOx) (g/Km/Veh.)	1.321	0.779	7.061	8.678
Emission Factor (CO) (g/Km/Veh.)	13.568	0.91	8.41	9.017

Alignment	Total no. of veh.	Car	Taxi	Goods Vehicles	Bus	% heavy vehicles	Car & Taxi	Goods veh. & bus	Bus	Total (excl. buses)	Ave. emiss. factors (g/Km/veh)			Ave. emiss. factors (g/m/veh)		
											PM	NOx	CO	PM	NOx	CO
D	438	240	157	41	0	9.36	397	41	0	438	0.1609	1.6842	8.5526	0.259473	2.684235	13.79449
D1	607	329	215	63	0	10.38	544	63	0	607	0.1654	1.7248	8.5510	0.266849	2.782016	13.79191
F	1045	569	372	104	0	9.95	941	104	0	1045	0.1635	1.6994	8.5517	0.263757	2.741032	13.79299
U1	2049	1135	741	174	0	8.49	1876	174	0	2049	0.1570	1.6130	8.5581	0.253272	2.601674	13.80344
OO	2535	1419	926	190	0	7.50	2345	190	0	2535	0.1525	1.5531	8.5555	0.245956	2.505068	13.79922

YEAR 2017 AM PEAK TRAFFIC FLOW

Alignment	Total no. of veh.	Car	Taxi	Goods Vehicles	Bus	% heavy vehicles	Car & Taxi	Goods veh. & bus	Bus	Total (excl. buses)
A	5950	2657	1735	561	997	26.18	4392	1558	997	4953
B	232	80	53	13	86	42.67	133	99	86	146
C	5718	2576	1683	548	911	25.52	4259	1459	911	4807
D	212	102	66	44	0	20.75	168	44	0	212
D1	917	511	333	73	0	7.96	844	73	0	917
E	4858	2114	1381	457	906	28.06	3495	1363	906	3952
F	1129	612	400	117	0	10.36	1012	117	0	1129
G	5615	2549	1665	517	883	24.93	4214	1400	883	4732
H	3924	1750	1143	282	749	26.27	2893	1031	749	3175
I	184	86	56	23	19	22.83	142	42	19	165
J	2685	1075	702	198	708	33.74	1777	906	708	1977
K	1240	675	440	83	41	10.00	1115	124	41	1199
L	529	269	176	66	18	15.88	445	84	18	511
M	81	22	14	45	0	55.56	36	45	0	81
N	1112	494	322	209	87	26.62	816	296	87	1025
N1	310	131	86	93	0	30.00	217	93	0	310
O	1114	474	309	204	128	29.80	783	332	128	986
P	5047	2030	1325	1396	297	33.54	3355	1693	297	4750
Q	2413	1174	767	467	4	19.52	1941	471	4	2409
R	1881	1002	655	223	1	11.91	1657	224	1	1880
S	166	85	55	26	0	15.66	140	26	0	166
T	5756	2886	1885	980	4	17.10	4771	984	4	5752
T1	3117	1595	1041	481	0	15.43	2636	481	0	3117
T2	3139	1604	1047	482	5	15.51	2651	487	5	3134
T3	638	332	217	89	0	13.95	549	89	0	638
U	2414	1226	801	384	4	16.07	2027	388	4	2410
V	3052	1558	1017	474	4	15.66	2575	478	4	3048
V1	1879	1042	680	157	0	8.36	1722	157	0	1879
W	645	336	219	90	0	13.95	555	90	0	645
X	9	5	3	1	0	11.11	8	1	0	9
Y	3998	2207	1442	328	21	8.73	3649	349	21	3977
Z	3920	2165	1414	320	21	8.70	3579	341	21	3899
AA	794	426	278	77	14	11.46	704	91	14	780
BB	4295	2229	1455	607	5	14.25	3684	612	5	4290
CC	5090	2654	1734	682	20	13.79	4388	702	20	5070
DD	1212	485	316	236	174	33.83	801	410	174	1038
EE	749	329	215	143	62	27.37	544	205	62	687
FF	1001	416	272	108	204	31.17	688	312	204	797
GG	5948	2595	1695	1540	118	27.87	4290	1658	118	5830
HH	3479	1973	1289	218	0	6.27	3262	218	0	3479
II	1469	816	533	120	0	8.17	1349	120	0	1469
JJ	2554	1483	968	104	0	4.07	2451	104	0	2554
LL	101	56	36	8	0	7.92	92	8	0	101
MM	2599	1509	986	103	0	3.96	2495	103	0	2599
NN	653	367	240	46	0	7.04	607	46	0	653
OO	2649	1504	983	162	0	6.12	2487	162	0	2649
PP	175	101	66	8	0	4.57	167	8	0	175
QQ	1959	944	616	253	146	20.37	1560	399	146	1813
RR	2778	1116	728	224	708	33.55	1844	932	708	2070
SS	2279	829	542	210	698	39.84	1371	908	698	1581
TT	267	142	92	31	0	11.61	234	31	0	267
UU	319	174	114	31	0	9.72	288	31	0	319
VV	93	41	26	26	0	27.96	67	26	0	93
WW	1894	917	599	231	147	19.96	1516	378	147	1747
XX	379	201	131	48	0	12.66	332	48	0	379
YY	4897	1957	1278	1381	280	33.92	3235	1661	280	4617
ZZ	2045	1086	710	248	1	12.18	1796	249	1	2044
CCC	1610	760	497	203	151	21.99	1257	354	151	1459
DDD	1415	645	421	181	170	24.81	1066	351	170	1245
EEE	218	22	14	11	171	83.49	36	182	171	47
FFF	460	223	145	93	0	20.22	368	93	0	460

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Justice Drive Extension

Justice Drive Extension

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Justice Drive Extension

Appendix B
Results of the Construction Noise Modelling

Mouchel Asia Limited

Noise Level During Day-Time
Demolition Work (07:00-19:00 hours)

Noise Sensitive Receiver	Predicted Noise Level Without Noise Mitigation	Corrected Noise Level With Noise Mitigation
R5	80 dBA	62 dBA
R6	79 dBA	62 dBA
R7	78 dBA	61 dBA
R8	80 dBA	62 dBA
R9	78 dBA	60 dBA
R10	82 dBA	64 dBA
R11	80 dBA	62 dBA
R12	86 dBA	69 dBA
R13	86 dBA	68 dBA
R14	88 dBA	70 dBA
R15	87 dBA	69 dBA
R16	86 dBA	68 dBA
R17	77 dBA	59 dBA
R18	79 dBA	61 dBA

JUSTICE DRIVE EXTENSION **Noise Level During Construction With Noise Mitigation Measures**

	X1	Y1	Z1		
Co-ordinates of Construction Site	835370	815778	4.2		
	X2	Y2	Z2	Distance	Correction Factor
Co-ordinates of NSR (R5)	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
DEMOLITION WORK					
Air Compressor,air flow<=10cu.m./min (-5 dBA)	2	95	98.01		
Breaker,hand-held,mass>10Kg and<20Kg (-7 dBA)	4	101	107.02		
Breaker,excavator mounted (pneumatic)(-8 dBA)	2	114	117.01		
Bulldozer (-10dBA)	1	105	105.00		
Crane,mobile/barge mounted (diesel)(-5 dBA)	1	107	107.00		
Drill,percussive,hand-held (electric)	2	103	106.01		
Dumper	1	106	106.00		
Dump truck (-10 dBA)	1	107	107.00		
Excavator/loader,wheeled/tracked (-5 dBA)	1	107	107.00		
Generator,super silenced,70 dBA at 7m	1	95	95.00		
Lorry (-5 dBA)	1	107	107.00		
Total SWL at site				119	
Total PNL at NSR arising from works at site				72	
CNL (dBA) at NSR with barriers as mitigation measures				62	

JUSTICE DRIVE EXTENSION

Noise Level During Construction Without Noise Mitigation Measures

	X1	Y1	Z1		
Co-ordinates of Construction Site	835370	815778	4.2		
	X2	Y2	Z2	Distance	Correction Factor
Co-ordinates of NSR (R5)	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
DEMOLITION WORK					
Air Compressor,air flow<=10cu.m./min	2	100	103.01		
Breaker,hand-held,mass>10Kg and<20Kg	4	108	114.02		
Breaker,excavator mounted (pneumatic)	2	122	125.01		
Bulldozer	1	115	115.00		
Crane,mobile/barge mounted (diesel)	1	112	112.00		
Drill,percussive,hand-held (electric)	2	103	106.01		
Dumper	1	106	106.00		
Dump truck	1	117	117.00		
Excavator/loader,wheeled/tracked	1	112	112.00		
Generator,super silenced,70 dBA at 7m	1	95	95.00		
Lorry	1	112	112.00		
Total SWL at site				127	
Total PNL at NSR arising from works at site				80	

Noise Level During Day-Time
Foundation Construction (07:00-19:00 hours)

Noise Sensitive Receiver	Predicted Noise Level Without Noise Mitigation	Corrected Noise Level With Noise Mitigation
R5	81 dBA	62 dBA
R6	80 dBA	62 dBA
R7	79 dBA	61 dBA
R8	81 dBA	62 dBA
R9	79 dBA	60 dBA
R10	83 dBA	64 dBA
R11	81 dBA	62 dBA
R12	87 dBA	69 dBA
R13	87 dBA	68 dBA
R14	89 dBA	70 dBA
R15	88 dBA	69 dBA
R16	87 dBA	68 dBA
R17	78 dBA	59 dBA
R18	80 dBA	61 dBA

JUSTICE DRIVE EXTENSION **Noise Level During Construction With Noise Mitigation Measures**

Co-ordinates of Construction Site	X1	Y1	Z1		
	835370	815778	4.2		
Co-ordinates of NSR (R5)	X2	Y2	Z2	Distance	Correction Factor
	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
FOUNDATION CONSTRUCTION					
Air Compressor,air flow<=10cu.m./min (-5 dBA)	2	95	98.01		
Bar bender and cutter (electric)	2	90	93.01		
Breaker,hand-held,mass>10Kg and<20Kg (-8 dBA)	4	100	106.02		
Bulldozer (-10 dBA)	1	105	105.00		
Chipper, hand-held (pneumatic) (-8 dBA)	4	104	110.02		
Concrete lorry mixer (-10 dBA)	2	99	102.01		
Concrete pump, stationary/lorry mounted (-10 dBA)	2	99	102.01		
Crane,mobile/barge mounted (diesel) (-10 dBA)	2	102	105.01		
Compactor, vibratory (-8 dBA)	2	97	100.01		
Dumper	2	106	109.01		
Dump truck (-10 dBA)	2	107	110.01		
Excavator/loader,wheeled/tracked (-10 dBA)	2	102	105.01		
Generator,super silenced,70 dBA at 7m	1	95	95.00		
Lorry (-10 dBA)	2	102	105.01		
Piling, large diameter bored, grab and chisel (-10 dB	2	105	108.01		
Poker, vibratory, hand held (-10 dBA)	4	103	109.02		
Planer, wood, hand-held (electric) (-10 dBA)	2	107	110.01		
Saw, circular, wood	2	108	111.01		
Water pump, submersible (electric)	2	85	88.01		
Total SWL (dBA) at site				119	
Total PNL (dBA) at NSR arising from works at site				72	
CNL (dBA) at NSR with barriers as mitigation measures				62	

JUSTICE DRIVE EXTENSION

Noise Level During Construction Without Noise Mitigation Measures

	X1	Y1	Z1		
Co-ordinates of Construction Site	835370	815778	4.2		
Co-ordinates of NSR (R5)	X2	Y2	Z2	Distance	Correction Factor
	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
FOUNDATION CONSTRUCTION					
Air Compressor,air flow<=10cu.m./min	2	100	103.01		
Bar bender and cutter (electric)	2	90	93.01		
Breaker,hand-held,mass>10Kg and<20Kg	4	108	114.02		
Bulldozer	1	115	115.00		
Chipper, hand-held (pneumatic)	4	112	118.02		
Concrete lorry mixer	2	109	112.01		
Concrete pump, stationary/lorry mounted	2	109	112.01		
Crane,mobile/barge mounted (diesel)	2	112	115.01		
Compactor, vibratory	2	105	108.01		
Dumper	2	106	109.01		
Dump truck	2	117	120.01		
Excavator/loader,wheeled/tracked	2	112	115.01		
Generator,super silenced,70 dBA at 7m	1	95	95.00		
Lorry	2	112	115.01		
Piling, large diameter bored, grab and chisel	2	115	118.01		
Poker, vibratory, hand held	4	113	119.02		
Planer, wood, hand-held (electric)	2	117	120.01		
Saw, circular, wood	2	108	111.01		
Water pump, submersible (electric)	2	85	88.01		
Total SWL (dBA) at site				128	
Total PNL (dBA) at NSR arising from works at site				81	

Noise Level During Day-Time
Bridge Deck Construction (07:00-19:00 hours)

Noise Sensitive Receiver	Predicted Noise Level Without Noise Mitigation	Corrected Noise Level With Noise Mitigation
R5	78 dBA	60 dBA
R6	78 dBA	59 dBA
R7	77 dBA	58 dBA
R8	79 dBA	60 dBA
R9	76 dBA	58 dBA
R10	80 dBA	62 dBA
R11	78 dBA	60 dBA
R12	85 dBA	66 dBA
R13	84 dBA	65 dBA
R14	86 dBA	67 dBA
R15	86 dBA	67 dBA
R16	84 dBA	66 dBA
R17	75 dBA	57 dBA
R18	77 dBA	59 dBA

JUSTICE DRIVE EXTENSION

Noise Level During Construction With Noise Mitigation Measures

	X1	Y1	Z1		
Co-ordinates of Construction Site	835370	815778	4.2		
Co-ordinates of NSR (R5)	X2	Y2	Z2	Distance	Correction Factor
	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
BRIDGE DECK CONSTRUCTION					
Air Compressor,air flow<=10cu.m./min (-5 dBA)	2	95	98.01		
Bar bender and cutter (electric)	2	90	93.01		
Chipper, hand-held (pneumatic) (-8 dBA)	4	104	110.02		
Concrete lorry mixer (-10 dBA)	2	99	102.01		
Concrete pump, stationary/lorry mounted (-10 dBA)	2	99	102.01		
Crane,mobile/barge mounted (diesel) (-10 dBA)	2	102	105.01		
Lorry (-10 dBA)	2	102	105.01		
Poker, vibratory, hand held (-13 dBA)	4	100	106.02		
Planer, wood, hand-held (electric) (-10 dBA)	2	107	110.01		
Saw, circular, wood	2	108	111.01		
Total SWL (dBA) at site				117	
Total PNL (dBA) at NSR arising from works at site				70	
CNL (dBA) at NSR with barriers as mitigation measures				60	

JUSTICK DRIVE EXTENSION

Noise Level During Construction Without Noise Mitigation Measures

	X1	Y1	Z1		
Co-ordinates of Construction Site	835370	815778	4.2		
Co-ordinates of NSR (R5)	X2	Y2	Z2	Distance	Correction Factor
	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
BRIDGE DECK CONSTRUCTION					
Air Compressor,air flow<=10cu.m./min	2	100	103.01		
Bar bender and cutter (electric)	2	90	93.01		
Chipper, hand-held (pneumatic)	4	112	118.02		
Concrete lorry mixer	2	109	112.01		
Concrete pump, stationary/lorry mounted	2	109	112.01		
Crane,mobile/barge mounted (diesel)	2	112	115.01		
Lorry	2	112	115.01		
Poker, vibratory, hand held	4	113	119.02		
Planer, wood, hand-held (electric)	2	117	120.01		
Saw, circular, wood	2	108	111.01		
Total SWL (dBA) at site				125	
Total PNL (dBA) at NSR arising from works at site				78	

Noise Level During Day-Time
Pavement Construction (07:00-19:00 hours)

Noise Sensitive Receiver	Predicted Noise Level Without Noise Mitigation	Corrected Noise Level With Noise Mitigation
R5	77 dBA	62 dBA
R6	77 dBA	61 dBA
R7	76 dBA	60 dBA
R8	77 dBA	62 dBA
R9	75 dBA	60 dBA
R10	79 dBA	64 dBA
R11	77 dBA	62 dBA
R12	84 dBA	69 dBA
R13	83 dBA	68 dBA
R14	85 dBA	70 dBA
R15	84 dBA	69 dBA
R16	83 dBA	68 dBA
R17	74 dBA	59 dBA
R18	76 dBA	61 dBA

JUSTICE DRIVE EXTENSION

Noise Level During Construction With Noise Mitigation Measures

Co-ordinates of Construction Site	X1	Y1	Z1		
	835370	815778	4.2		
Co-ordinates of NSR (R5)	X2	Y2	Z2	Distance	Correction Factor
	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
PAVEMENT CONSTRUCTION					
Air Compressor,air flow<=10cu.m./min (-5 dBA)	2	95	98.01		
Asphalt paver	1	109	109.00		
Breaker,hand-held,mass>10Kg and<20Kg (-8 dBA)	4	100	106.02		
Concrete lorry mixer (-10 dBA)	2	99	102.01		
Concrete mixer (petrol)	2	96	99.01		
Compactor, vibratory (-8 dBA)	2	97	100.01		
Dumper	2	106	109.01		
Dump truck (-10 dBA)	2	107	110.01		
Excavator/loader,wheeled/tracked (-10 dBA)	2	102	105.01		
Lorry (-10 dBA)	2	102	105.01		
Paint line marker	1	90	90.00		
Road roller	1	108	108.00		
Roller, vibratory	1	108	108.00		
Saw/groover, concrete (petrol)	1	115	115.00		
Total SWL (dBA) at site				119	
Total PNL (dBA) at NSR arising from works at site				72	
CNL (dBA) at NSR with barriers as mitigation measures				62	

JUSTICE DRIVE EXTENSION

Noise Level During Construction Without Noise Mitigation Measures

	X1	Y1	Z1		
Co-ordinates of Construction Site	835370	815778	4.2		
Co-ordinates of NSR (R5)	X2	Y2	Z2	Distance	Correction Factor
	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
PAVEMENT CONSTRUCTION					
Air Compressor,air flow<=10cu.m./min	2	100	103.01		
Asphalt paver	1	109	109.00		
Breaker,hand-held,mass>10Kg and<20Kg	4	108	114.02		
Concrete lorry mixer	2	109	112.01		
Concrete mixer (petrol)	2	96	99.01		
Compactor, vibratory	2	105	108.01		
Dumper	2	106	109.01		
Dump truck	2	117	120.01		
Excavator/loader,wheeled/tracked	2	112	115.01		
Lorry	2	112	115.01		
Paint line marker	1	90	90.00		
Road roller	1	108	108.00		
Roller, vibratory	1	108	108.00		
Saw/groover, concrete (petrol)	1	115	115.00		
Total SWL (dBA) at site				124	
Total PNL (dBA) at NSR arising from works at site				77	

Noise Level During Evening-Time Night-Time Demolition Work (19:00-07:00 hours)

Noise Sensitive Receiver	Predicted Noise Level Without Noise Mitigation	Corrected Noise Level With Noise Mitigation	Corrected Noise Level(SPME) With Noise Mitigation
R1	80 dBA	50 dBA	42 dBA
R2	84 dBA	55 dBA	46 dBA
R3	86 dBA	57 dBA	49 dBA
R4	85 dBA	55 dBA	47 dBA
R5	70 dBA	40 dBA	32 dBA
R6	69 dBA	40 dBA	31 dBA
R7	68 dBA	39 dBA	30 dBA
R8	70 dBA	40 dBA	32 dBA
R9	68 dBA	38 dBA	30 dBA
R10	72 dBA	42 dBA	34 dBA
R11	70 dBA	40 dBA	32 dBA
R12	76 dBA	47 dBA	39 dBA
R13	76 dBA	46 dBA	38 dBA
R14	78 dBA	48 dBA	40 dBA
R15	77 dBA	47 dBA	39 dBA
R16	76 dBA	46 dBA	38 dBA
R17	67 dBA	37 dBA	29 dBA
R18	69 dBA	39 dBA	31 dBA

JUSTICE DRIVE EXTENSION

Noise Level During Construction With Noise Mitigation Measures

	X1	Y1	Z1		
Co-ordinates of Construction Site	835370	815778	4.2		
Co-ordinates of NSR (R5)	X2	Y2	Z2	Distance	Correction Factor
	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
NIGHT-TIME DEMOLITION WORK					
Air Compressor,air flow<=10cu.m./min (-5 dBA)	1	95	95.00		
Breaker,hand-held,mass>10Kg and<20Kg (-7 dBA)	2	101	104.01		
Crane, mobile/barge mounted (Diesel) (-5 dBA)	1	107	107.00		
Drill, percussive, hand-held (electric)	2	103	106.01		
Generator, super silenced, 70 dBA at 7 m	1	95	95.00		
Lorry (-5 dBA)	1	107	107.00		
Total SWL (dBA) at site				112	
Total PNL (dBA) at NSR arising from works at site				65	
CNL (dBA) at NSR with full enclosures as mitigation measures				40	

JUSTICE DRIVE EXTENSION

Noise Level During Construction Without Noise Mitigation Measures

Co-ordinates of Construction Site	X1	Y1	Z1		
	835370	815778	4.2		
Co-ordinates of NSR (R5)	X2	Y2	Z2	Distance	Correction Factor
	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
NIGHT-TIME DEMOLITION WORK					
Air Compressor,air flow<=10cu.m./min	1	100	100.00		
Breaker,hand-held,mass>10Kg and<20Kg	2	108	111.01		
Crane, mobile/barge mounted (Diesel)	1	112	112.00		
Drill, percussive, hand-held (electric)	2	103	106.01		
Generator, super silenced, 70 dBA at 7 m	1	95	95.00		
Lorry	1	112	112.00		
Total SWL (dBA) at site				117	
Total PNL (dBA) at NSR arising from works at site				70	

JUSTICE DRIVE EXTENSION

Noise Level During Construction With Noise Mitigation Measures

Co-ordinates of Construction Site	X1	Y1	Z1		
	835370	815778	4.2		
Co-ordinates of NSR (R5)	X2	Y2	Z2	Distance	Correction Factor
	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
NIGHT-TIME DEMOLITION WORK					
SPECIFIED POWERED MECHANICAL EQUIPMENT (SPME)					
Breaker,hand-held,mass>10Kg and<20Kg (-7 dBA)	2	101	104.01		
Total SWL (dBA) at site				104	
Total PNL (dBA) at NSR arising from works at site				57	
CNL (dBA) at NSR with full enclosures as mitigation measures				32	

Noise Level During Evening-Time and Night-Time
Bridge Deck Construction (19:00-07:00 hours)

Noise Sensitive Receiver	Predicted Noise Level Without Noise Mitigation	Corrected Noise Level With Noise Mitigation	Corrected Noise Level(SPME) With Noise Mitigation
R1	83 dBA	47 dBA	43 dBA
R2	87 dBA	51 dBA	47 dBA
R3	89 dBA	53 dBA	49 dBA
R4	87 dBA	51 dBA	47 dBA
R5	72 dBA	36 dBA	32 dBA
R6	72 dBA	36 dBA	32 dBA
R7	71 dBA	35 dBA	31 dBA
R8	73 dBA	37 dBA	33 dBA
R9	70 dBA	34 dBA	30 dBA
R10	74 dBA	38 dBA	34 dBA
R11	72 dBA	36 dBA	32 dBA
R12	79 dBA	43 dBA	39 dBA
R13	78 dBA	42 dBA	38 dBA
R14	80 dBA	44 dBA	40 dBA
R15	80 dBA	44 dBA	39 dBA
R16	78 dBA	42 dBA	38 dBA
R17	69 dBA	33 dBA	29 dBA
R18	71 dBA	35 dBA	31 dBA

JUSTICE DRIVE EXTENSION

Noise Level During Construction With Noise Mitigation Measures

	X1	Y1	Z1		
Co-ordinates of Construction Site	835370	815778	4.2		
	X2	Y2	Z2	Distance	Correction Factor
Co-ordinates of NSR (R5)	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
NIGHT-TIME BRIDGE DECK CONSTRUCTION					
Air Compressor,air flow<=10cu.m./min (-5 dBA)	1	95	95.00		
Concrete lorry mixer (-10 dBA)	1	99	99.00		
Concrete pump, stationary/lorry mounted (-10 dBA)	1	99	99.00		
Crane, mobile/barge mounted (Diesel) (-10 dBA)	1	102	102.00		
Lorry (-10 dBA)	1	102	102.00		
Poker, vibratory, hand-held (-13 dBA)	2	100	103.01		
Total SWL (dBA) at site				108	
Total PNL (dBA) at NSR arising from works at site				61	
CNL (dBA) at NSR with full enclosures as mitigation measures				36	

JUSTICE DRIVE EXTENSION

Noise Level During Construction Without Noise Mitigation Measures

Co-ordinates of Construction Site	X1	Y1	Z1		
	835370	815778	4.2		
Co-ordinates of NSR (R5)	X2	Y2	Z2	Distance	Correction Factor
	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
NIGHT-TIME BRIDGE DECK CONSTRUCTION					
Air Compressor,air flow<=10cu.m./min	1	100	100.00		
Concrete lorry mixer	1	109	109.00		
Concrete pump, stationary/lorry mounted	1	109	109.00		
Crane, mobile/barge mounted (Diesel)	1	112	112.00		
Lorry	1	112	112.00		
Poker, vibratory, hand-held	2	113	116.01		
Total SWL (dBA) at site				119	
Total PNL (dBA) at NSR arising from works at site				72	

JUSTICE DRIVE EXTENSION

Noise Level During Construction With Noise Mitigation Measures

Co-ordinates of Construction Site	X1	Y1	Z1		
	835370	815778	4.2		
Co-ordinates of NSR (R5)	X2	Y2	Z2	Distance	Correction Factor
	835491	815733	7.1	129.129 m	50 dBA

Activity	No	SWL (dBA)	Total SWL (dBA)		
NIGHT-TIME BRIDGE DECK CONSTRUCTION					
SPECIFIED POWERED MECHANICAL EQUIPMENT (SPME)					
Concrete lorry mixer (-10 dBA)	1	99	99.00		
Poker, vibratory, hand-held (-13 dBA)	2	100	103.01		
Total SWL (dBA) at site				104	
Total PNL (dBA) at NSR arising from works at site				57	
CNL (dBA) at NSR with full enclosures as mitigation measures				32	

Justice Drive Extension

Justice Drive Extension

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Appendix C Results of the Test for Residual Noise Impacts

Mouchel Asia Limited

The Three Eligibility Criteria Test for the Noise Levels, L_{10} (1 hour), dBA, at the Noise Sensitive Receivers During Operation

NSR	Floor	Year 2017 old roads	Year 2017 new roads	Year 2017 total noise levels (old&new roads)	Year 1999 prevailing traffic noise level	Condition 1	Condition 2	Condition 3
R5	1	77.5	55.1	77	76.6	Yes	No	No
R5	2	77.7	55.5	78	76.7	Yes	Yes	No
R5	3	78.1	55.7	78	76.9	Yes	Yes	No
R5	4	78.1	55.9	78	76.9	Yes	Yes	No
R5	5	78.1	56.4	78	76.9	Yes	Yes	No
R6	1	77.0	54.6	77	76.5	Yes	No	No
R6	2	77.0	55.3	77	76.5	Yes	No	No
R6	3	77.0	55.4	77	76.5	Yes	No	No
R6	4	77.1	55.7	77	76.6	Yes	No	No
R6	5	77.2	55.9	77	76.6	Yes	No	No
R7	1	76.8	48.9	77	77.5	Yes	No	No
R7	2	76.8	49.4	77	77.4	Yes	No	No
R7	3	76.7	49.8	77	77.2	Yes	No	No
R7	4	76.6	50.2	77	77.1	Yes	No	No
R7	5	76.5	51.0	77	76.9	Yes	No	No
R8	1	74.6	52.7	75	74.1	Yes	No	No
R8	2	74.6	53.0	75	74.1	Yes	No	No
R8	3	74.6	53.6	75	74.1	Yes	No	No
R9	1	82.2	48.8	82	80.5	Yes	Yes	No
R9	2	82.1	48.7	82	80.3	Yes	Yes	No
R9	3	81.8	48.4	82	80.1	Yes	Yes	No
R9	4	81.5	48.1	82	79.8	Yes	Yes	No
R9	5	81.2	49.6	81	79.4	Yes	Yes	No
R10	1	82.4	56.9	82	82.3	Yes	No	No
R10	2	81.8	56.9	82	81.7	Yes	No	No
R10	3	81.1	56.7	81	80.9	Yes	No	No
R10	4	80.3	56.8	80	80.2	Yes	No	No
R10	5	79.7	56.7	80	79.6	Yes	No	No
R10	6	79.1	56.9	79	79.0	Yes	No	No
R10	7	78.6	56.9	79	78.5	Yes	No	No
R10	8	78.1	56.8	78	78.1	Yes	No	No
R10	9	77.7	56.9	78	77.7	Yes	No	No
R10	10	77.4	57.0	77	77.3	Yes	No	No
R10	11	77.0	57.0	77	77.0	Yes	No	No
R10	12	76.7	57.2	77	76.7	Yes	No	No
R10	13	76.4	57.5	76	76.4	Yes	No	No
R10	14	76.1	57.7	76	76.2	Yes	No	No
R10	15	75.9	57.9	76	75.9	Yes	No	No
R10	16	75.7	58.6	76	75.7	Yes	No	No
R10	17	75.4	58.6	76	75.5	Yes	No	No
R10	18	75.2	59.0	75	75.3	Yes	No	No
R10	19	75.0	59.0	75	75.1	Yes	No	No
R10	20	74.8	59.3	75	74.9	Yes	No	No
R11	1	82.9	55.5	83	82.7	Yes	No	No
R11	2	82.1	56.2	82	82.0	Yes	No	No
R11	3	81.3	55.7	81	81.2	Yes	No	No
R11	4	80.5	55.9	81	80.4	Yes	No	No
R11	5	79.9	56.0	80	79.7	Yes	No	No
R11	6	79.3	56.1	79	79.1	Yes	No	No
R11	7	78.7	56.2	79	78.6	Yes	No	No
R11	8	78.3	56.0	78	78.2	Yes	No	No
R11	9	77.8	56.1	78	77.7	Yes	No	No
R11	10	77.5	56.1	77	77.4	Yes	No	No
R11	11	77.1	56.1	77	77.0	Yes	No	No

The Three Eligibility Criteria Test for the Noise Levels, L_{10} (1 hour), dBA, at the Noise Sensitive Receivers During Operation

NSR	Floor	Year 2017 old roads	Year 2017 new roads	Year 2017 total noise levels (old&new roads)	Year 1999 prevailing traffic noise level	Condition 1	Condition 2	Condition 3
R11	12	76.8	56.1	77	76.7	Yes	No	No
R11	13	76.5	56.3	77	76.4	Yes	No	No
R11	14	76.2	56.6	76	76.2	Yes	No	No
R11	15	76.0	56.7	76	75.9	Yes	No	No
R11	16	75.7	57.4	76	75.7	Yes	No	No
R11	17	75.5	57.4	76	75.5	Yes	No	No
R11	18	75.3	57.6	75	75.3	Yes	No	No
R11	19	75.1	57.8	75	75.1	Yes	No	No
R11	20	74.9	57.8	75	74.9	Yes	No	No
R11	21	74.7	58.1	75	74.7	Yes	No	No
R11	22	74.5	58.3	75	74.5	Yes	No	No
R11	23	74.4	58.3	74	74.4	Yes	No	No
R11	24	74.2	58.5	74	74.2	Yes	No	No
R11	25	74.1	58.4	74	74.1	Yes	No	No
R14	1	72.5	60.6	73	72.7	Yes	No	No
R14	2	72.5	60.9	73	72.7	Yes	No	No
R14	3	72.5	61.4	73	72.7	Yes	No	No
R14	4	72.4	61.7	73	72.7	Yes	No	No
R14	5	72.3	61.9	73	72.6	Yes	No	No
R14	6	72.2	62.0	73	72.5	Yes	No	No
R14	7	72.2	62.0	73	72.5	Yes	No	No
R14	8	72.1	62.0	72	72.4	Yes	No	No
R14	9	72.0	61.9	72	72.3	Yes	No	No
R14	10	72.0	61.8	72	72.3	Yes	No	No
R15	1	77.6	64.8	78	77.9	Yes	No	No
R15	2	77.6	65.1	78	77.9	Yes	No	No
R15	3	77.6	65.2	78	77.9	Yes	No	No
R15	4	77.5	65.5	78	77.8	Yes	No	No
R15	5	77.5	65.6	78	77.8	Yes	No	No
R15	6	77.4	65.7	78	77.7	Yes	No	No
R15	7	77.3	65.8	78	77.6	Yes	No	No
R15	8	77.2	65.9	78	77.5	Yes	No	No
R15	9	77.1	66.0	77	77.5	Yes	No	No
R15	10	77.1	65.9	77	77.4	Yes	No	No
R16	1	77.8	64.0	78	78.0	Yes	No	No
R16	2	77.7	64.2	78	78.0	Yes	No	No
R16	3	77.7	64.4	78	77.9	Yes	No	No
R16	4	77.6	64.6	78	77.9	Yes	No	No
R16	5	77.5	64.8	78	77.8	Yes	No	No
R16	6	77.5	64.9	78	77.7	Yes	No	No
R16	7	77.4	65.1	78	77.6	Yes	No	No
R16	8	77.3	65.2	78	77.5	Yes	No	No
R16	9	77.2	65.3	77	77.5	Yes	No	No
R16	10	77.1	65.4	77	77.4	Yes	No	No
R18	1	74.3	59.7	74	74.2	Yes	No	No
R18	2	74.3	59.8	74	74.1	Yes	No	No
R18	3	74.2	59.9	74	74.1	Yes	No	No
R18	4	74.2	59.8	74	74.1	Yes	No	No
R18	5	74.1	59.7	74	74.0	Yes	No	No
R18	6	74.1	59.9	74	74.0	Yes	No	No
R18	7	74.0	59.9	74	73.9	Yes	No	No
R18	8	73.9	59.9	74	73.8	Yes	No	No
R18	9	73.8	59.8	74	73.7	Yes	No	No
R18	10	73.7	59.8	74	73.6	Yes	No	No

Justice Drive Extension

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Appendix D
Construction Emission Factors

Mouchel Asia Limited

FDM Emission Rate Calculation (Based on AP-42)

JOB : JUSTICE DRIVE EXTENSION

DEMOLITION WORK OF THE JUSTICE DRIVE EXTENSION (WIDTH: 9 metres)

soil moisture content : 4% silt content: 4.8% wet days in 1994: 105

1) Hauling

INPUT DATA		OUTPUT DATA	
k constant =	0.8	Loaded Weight (ton) =	20
Silt Cont. (%) =	4.8	Unloaded Weight (ton) =	5
Speed (km/h) =	21		
Truck Capacity (m3) =	6	Emission rate (loaded) =	1.0889
Load Density (kg/M3) =	2500	Emission rate (unloaded) =	0.4126
Truck Weight (kg) =	5000		
No. of Wheels =	10	Total (kg/VKT) =	1.5015
No. of Wet Days =	105		
		No. of Truck per hr =	2
		Emission rate (g/s/m) =	8.3419E-04
		Suppression (%)	70
		unmitigated (g/s/m)	mitigated (g/s/m)
		8.3419E-04	2.5026E-04

2) Stockpiling

INPUT DATA		OUTPUT DATA	
Silt Cont. (%) =	4.8	Emission rate (g/s/m2) =	7.786E-06
No. of Wet Days =	105		
width of the road (m) =	9	Emission rate (g/s/m) =	7.01E-05
		Suppression (%)	70.00
		mitigated emission rate (g/s/m) =	2.10E-05

3) Construction

INPUT DATA		OUTPUT DATA	
Emission Rate (g/m2/month)	269	Emission Rate (g/m/s) =	9.34E-04
width of the road (m)	9		
month (30 days)	30	Suppression (%)	70
		mitigated emission rate (g/s/m) =	2.80E-04

Unmitigated (width of main carriageway: 9 m)

Hauling + Stockpiling + Construction 1.84E-03 g/s/m
(line source)

Mitigated (width of main carriageway: 9 m)

Hauling + Stockpiling + Construction= 5.51E-04 g/s/m
(line source)

FDM Emission Rate Calculation (Based on AP-42)

JOB : JUSTICE DRIVE EXTENSION

BRIDGE DECK CONSTRUCTION OF THE JUSTICE DRIVE EXTENSION (WIDTH: 9 metres)

soil moisture content : 4% silt content: 4.8% wet days in 1994: 105

1) Hauling

INPUT DATA		OUTPUT DATA	
k constant =	0.8	Loaded Weight (ton) =	20
Silt Cont. (%) =	4.8	Unloaded Weight (ton) =	5
Speed (km/h) =	21		
Truck Capacity (m3) =	6	Emission rate (loaded) =	1.0889
Load Density (kg/M3) =	2500	Emission rate (unloaded) =	0.4126
Truck Weight (kg) =	5000		
No. of Wheels =	10	Total (kg/VKT) =	1.5015
No. of Wet Days =	105		
		No. of Truck per hr =	2
		Emission rate (g/s/m) = 8.3419E-04	Suppression (%) 70
		unmitigated (g/s/m)	mitigated (g/s/m)
		8.3419E-04	2.5026E-04

2) Stockpiling

INPUT DATA		OUTPUT DATA	
Silt Cont. (%) =	4.8	Emission rate (g/s/m2) =	7.786E-06
No. of Wet Days =	105		
width of the road (m) =	9	Emission rate (g/s/m) =	7.01E-05
		Suppression (%)	70.00
		mitigated emission rate (g/s/m) =	2.10E-05

3) Construction

INPUT DATA		OUTPUT DATA	
Emission Rate (g/m2/month)	269	Emission Rate (g/m/s) =	9.34E-04
width of the road (m)	9		
month (30 days)	30	Suppression (%)	70
		mitigated emission rate (g/s/m) =	2.80E-04

Unmitigated (width of main carriageway: 9 m)

Hauling + Stockpiling + Construction 1.84E-03 g/s/m
(line source)

Mitigated (width of main carriageway: 9 m)

Hauling + Stockpiling + Construction= 5.51E-04 g/s/m
(line source)

FDM Emission Rate Calculation (Based on AP-42)

JOB : JUSTICE DRIVE EXTENSION

FOUNDATION CONSTRUCTION WORK OF THE JUSTICE DRIVE EXTENSION (WIDTH: 9 metres)

soil moisture content : 4% silt content: 4.8% wet days in 1994: 105

1) Hauling

INPUT DATA		OUTPUT DATA	
k constant =	0.8	Loaded Weight (ton) =	20
Silt Cont. (%) =	4.8	Unloaded Weight (ton) =	5
Speed (km/h) =	21		
Truck Capacity (m3) =	6	Emission rate (loaded) =	1.0889
Load Density (kg/M3) =	2500	Emission rate (unloaded) =	0.4126
Truck Weight (kg) =	5000		
No. of Wheels =	10	Total (kg/VKT) =	1.5015
No. of Wet Days =	105		
		No. of Truck per hr =	4

Emission rate (g/s/m) =	Suppression (%)
1.6684E-03	70
unmitigated (g/s/m)	mitigated (g/s/m)
1.6684E-03	5.0051E-04

2) Stockpiling

INPUT DATA		OUTPUT DATA	
Silt Cont. (%) =	4.8	Emission rate (g/s/m2) =	7.786E-06
No. of Wet Days =	105		
width of the road (m) =	9	Emission rate (g/s/m) =	7.01E-05
		Suppression (%)	70.00
		mitigated emission rate (g/s/m) =	2.10E-05

3) Construction

INPUT DATA		OUTPUT DATA	
Emission Rate (g/m2/month)	269	Emission Rate (g/m/s) =	9.34E-04
width of the road (m)	9		
month (30 days)	30	Suppression (%)	70
		mitigated emission rate (g/s/m) =	2.80E-04

Unmitigated (width of main carriageway: 9 m)

Hauling + Stockpiling + Construction (line source) 2.67E-03 g/s/m

Mitigated (width of main carriageway: 9 m)

Hauling + Stockpiling + Construction (line source) 8.02E-04 g/s/m

FDM Emission Rate Calculation (Based on AP-42)

JOB : JUSTICE DRIVE EXTENSION

PAVEMENT CONSTRUCTION OF THE JUSTICE DRIVE EXTENSION (WIDTH: 9.3 metres)

soil moisture content : 4% silt content: 4.8% wet days in 1994: 105

1) Hauling

INPUT DATA		OUTPUT DATA	
k constant =	0.8	Loaded Weight (ton) =	20
Silt Cont. (%) =	4.8	Unloaded Weight (ton) =	5
Speed (km/h) =	21		
Truck Capacity (m3) =	6	Emission rate (loaded) =	1.0889
Load Density (kg/M3) =	2500	Emission rate (unloaded) =	0.4126
Truck Weight (kg) =	5000		
No. of Wheels =	10	Total (kg/VKT) =	1.5015
No. of Wet Days =	105		
		No. of Truck per hr =	4
		Emission rate (g/s/m) = 1.6684E-03	Suppression (%) 70
		unmitigated (g/s/m)	mitigated (g/s/m)
		1.6684E-03	5.0051E-04

2) Stockpiling

INPUT DATA		OUTPUT DATA	
Silt Cont. (%) =	4.8	Emission rate (g/s/m2) =	7.786E-06
No. of Wet Days =	105		
width of the road (m) =	9.3	Emission rate (g/s/m) =	7.24E-05
		Suppression (%)	70.00
		mitigated emission rate (g/s/m) =	2.17E-05

3) Construction

INPUT DATA		OUTPUT DATA	
Emission Rate (g/m2/month)	269	Emission Rate (g/m/s) =	9.65E-04
width of the road (m)	9.3		
month (30 days)	30	Suppression (%)	70
		mitigated emission rate (g/s/m) =	2.90E-04

Unmitigated (width of main carriageway: 9.3 m)

Hauling + Stockpiling + Construction 2.71E-03 g/s/m
(line source)

Mitigated (width of main carriageway: 9.3 m)

Hauling + Stockpiling + Construction= 8.12E-04 g/s/m
(line source)

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Appendix E
Traffic Emission Factors

Mouchel Asia Limited

NOx

NOx	Car				Taxi				Bus				Goods Vehicle				Total emission factors (g/km)	
	no. of vehicles		emission factors (g/km/veh.)		no. of vehicles		emission factors (g/km/veh.)		no. of vehicles		emission factors (g/km/veh.)		no. of vehicles		emission factors (g/km/veh.)			
	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011
Alignment D	302	240	1.403	1.321	197	157	0.779	0.779	0	0	11.139	8.678	35	41	9.04	7.061	893.569	728.844
Alignment D1	277	329	1.403	1.321	181	215	0.779	0.779	0	0	11.139	8.678	69	63	9.04	7.061	1153.390	1046.937
Alignment F	579	569	1.403	1.321	378	372	0.779	0.779	0	0	11.139	8.678	104	104	9.04	7.061	2046.959	1775.781
Alignment U1	786	1135	1.403	1.321	514	741	0.779	0.779	0	0	11.139	8.678	60	174	9.04	7.061	2045.564	3305.188
Alignment OO	1211	1419	1.403	1.321	791	926	0.779	0.779	0	0	11.139	8.678	140	190	9.04	7.061	3580.822	3937.443

NOx	Total no.of vehicles	Average emission factors (g/mile/veh.) in year 2011
Alignment D	438	2.684
Alignment D1	607	2.782
Alignment F	1045	2.741
Alignment U1	2050	2.600
Alignment OO	2535	2.505

CO	Car				Taxi				Bus				Goods Vehicle				Total emission factors (g/km)	
	no. of vehicles		emission factors (g/km/veh.)		no. of vehicles		emission factors (g/km/veh.)		no. of vehicles		emission factors (g/km/veh.)		no. of vehicles		emission factors (g/km/veh.)			
	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011
Alignment D	302	240	13.752	13.568	197	157	0.911	0.91	0	0	9.064	9.017	35	41	8.385	8.41	4626.046	3744.000
Alignment D1	277	329	13.752	13.568	181	215	0.911	0.91	0	0	9.064	9.017	69	63	8.385	8.41	4552.760	5189.352
Alignment F	579	569	13.752	13.568	378	372	0.911	0.91	0	0	9.064	9.017	104	104	8.385	8.41	9178.806	8933.352
Alignment U1	786	1135	13.752	13.568	514	741	0.911	0.91	0	0	9.064	9.017	60	174	8.385	8.41	11780.426	17537.330
Alignment OO	1211	1419	13.752	13.568	791	926	0.911	0.91	0	0	9.064	9.017	140	190	8.385	8.41	18548.173	21693.552

CO	Total no.of vehicles	Average emission factors (g/mile/veh.) in year 2011
Alignment D	438	13.787
Alignment D1	607	13.789
Alignment F	1045	13.788
Alignment U1	2050	13.798
Alignment OO	2535	13.803

PM

PM	Car				Taxi				Bus				Goods Vehicle				Total emission factors (g/km)	
	no. of vehicles		emission factors (g/km/veh.)		no. of vehicles		emission factors (g/km/veh.)		no. of vehicles		emission factors (g/km/veh.)		no. of vehicles		emission factors (g/km/veh.)			
	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011	2002	2011
Alignment D	302	240	0.041	0.041	197	157	0.239	0.238	0	0	1.333	0.894	35	41	0.976	0.568	93.625	70.494
Alignment D1	277	329	0.041	0.041	181	215	0.239	0.238	0	0	1.333	0.894	69	63	0.976	0.568	121.960	100.443
Alignment F	579	569	0.041	0.041	378	372	0.239	0.238	0	0	1.333	0.894	104	104	0.976	0.568	215.585	170.937
Alignment U1	786	1135	0.041	0.041	514	741	0.239	0.238	0	0	1.333	0.894	60	174	0.976	0.568	213.632	321.725
Alignment OO	1211	1419	0.041	0.041	791	926	0.239	0.238	0	0	1.333	0.894	140	190	0.976	0.568	375.340	386.487

PM	Total no.of vehicles	Average emission factors (g/mile/veh.) in year 2011
Alignment D	438	0.260
Alignment D1	607	0.267
Alignment F	1045	0.264
Alignment U1	2050	0.253
Alignment OO	2535	0.246

JUSTICE DRIVE EXTENSION

YEAR 2002 PM PEAK TRAFFIC FLOW EMISSION FACTORS

NEW ROADS

Types of vehicle	Car	Taxi	Goods Vehicles	Bus
Emission Factor (PM) (g/Km/Veh.)	0.041	0.239	0.976	1.333
Emission Factor (NOx) (g/Km/Veh.)	1.403	0.779	9.040	11.139
Emission Factor (CO) (g/Km/Veh.)	13.752	0.911	8.385	9.064

Alignment	Total no. of veh.	Car	Taxi	Goods Vehicles	Bus	% heavy vehicles	Car & Taxi	Goods veh. & bus	Bus	Total (excl. buses)	Ave. emiss. factors (g/Km/veh)			Ave. emiss. factors (g/mi/veh)		
											PM	NOx	CO	PM	NOx	CO
D	534	302	197	35	0	6.55	499	35	0	534	0.175378	1.673191	8.659742	0.282868	2.698696	13.96733
D1	527	277	181	69	0	13.09	458	69	0	527	0.2314	2.188669	8.640517	0.373226	3.530111	13.93632
F	1061	579	378	104	0	9.80	957	104	0	1061	0.203204	1.92923	8.650193	0.327749	3.111661	13.95192
U1	1359	786	514	60	0	4.42	1300	60	0	1359	0.157137	1.505391	8.672418	0.253446	2.428049	13.98777
OO	2142	1211	791	140	0	6.54	2002	140	0	2142	0.175221	1.671744	8.659796	0.282614	2.696361	13.96741

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JUSTICE DRIVE EXTENSION

YEAR 2002 PM PEAK TRAFFIC FLOW EMISSION FACTORS

EXISTING ROADS

Types of vehicle	Car	Taxi	Goods Vehicles	Bus
Emission Factor (PM) (g/Km/Veh.)	0.041	0.239	0.976	1.333
Emission Factor (NOx) (g/Km/Veh.)	1.403	0.779	9.04	11.139
Emission Factor (CO) (g/Km/Veh.)	13.752	0.911	8.385	9.064

Alignment	Total no. of veh.	Car	Taxi	Goods Vehicles	Bus	% heavy vehicles	Car & Taxi	Goods veh. & bus	Bus	Total (excl. buses)	Ave. emiss. factors (g/Km/veh)			Ave. emiss. factors (g/mi/veh)		
											PM	NOx	CO	PM	NOx	CO
A	5634	2487	1624	599	924	27.02	4111	1523	924	4710	0.409287	3.631026	8.710549	0.660141	5.856494	14.04927
C	4544	2033	1328	491	693	26.05	3361	1184	693	3851	0.396809	3.529985	8.707833	0.640015	5.693525	14.04489
E	3299	1358	887	404	651	31.96	2245	1054	651	2648	0.463506	4.090427	8.720851	0.747591	6.597463	14.06589
G	3797	1612	1052	469	665	29.85	2664	1133	665	3132	0.437486	3.877473	8.711168	0.705622	6.253989	14.05027
H	3292	1313	857	404	719	34.11	2170	1123	719	2573	0.489503	4.304578	8.729652	0.789521	6.942865	14.08008
P	3777	1576	1029	956	216	31.04	2605	1172	216	3561	0.405573	3.723673	8.627489	0.654151	6.005924	13.9153
R	1635	916	598	119	3	7.46	1514	122	3	1632	0.183881	1.74929	8.663628	0.296582	2.821436	13.97359
T	4441	2321	1515	602	3	13.62	3836	605	3	4438	0.236183	2.231876	8.639418	0.38094	3.5998	13.93454
T1	2799	1397	912	444	48	17.58	2309	492	48	2751	0.276031	2.579045	8.645177	0.445212	4.15975	13.94383
Z	1187	592	386	92	116	17.52	978	208	116	1071	0.304144	2.742075	8.688536	0.490555	4.422701	14.01054
BB	4578	2349	1534	688	7	15.17	3883	694	7	4571	0.249657	2.35496	8.633923	0.402672	3.798323	13.92568
CC	4559	2358	1540	646	16	14.53	3897	662	16	4543	0.244988	2.309522	8.640395	0.395142	3.725035	13.93612
DD	1493	687	449	191	165	23.84	1136	356	165	1328	0.362892	3.267474	8.678133	0.585309	5.270119	13.99699
FF	1521	716	468	144	192	22.09	1184	336	192	1329	0.353477	3.16221	8.694069	0.570125	5.100339	14.02269
GG	2660	1200	783	611	66	25.45	1983	677	66	2594	0.34613	3.21494	8.621019	0.558274	5.185388	13.90487
HH	3439	1934	1263	241	0	7.01	3197	241	0	3439	0.179229	1.70861	8.655885	0.289079	2.755823	13.9611
NN	708	403	264	38	0	5.38	667	38	0	708	0.165169	1.579169	8.650894	0.266401	2.547046	13.95305
PP	242	131	86	25	0	10.49	217	25	0	242	0.209108	1.983504	8.6479	0.337271	3.1992	13.94823
YY	5134	2148	1403	1304	278	30.81	3551	1582	278	4856	0.402539	3.699156	8.623491	0.649257	5.966381	13.90886
ZZ	3894	2013	1314	566	1	14.56	3327	567	1	3893	0.244068	2.304929	8.636376	0.393658	3.717627	13.92964

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JUSTICE DRIVE EXTENSION

YEAR 2011 PM PEAK TRAFFIC FLOW EMISSION FACTORS

NEW ROADS

Types of vehicle	Car	Taxi	Goods Vehicles	Bus
Emission Factor (PM) (g/Km/Veh.)	0.041	0.238	0.588	0.894
Emission Factor (NOx) (g/Km/Veh.)	1.321	0.779	7.061	8.678
Emission Factor (CO) (g/Km/Veh.)	13.568	0.910	8.410	9.017

Alignment	Total no. of veh.	Car	Taxi	Goods Vehicles	Bus	% heavy vehicles	Car & Taxi	Goods veh. & bus	Bus	Total (excl. buses)	Ave. emiss. factors (g/Km/veh)			Ave. emiss. factors (g/mi/veh)		
											PM	NOx	CO	PM	NOx	CO
D	438	240	157	41	0	9.36	397	41	0	438	0.1609	1.6642	8.5526	0.259473	2.684235	13.79449
D1	607	329	215	63	0	10.38	544	63	0	607	0.1654	1.7248	8.5510	0.266849	2.782016	13.79191
F	1045	569	372	104	0	9.95	941	104	0	1045	0.1635	1.6994	8.5517	0.263757	2.741032	13.79299
U1	2049	1135	741	174	0	8.49	1876	174	0	2049	0.1570	1.6130	8.5581	0.253272	2.601674	13.80344
OO	2535	1419	926	190	0	7.50	2345	190	0	2535	0.1525	1.5531	8.5555	0.245956	2.505068	13.79922

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JUSTICE DRIVE EXTENSION

YEAR 2011 PM PEAK TRAFFIC FLOW EMISSION FACTORS

EXISTING ROADS

Types of vehicle	Car	Taxi	Goods Vehicles	Bus
Emission Factor (PM) (g/Km/Veh.)	0.041	0.238	0.588	0.894
Emission Factor (NOx) (g/Km/Veh.)	1.321	0.779	7.061	8.678
Emission Factor (CO) (g/Km/Veh.)	13.568	0.910	8.410	9.017

Alignment	Total no. of veh.	Car	Taxi	Goods Vehicles	Bus	% heavy vehicles	Car & Taxi	Goods veh. & bus	Bus	Total (excl. buses)	Ave. emiss. factors (g/Km/veh)			Ave. emiss. factors (g/ml/veh)		
											PM	NOx	CO	PM	NOx	CO
A	5689	2579	1685	504	920	25.03	4264	1424	920	4769	0.2840	2.8585	8.6246	0.457995	4.610546	13.91063
C	5580	2562	1673	503	841	24.09	4235	1344	841	4739	0.2761	2.7845	8.6194	0.445367	4.491127	13.90221
E	4360	1875	1224	416	844	28.90	3099	1260	844	3516	0.3117	3.1403	8.6374	0.502763	5.065041	13.93127
G	4888	2170	1417	471	830	26.62	3587	1301	830	4058	0.2937	2.9662	8.6285	0.473768	4.784211	13.91695
H	3259	1351	883	315	710	31.45	2234	1025	710	2549	0.3311	3.3318	8.6501	0.534064	5.373881	13.95173
P	3863	1557	1017	1011	278	33.37	2574	1289	278	3585	0.2922	3.2100	8.5585	0.471237	5.17743	13.80403
R	2180	1198	783	198	1	9.13	1981	199	1	2179	0.1600	1.6511	8.5532	0.258031	2.663124	13.79553
T	5737	2930	1914	890	3	15.57	4844	893	3	5734	0.1889	2.0345	8.5431	0.3047	3.281482	13.77926
T1	3268	1648	1077	543	0	16.62	2725	543	0	3268	0.1935	2.0962	8.5412	0.312033	3.380958	13.77608
Z	2745	1468	959	300	19	11.62	2427	319	19	2726	0.1733	1.8104	8.5564	0.279558	2.920014	13.80056
BB	4806	2526	1649	627	5	13.15	4175	632	5	4801	0.1783	1.8918	8.5490	0.287513	3.051242	13.78877
CC	6080	3234	2112	714	19	12.06	5346	733	19	6061	0.1740	1.8296	8.5488	0.28061	2.950923	13.78844
DD	1099	482	314	141	162	27.57	796	303	162	937	0.2907	2.9868	8.6134	0.468905	4.817445	13.8926
FF	953	406	265	92	190	29.59	671	282	190	763	0.3167	3.1911	8.6418	0.510864	5.146983	13.93835
GG	4790	2184	1427	1069	109	24.59	3611	1178	109	4681	0.2367	2.6077	8.5406	0.381751	4.206021	13.77524
HH	3564	1998	1305	261	0	7.32	3303	261	0	3564	0.1517	1.5429	8.5558	0.244712	2.488566	13.79986
NN	777	442	288	47	0	6.05	730	47	0	777	0.1460	1.4670	8.5578	0.235479	2.366187	13.80289
PP	253	138	90	26	0	10.28	228	26	0	253	0.1655	1.7231	8.5850	0.266866	2.779254	13.84678
YY	3391	1315	859	957	260	35.89	2174	1217	260	3131	0.3050	3.3677	8.5574	0.491979	5.431839	13.80225
ZZ	2272	1246	813	212	1	9.38	2059	213	1	2271	0.1611	1.6658	8.5528	0.259807	2.686754	13.79488

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Justice Drive Extension

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Appendix F
Noise and Air Monitoring Report

Mouchel Asia Limited

APPENDIX F - NOISE AND AIR MONITORING REPORT

CONTENTS

TABLES

FIGURES

1 INTRODUCTION

1.1 On the 31st May 1996, the Highways Department of the Hong Kong Government appointed Mouchel Asia Limited, under Agreement No. CE 61/95, to provide professional services in respect of the design and construction supervision of Justice Drive Extension (hereinafter referred to as the Project).

1.2 As part of this Assignment, an Environmental Impact Assessment (EIA) is required to provide an assessment of the potential noise and air quality impacts associated with the Project's construction and operation and to determine how the Project can be constructed and operated in an environmentally acceptable manner.

1.3 As part of the EIA, the existing noise and air pollution environments in the area of the Project have been monitored to measure the ambient conditions. This report presents the results of the baseline monitoring. The data will be analysed and included in the final EIA Report. The baseline monitoring was carried out by Mouchel Asia Environmental.

2 BASELINE NOISE MONITORING

2.1 Noise Monitoring Location and Schedule

2.1.1 The measurement locations and sampling periods for the baseline noise monitoring are presented in Figure F1 and Table F2.1 respectively.

Table F2.1: Noise Monitoring Schedule

Noise Measurement Location (NSR)	Sampling Period
N1: The facade facing on 2/F of NAAFI Building	0:00 on 27/3/97 to 0:00 on 02/4/97
N2: The facade facing on G/F of Paget House	0:00 on 21/3/97 to 0:00 on 27/3/97
N3: The facade facing on 14/F of Sincere Insurance Building on Queens Road East	0:00 on 16/3/97 to 0:00 on 22/3/97
N4: The facade facing on roof of Hong Kong Academy for Performing Arts	0:00 on 15/3/97 to 0:00 on 21/3/97

2.2 Noise Monitoring Methodology

2.2.1 The baseline noise monitoring was carried out using a B&K 2231/2236 Precision Integrating Sound Level Meter and a B&K 4231 Sound Level Calibrator.

2.2.2 The parameters measured for the noise monitoring were A-weighted L_{10}, L_{90} and L_{eq}, for 60 min. period.

2.2.3 The microphone of the sound level meter was positioned 1 m from the exterior of the building facade and 1 m below the roof level using a metallic rod and extension cable.

2.3 Noise Monitoring Results

2.3.1 The measured noise levels are presented in Tables F2.2 to F2.5 attached.

3 BASELINE AIR MONITORING

3.1 Air Monitoring Location and Schedule

3.1.1 The measurement locations and sampling periods for the baseline air monitoring are presented in Figure F1 and Table F3.1 respectively.

Table F3.1: Air Monitoring Schedule

Air Measurement Location (ASR)	Sampling Period
A1: The facade facing on roof of Hong Kong Academy for Performing Arts	11:00 on 24/3/97 to 11:00 on 08/4/97 (NO_2) 11:00 on 15/3/97 to 11:00 on 28/3/97 (TSP/ RSP)

3.2 Air Monitoring Methodology

NO_2 Measurement

3.2.1 Nitrogen dioxide was analysed using an API Model 200A Chemiluminescence NO-NO_2-NO_X analyser. The analyser was calibrated using a Dasibi Model 5008 programmable multi-gas calibrator. A standard calibration gas of known concentration was used to ensure the response of the analyser, and performance checks were carried out regularly to ensure the quality of the data. The analogue output signal from the analyser was logged using a Metrosonics Model DL-714 data logger.

Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP) Measurement

3.2.2 Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP) were measured using two GS2310 Series high volume air samplers with different associated equipment in accordance with 40 CFR Part 50 and 53 respectively. The samplers were calibrated using a G2535 calibration kit.

3.2.3 The sampling filters were weighed on an analytical balance both before and after sampling to determine the net dust weights. The total air volumes sampled, corrected to standard conditions, were calculated from the measured flow rates and duration of the sampling period. Ambient air TSP & RSP concentrations were then calculated from the mass of the collected particles divided by the volume of the air sampled, corrected to standard conditions. Results were expressed in micrograms per cubic metre.

3.3 Air Monitoring Results

3.3.1 The measured air pollution levels are presented in Tables F3.2 to F3.3 attached.

Measurement Location :		Second Floor at AAFI Building, N1					
Measurement Period:		27/03/97-02/04/97					
Measurement Equipment:		B & K 2236 Precision Integrating Sound Level Meter					
Date:	27/03/97			Date:	28/03/97		
Time	L10	L90	Leq	Time	L10	L90	Leq
00:00-01:00	70.5	61.5	67.6	00:00-01:00	69.5	60.5	66.8
01:00-02:00	69.0	60.5	66.0	01:00-02:00	68.0	61.5	65.5
02:00-03:00	66.0	60.0	62.9	02:00-03:00	65.5	59.0	62.8
03:00-04:00	62.5	57.0	61.1	03:00-04:00	62.0	57.0	60.7
04:00-05:00	62.5	57.0	61.3	04:00-05:00	62.0	57.0	60.8
05:00-06:00	67.0	60.0	64.0	05:00-06:00	66.0	59.5	63.6
06:00-07:00	69.5	61.0	67.1	06:00-07:00	70.0	61.0	67.2
07:00-08:00	73.0	65.0	70.2	07:00-08:00	73.5	65.5	70.9
08:00-09:00	73.0	65.0	70.5	08:00-09:00	75.5	71.0	73.7
09:00-10:00	75.5	71.0	75.2	09:00-10:00	76.0	71.5	75.7
10:00-11:00	76.0	71.0	75.0	10:00-11:00	76.5	71.5	74.7
11:00-12:00	76.5	71.5	75.1	11:00-12:00	76.5	71.0	74.6
12:00-13:00	76.0	71.0	73.7	12:00-13:00	76.0	70.5	73.9
13:00-14:00	76.0	71.0	74.0	13:00-14:00	75.5	70.5	73.7
14:00-15:00	75.5	71.5	74.1	14:00-15:00	76.0	71.0	74.0
15:00-16:00	76.0	71.0	74.1	15:00-16:00	82.0	71.0	77.7
16:00-17:00	75.0	70.5	73.4	16:00-17:00	84.0	79.0	82.1
17:00-18:00	74.5	69.5	72.5	17:00-18:00	83.0	78.0	81.2
18:00-19:00	73.5	69.5	72.2	18:00-19:00	82.5	78.0	80.8
19:00-20:00	73.5	69.0	72.0	19:00-20:00	82.5	78.0	80.9
20:00-21:00	73.5	69.0	71.5	20:00-21:00	82.0	77.5	80.5
21:00-22:00	73.0	68.5	71.3	21:00-22:00	82.0	77.5	80.3
22:00-23:00	72.5	68.5	70.8	22:00-23:00	81.5	76.5	79.8
23:00-00:00	71.5	63.0	69.0	23:00-00:00	79.5	71.5	76.9
Date:	29/03/97			Date:	30/03/97		
Time	L10	L90	Leq	Time	L10	L90	Leq
00:00-01:00	78.0	68.5	75.4	00:00-01:00	78.0	71.0	75.5
01:00-02:00	76.0	67.5	72.9	01:00-02:00	76.5	69.5	73.7
02:00-03:00	72.5	66.5	70.6	02:00-03:00	73.5	66.5	70.9
03:00-04:00	72.0	64.5	69.6	03:00-04:00	71.5	64.0	69.6
04:00-05:00	70.5	65.0	69.1	04:00-05:00	70.0	63.5	68.5
05:00-06:00	72.0	66.5	70.0	05:00-06:00	73.0	66.5	70.7
06:00-07:00	77.5	68.0	74.2	06:00-07:00	76.5	67.5	73.7
07:00-08:00	79.5	71.0	77.3	07:00-08:00	79.0	69.5	76.6
08:00-09:00	82.0	76.0	79.8	08:00-09:00	81.0	75.5	78.9
09:00-10:00	83.0	77.5	81.0	09:00-10:00	82.0	76.5	79.8
10:00-11:00	82.5	77.5	80.7	10:00-11:00	82.5	77.5	80.8
11:00-12:00	83.5	78.0	81.5	11:00-12:00	82.5	77.5	80.7
12:00-13:00	82.5	78.0	80.9	12:00-13:00	82.5	77.5	80.7
13:00-14:00	82.5	78.0	80.8	13:00-14:00	82.5	77.5	80.6
14:00-15:00	82.5	78.0	81.0	14:00-15:00	82.5	78.0	80.9
15:00-16:00	83.0	78.5	81.3	15:00-16:00	82.5	78.0	80.8
16:00-17:00	82.0	78.0	80.6	16:00-17:00	82.0	77.5	80.3
17:00-18:00	82.0	78.5	80.8	17:00-18:00	82.0	78.0	80.8
18:00-19:00	82.0	78.5	80.6	18:00-19:00	82.0	78.0	80.7
19:00-20:00	81.5	78.0	80.3	19:00-20:00	82.0	77.5	80.5
20:00-21:00	81.5	77.5	80.2	20:00-21:00	82.0	77.0	80.2
21:00-22:00	81.5	77.5	80.2	21:00-22:00	81.5	77.0	79.8
22:00-23:00	81.0	75.0	79.0	22:00-23:00	80.5	76.5	79.0
23:00-00:00	79.0	71.0	76.4	23:00-00:00	80.0	72.0	77.6

Table F2.2

Date:	31/03/97				Date:	01/04/97		
Time	L10	L90	Leq		Time	L10	L90	Leq
00:00-01:00	78.0	71.5	75.9		00:00-01:00	77.0	68.5	73.6
01:00-02:00	77.5	69.0	75.0		01:00-02:00	74.5	67.5	71.5
02:00-03:00	72.5	67.0	70.7		02:00-03:00	72.0	66.0	70.1
03:00-04:00	71.0	65.5	69.1		03:00-04:00	69.5	65.0	68.7
04:00-05:00	71.0	65.0	69.6		04:00-05:00	70.5	65.0	69.4
05:00-06:00	74.0	66.5	71.5		05:00-06:00	72.5	67.0	70.6
06:00-07:00	77.5	67.5	75.3		06:00-07:00	77.0	68.5	73.9
07:00-08:00	79.5	70.0	77.0		07:00-08:00	79.5	70.0	77.4
08:00-09:00	80.5	75.5	78.5		08:00-09:00	80.5	74.5	78.3
09:00-10:00	81.0	76.5	79.4		09:00-10:00	82.0	76.0	80.1
10:00-11:00	81.5	77.0	79.6		10:00-11:00	82.5	77.0	80.3
11:00-12:00	81.5	77.0	79.9		11:00-12:00	82.5	77.0	80.4
12:00-13:00	81.5	77.0	79.8		12:00-13:00	81.5	77.0	80.0
13:00-14:00	82.0	77.0	80.3		13:00-14:00	82.0	77.5	80.5
14:00-15:00	82.0	77.5	80.3		14:00-15:00	82.0	77.5	80.3
15:00-16:00	81.5	77.5	80.3		15:00-16:00	82.0	78.0	80.6
16:00-17:00	81.5	77.5	80.1		16:00-17:00	82.0	77.5	80.5
17:00-18:00	81.5	77.5	80.1		17:00-18:00	82.0	77.5	80.4
18:00-19:00	81.5	77.5	80.1		18:00-19:00	82.0	77.5	80.5
19:00-20:00	81.5	77.0	79.9		19:00-20:00	82.0	77.5	80.4
20:00-21:00	81.0	76.5	79.4		20:00-21:00	81.5	77.0	80.0
21:00-22:00	81.0	76.5	79.3		21:00-22:00	81.0	77.0	79.6
22:00-23:00	80.5	76.5	79.0		22:00-23:00	80.5	75.0	78.7
23:00-00:00	80.0	71.0	77.6		23:00-00:00	79.5	71.0	77.0
Date:	02/04/97							
Time	L10	L90	Leq					
00:00-01:00	78.5	71.0	76.7					
01:00-02:00	75.5	70.0	73.0					
02:00-03:00	72.0	66.0	69.7					
03:00-04:00	71.5	65.5	69.8					
04:00-05:00	71.0	65.0	69.0					
05:00-06:00	73.0	66.0	71.2					
06:00-07:00	78.0	71.0	75.5					
07:00-08:00	81.0	74.0	79.1					
08:00-09:00	83.0	78.0	81.4					
09:00-10:00	84.5	78.5	82.5					
10:00-11:00	84.5	79.5	82.7					
11:00-12:00	84.0	79.0	82.2					
12:00-13:00	83.0	78.5	81.5					
13:00-14:00	83.5	79.0	82.1					
14:00-15:00	84.0	79.5	82.5					
15:00-16:00	84.5	79.5	82.7					
16:00-17:00	83.0	78.5	81.8					
17:00-18:00	83.0	78.5	81.3					
18:00-19:00	82.5	78.5	81.0					
19:00-20:00	82.0	78.0	80.4					
20:00-21:00	81.5	77.5	80.1					
21:00-22:00	81.5	77.0	80.1					
22:00-23:00	81.0	76.5	79.4					
23:00-00:00	80.0	71.0	77.5					

Measurement Location:	Ground Floor at Paget House , N2
Measurement Period:	21/03/97-27/03/97
Measurement Equipment:	B & K 2236 Precision Integrating Sound Level Meter

Date:	21/03/97			Date:	22/03/97		
Time	L10	L90	Leq	Time	L10	L90	Leq
00:00-01:00	63.0	57.5	61.3	00:00-01:00	63.5	57.0	61.0
01:00-02:00	62.5	56.5	60.2	01:00-02:00	62.5	56.0	59.8
02:00-03:00	60.0	54.0	56.4	02:00-03:00	60.3	54.0	57.7
03:00-04:00	60.0	54.0	56.7	03:00-04:00	61.0	54.1	58.4
04:00-05:00	60.0	54.0	56.5	04:00-05:00	60.5	54.2	57.9
05:00-06:00	61.0	54.0	58.1	05:00-06:00	61.1	55.0	59.0
06:00-07:00	63.5	57.0	61.5	06:00-07:00	62.9	56.0	61.0
07:00-08:00	66.5	62.0	64.7	07:00-08:00	67.0	62.4	65.2
08:00-09:00	68.5	63.5	66.3	08:00-09:00	68.9	63.5	66.8
09:00-10:00	69.5	65.5	67.5	09:00-10:00	70.0	65.6	67.8
10:00-11:00	69.5	65.0	67.2	10:00-11:00	70.0	65.4	67.2
11:00-12:00	70.0	66.0	68.1	11:00-12:00	71.0	66.0	68.3
12:00-13:00	70.5	66.0	68.2	12:00-13:00	70.4	65.9	68.0
13:00-14:00	71.0	66.0	68.3	13:00-14:00	70.9	66.0	68.0
14:00-15:00	71.0	66.5	68.8	14:00-15:00	71.1	66.4	68.1
15:00-16:00	70.5	65.5	68.3	15:00-16:00	70.8	65.7	68.2
16:00-17:00	70.5	66.0	68.0	16:00-17:00	70.6	66.0	68.3
17:00-18:00	70.0	65.0	67.9	17:00-18:00	70.4	65.3	68.2
18:00-19:00	71.0	66.0	68.2	18:00-19:00	70.5	66.1	68.3
19:00-20:00	71.0	66.5	68.7	19:00-20:00	71.1	66.5	68.8
20:00-21:00	70.5	66.0	68.4	20:00-21:00	71.5	66.2	68.7
21:00-22:00	68.5	64.5	66.5	21:00-22:00	69.3	64.9	66.2
22:00-23:00	67.0	64.0	65.7	22:00-23:00	67.5	63.2	65.1
23:00-00:00	64.5	59.0	62.0	23:00-00:00	65.1	59.0	63.0

Date:	23/03/97			Date:	24/03/97		
Time	L10	L90	Leq	Time	L10	L90	Leq
00:00-01:00	64.0	57.5	61.2	00:00-01:00	63.5	57.5	61.3
01:00-02:00	63.5	57.0	61.0	01:00-02:00	63.0	57.5	61.1
02:00-03:00	60.5	54.5	57.0	02:00-03:00	61.0	56.0	58.0
03:00-04:00	61.0	54.0	56.8	03:00-04:00	60.5	54.5	57.5
04:00-05:00	61.0	54.0	56.8	04:00-05:00	60.5	54.5	57.6
05:00-06:00	61.5	55.0	58.3	05:00-06:00	62.0	57.0	58.9
06:00-07:00	64.0	56.5	61.4	06:00-07:00	64.5	58.0	61.7
07:00-08:00	67.0	62.5	64.0	07:00-08:00	68.0	60.5	65.4
08:00-09:00	68.5	64.0	66.7	08:00-09:00	69.0	62.0	66.2
09:00-10:00	70.0	65.5	68.9	09:00-10:00	71.5	63.0	69.0
10:00-11:00	69.5	65.0	67.6	10:00-11:00	70.0	61.0	67.0
11:00-12:00	70.0	66.5	68.0	11:00-12:00	71.5	63.0	67.9
12:00-13:00	71.0	66.5	68.1	12:00-13:00	73.0	65.0	70.4
13:00-14:00	70.5	66.0	68.0	13:00-14:00	71.5	63.0	68.9
14:00-15:00	71.0	66.5	68.2	14:00-15:00	72.0	66.0	69.7
15:00-16:00	71.0	66.5	68.3	15:00-16:00	73.0	65.0	70.9
16:00-17:00	70.5	66.0	68.0	16:00-17:00	71.5	62.5	68.9
17:00-18:00	70.5	66.0	68.5	17:00-18:00	70.0	61.0	67.2
18:00-19:00	71.0	66.0	68.6	18:00-19:00	71.5	63.0	69.0
19:00-20:00	71.5	64.5	68.9	19:00-20:00	71.0	61.5	68.1
20:00-21:00	70.0	64.5	67.2	20:00-21:00	69.5	60.5	66.8
21:00-22:00	69.5	63.5	66.4	21:00-22:00	70.0	61.0	65.0
22:00-23:00	67.5	61.0	64.2	22:00-23:00	68.0	61.0	65.3
23:00-00:00	65.0	59.5	62.2	23:00-00:00	66.0	59.5	63.0

Table F2.3

Date:	25/03/97				Date:	26/03/97		
Time	L10	L90	Leq		Time	L10	L90	Leq
00:00-01:00	65.0	58.5	63.0		00:00-01:00	64.5	58.5	62.1
01:00-02:00	64.0	58.0	61.9		01:00-02:00	64.0	57.5	61.4
02:00-03:00	62.0	56.5	59.0		02:00-03:00	61.5	56.5	58.4
03:00-04:00	60.5	54.0	58.3		03:00-04:00	61.0	56.0	58.7
04:00-05:00	60.5	54.5	58.4		04:00-05:00	61.0	55.5	58.1
05:00-06:00	61.5	56.5	59.0		05:00-06:00	62.5	57.0	59.3
06:00-07:00	63.5	58.0	61.4		06:00-07:00	64.0	58.0	61.7
07:00-08:00	67.5	60.0	64.1		07:00-08:00	66.5	60.0	63.8
08:00-09:00	69.0	60.0	66.0		08:00-09:00	69.5	60.5	66.2
09:00-10:00	71.5	62.5	68.5		09:00-10:00	71.0	62.5	67.3
10:00-11:00	70.5	61.5	67.7		10:00-11:00	70.5	63.5	67.0
11:00-12:00	72.0	64.5	69.4		11:00-12:00	71.5	63.0	66.9
12:00-13:00	73.0	65.5	70.1		12:00-13:00	73.0	66.5	70.2
13:00-14:00	72.5	68.5	70.8		13:00-14:00	72.5	66.0	69.8
14:00-15:00	72.5	66.5	69.8		14:00-15:00	72.5	66.0	69.4
15:00-16:00	73.5	69.0	71.5		15:00-16:00	73.0	67.5	70.2
16:00-17:00	72.0	68.0	70.4		16:00-17:00	72.5	68.0	70.3
17:00-18:00	71.5	63.0	69.0		17:00-18:00	71.0	62.5	67.9
18:00-19:00	71.0	62.0	68.3		18:00-19:00	71.0	62.5	68.0
19:00-20:00	71.0	62.0	67.9		19:00-20:00	71.0	61.5	67.2
20:00-21:00	70.5	61.5	67.4		20:00-21:00	70.5	60.0	67.0
21:00-22:00	70.5	61.0	67.2		21:00-22:00	71.0	60.0	66.4
22:00-23:00	68.5	61.0	65.8		22:00-23:00	69.0	60.0	64.9
23:00-00:00	65.5	58.5	62.8		23:00-00:00	66.0	59.0	63.0
Date:	27/03/97							
Time	L10	L90	Leq					
00:00-01:00	64.5	57.5	60.9					
01:00-02:00	63.5	57.0	60.0					
02:00-03:00	61.5	56.0	59.4					
03:00-04:00	61.0	54.5	58.5					
04:00-05:00	61.0	54.5	58.6					
05:00-06:00	62.5	56.5	59.2					
06:00-07:00	64.0	57.5	60.4					
07:00-08:00	67.5	60.0	63.2					
08:00-09:00	68.5	61.5	65.2					
09:00-10:00	71.0	62.5	68.5					
10:00-11:00	71.5	61.0	68.0					
11:00-12:00	72.0	63.0	68.6					
12:00-13:00	73.0	64.5	69.9					
13:00-14:00	71.0	63.0	67.3					
14:00-15:00	71.5	63.5	68.8					
15:00-16:00	72.5	64.0	69.5					
16:00-17:00	72.0	66.0	69.1					
17:00-18:00	71.0	62.0	66.9					
18:00-19:00	72.0	62.5	68.4					
19:00-20:00	71.5	62.0	68.0					
20:00-21:00	70.0	61.0	65.3					
21:00-22:00	70.5	61.0	64.8					
22:00-23:00	69.0	61.0	64.2					
23:00-00:00	66.5	60.0	63.1					

Measurement Location :		14/F of Sincere Insurance Building located at Queen Road East , N3						
Measurement Period:		16/03/97-22/03/97						
Measurement Equipment:		B & K 2231 Precision Integrating Sound Level Meter						
Date:	16/03/97				Date:	17/03/97		
Time	L10	L90	Leq		Time	L10	L90	Leq
00:00-01:00	69.9	65.4	68.0		00:00-01:00	69.4	64.4	67.4
01:00-02:00	68.4	64.4	66.5		01:00-02:00	67.4	61.9	65.3
02:00-03:00	66.9	62.9	65.0		02:00-03:00	64.4	59.4	62.4
03:00-04:00	65.4	60.4	63.4		03:00-04:00	62.9	56.9	60.7
04:00-05:00	64.4	58.9	62.2		04:00-05:00	62.4	56.4	59.8
05:00-06:00	63.9	58.4	61.8		05:00-06:00	62.4	55.9	60.3
06:00-07:00	64.4	58.9	62.4		06:00-07:00	63.9	57.4	61.6
07:00-08:00	67.9	60.9	65.2		07:00-08:00	68.9	62.4	66.4
08:00-09:00	69.9	64.4	67.5		08:00-09:00	71.9	67.4	69.9
09:00-10:00	75.4	65.9	72.1		09:00-10:00	84.9	71.9	80.7
10:00-11:00	71.9	67.4	70.1		10:00-11:00	85.4	72.9	81.0
11:00-12:00	73.4	68.4	71.2		11:00-12:00	83.9	72.4	79.4
12:00-13:00	74.4	68.4	72.2		12:00-13:00	72.9	68.9	71.3
13:00-14:00	71.4	67.4	69.5		13:00-14:00	84.4	71.9	80.3
14:00-15:00	74.4	67.9	72.0		14:00-15:00	84.4	72.9	80.5
15:00-16:00	72.9	68.4	71.0		15:00-16:00	82.9	70.4	78.5
16:00-17:00	71.9	67.4	70.6		16:00-17:00	80.4	70.9	76.9
17:00-18:00	76.4	69.4	73.6		17:00-18:00	78.9	70.4	76.1
18:00-19:00	74.4	67.4	72.0		18:00-19:00	71.9	68.4	70.6
19:00-20:00	70.9	66.9	69.0		19:00-20:00	71.4	67.9	69.8
20:00-21:00	70.4	66.4	68.8		20:00-21:00	70.9	66.9	69.1
21:00-22:00	69.9	65.9	68.0		21:00-22:00	70.4	66.9	68.9
22:00-23:00	69.9	65.4	67.9		22:00-23:00	70.9	66.4	69.3
23:00-00:00	69.9	65.4	67.9		23:00-00:00	69.9	65.4	67.8
Date:	18/03/97				Date:	19/03/97		
Time	L10	L90	Leq		Time	L10	L90	Leq
00:00-01:00	68.4	62.9	66.1		00:00-01:00	68.4	63.4	66.3
01:00-02:00	65.4	60.9	63.4		01:00-02:00	64.9	60.9	63.1
02:00-03:00	64.4	58.4	62.0		02:00-03:00	63.4	58.4	61.4
03:00-04:00	63.4	57.4	61.0		03:00-04:00	62.9	57.4	60.5
04:00-05:00	63.4	56.4	60.4		04:00-05:00	62.4	56.9	60.1
05:00-06:00	63.9	57.4	61.3		05:00-06:00	63.4	56.9	61.0
06:00-07:00	69.4	60.9	66.5		06:00-07:00	68.4	60.9	65.6
07:00-08:00	71.9	66.4	70.3		07:00-08:00	71.4	66.4	69.4
08:00-09:00	86.4	70.4	81.9		08:00-09:00	72.5	66.9	69.8
09:00-10:00	83.4	72.4	80.1		09:00-10:00	75.4	65.9	68.5
10:00-11:00	83.9	72.4	79.8		10:00-11:00	72.9	67.4	70.6
11:00-12:00	82.9	71.9	80.9		11:00-12:00	74.4	68.4	71.1
12:00-13:00	73.4	68.9	72.0		12:00-13:00	72.4	67.4	70.2
13:00-14:00	80.9	70.4	77.3		13:00-14:00	75.4	68.4	71.3
14:00-15:00	79.9	71.9	77.0		14:00-15:00	73.9	68.4	69.8
15:00-16:00	78.4	70.9	75.6		15:00-16:00	72.9	68.4	70.0
16:00-17:00	83.9	71.9	79.7		16:00-17:00	76.4	69.4	72.3
17:00-18:00	75.4	69.4	73.1		17:00-18:00	73.4	67.9	70.5
18:00-19:00	71.9	67.9	70.0		18:00-19:00	70.4	66.4	68.9
19:00-20:00	71.4	67.4	69.5		19:00-20:00	70.9	66.9	68.4
20:00-21:00	70.9	66.9	69.1		20:00-21:00	69.9	65.4	67.1
21:00-22:00	70.4	66.9	68.8		21:00-22:00	69.9	65.9	67.0
22:00-23:00	70.4	66.4	68.6		22:00-23:00	69.9	65.4	67.5
23:00-00:00	69.9	65.4	68.1		23:00-00:00	70.4	65.9	67.9

Table F2.4

Date:	20/03/97				Date:	21/03/97		
Time	L10	L90	Leq		Time	L10	L90	Leq
00:00-01:00	70.0	65.9	68.0		00:00-01:00	69.4	64.9	67.5
01:00-02:00	69.4	65.4	67.2		01:00-02:00	68.4	64.4	66.2
02:00-03:00	67.4	60.4	65.5		02:00-03:00	66.4	60.4	64.8
03:00-04:00	65.4	60.4	63.1		03:00-04:00	65.9	60.9	63.6
04:00-05:00	64.9	58.9	62.1		04:00-05:00	64.4	58.9	62.2
05:00-06:00	63.4	58.4	60.8		05:00-06:00	63.9	58.4	61.8
06:00-07:00	64.4	58.9	62.4		06:00-07:00	64.9	59.4	62.9
07:00-08:00	66.9	62.4	64.5		07:00-08:00	67.9	60.9	65.2
08:00-09:00	69.5	63.9	67.2		08:00-09:00	71.4	67.4	69.2
09:00-10:00	75.9	65.9	72.8		09:00-10:00	76.4	66.9	72.9
10:00-11:00	72.9	67.9	71.6		10:00-11:00	72.9	68.4	70.9
11:00-12:00	72.4	67.4	70.0		11:00-12:00	73.4	68.4	71.2
12:00-13:00	74.4	68.4	72.2		12:00-13:00	74.9	68.4	72.5
13:00-14:00	72.4	67.9	70.0		13:00-14:00	73.4	67.9	71.3
14:00-15:00	73.9	67.9	71.6		14:00-15:00	74.9	67.4	72.2
15:00-16:00	73.4	68.4	71.2		15:00-16:00	73.4	68.9	71.2
16:00-17:00	71.9	67.4	70.6		16:00-17:00	71.4	67.4	69.6
17:00-18:00	75.9	68.4	72.4		17:00-18:00	75.4	66.4	72.3
18:00-19:00	73.9	67.4	71.9		18:00-19:00	75.9	66.9	72.7
19:00-20:00	71.4	67.4	69.5		19:00-20:00	71.4	67.4	69.6
20:00-21:00	70.4	65.9	68.2		20:00-21:00	71.9	67.4	70.1
21:00-22:00	69.9	66.4	68.1		21:00-22:00	69.9	65.9	68.1
22:00-23:00	69.9	65.4	67.9		22:00-23:00	69.9	65.9	68.0
23:00-00:00	69.9	65.4	67.9		23:00-00:00	69.4	65.4	67.8

Date:	22/03/97		
Time	L10	L90	Leq
00:00-01:00	69.9	65.4	68.0
01:00-02:00	67.4	63.4	65.5
02:00-03:00	66.9	62.9	65.2
03:00-04:00	65.0	60.4	63.1
04:00-05:00	65.9	59.9	63.8
05:00-06:00	63.9	58.4	61.7
06:00-07:00	63.9	58.9	61.6
07:00-08:00	68.9	60.9	66.3
08:00-09:00	70.4	64.9	68.4
09:00-10:00	76.9	65.4	73.3
10:00-11:00	71.9	67.4	70.6
11:00-12:00	73.9	68.4	71.8
12:00-13:00	74.4	68.9	73.0
13:00-14:00	71.4	66.9	68.3
14:00-15:00	73.9	67.9	71.8
15:00-16:00	72.9	67.9	70.8
16:00-17:00	71.4	66.9	70.0
17:00-18:00	76.9	69.4	73.8
18:00-19:00	74.0	67.4	71.8
19:00-20:00	70.9	66.4	68.7
20:00-21:00	70.9	66.4	69.0
21:00-22:00	69.9	65.9	68.0
22:00-23:00	69.9	65.9	68.0
23:00-00:00	69.9	65.9	68.0

Measurement Location :		Roof of Hong Kong Academy For Performing Arts , N4						
Measurement Period:		15/03/97-21/03/97						
Measurement Equipment:		B & K 2231 Precision Integrating Sound Level Meter						
Date:	15/03/97				Date:	16/03/97		
Time	L10	L90	Leq		Time	L10	L90	Leq
00:00-01:00	71.3	67.3	69.5		00:00-01:00	71.8	67.8	70.0
01:00-02:00	70.8	65.8	68.7		01:00-02:00	71.8	66.8	69.7
02:00-03:00	70.3	64.8	67.9		02:00-03:00	70.8	65.8	68.9
03:00-04:00	69.3	63.3	67.0		03:00-04:00	69.8	64.3	67.7
04:00-05:00	68.8	62.3	66.2		04:00-05:00	69.3	63.3	66.9
05:00-06:00	69.3	62.3	66.5		05:00-06:00	68.8	62.3	66.4
06:00-07:00	71.3	64.3	68.7		06:00-07:00	70.3	62.8	67.5
07:00-08:00	73.3	67.8	71.0		07:00-08:00	70.8	64.8	68.3
08:00-09:00	73.3	69.8	71.0		08:00-09:00	71.8	66.8	69.8
09:00-10:00	73.3	69.8	71.1		09:00-10:00	72.8	68.8	70.9
10:00-11:00	73.3	69.3	71.2		10:00-11:00	72.8	69.3	71.3
11:00-12:00	73.3	69.3	71.6		11:00-12:00	72.8	69.3	71.2
12:00-13:00	73.3	69.8	72.1		12:00-13:00	72.8	69.3	71.2
13:00-14:00	73.3	69.3	71.5		13:00-14:00	72.3	68.8	70.8
14:00-15:00	73.3	69.8	71.7		14:00-15:00	73.3	69.8	71.6
15:00-16:00	73.3	69.8	71.6		15:00-16:00	73.3	69.3	71.7
16:00-17:00	73.3	69.8	71.7		16:00-17:00	73.8	69.8	71.8
17:00-18:00	72.8	69.8	71.4		17:00-18:00	73.3	69.8	71.6
18:00-19:00	72.8	69.8	71.5		18:00-19:00	72.3	69.3	70.9
19:00-20:00	71.8	67.8	70.0		19:00-20:00	72.3	68.8	70.6
20:00-21:00	71.3	67.8	69.7		20:00-21:00	71.8	68.3	70.3
21:00-22:00	71.8	68.3	70.2		21:00-22:00	71.3	67.3	69.7
22:00-23:00	71.8	67.8	70.1		22:00-23:00	70.8	67.3	69.4
23:00-00:00	71.8	67.8	70.1		23:00-00:00	71.3	67.8	69.7
Date:	17/03/97				Date:	18/03/97		
Time	L10	L90	Leq		Time	L10	L90	Leq
00:00-01:00	71.3	67.3	69.8		00:00-01:00	71.3	67.3	69.8
01:00-02:00	70.3	65.3	68.4		01:00-02:00	70.8	65.3	68.5
02:00-03:00	69.3	62.8	66.6		02:00-03:00	69.3	63.8	67.2
03:00-04:00	68.8	61.8	66.0		03:00-04:00	69.3	62.8	66.7
04:00-05:00	68.3	61.3	65.8		04:00-05:00	68.8	61.8	65.8
05:00-06:00	68.3	60.8	65.5		05:00-06:00	68.3	61.3	65.7
06:00-07:00	70.8	62.8	67.9		06:00-07:00	70.8	63.3	68.0
07:00-08:00	72.8	65.8	70.2		07:00-08:00	72.8	66.3	70.3
08:00-09:00	74.8	70.3	72.8		08:00-09:00	74.8	70.3	74.2
09:00-10:00	74.8	71.3	73.3		09:00-10:00	75.3	71.8	73.8
10:00-11:00	74.8	71.3	73.1		10:00-11:00	75.3	71.8	73.7
11:00-12:00	75.3	71.8	73.5		11:00-12:00	76.3	71.8	74.2
12:00-13:00	74.8	70.8	73.0		12:00-13:00	74.8	71.8	73.4
13:00-14:00	74.3	70.8	72.6		13:00-14:00	74.3	70.8	72.9
14:00-15:00	75.3	71.8	73.5		14:00-15:00	75.3	71.8	73.4
15:00-16:00	74.8	70.8	72.9		15:00-16:00	74.8	70.3	73.0
16:00-17:00	74.3	70.8	72.7		16:00-17:00	74.3	70.3	72.7
17:00-18:00	74.8	71.3	73.1		17:00-18:00	74.8	70.8	73.0
18:00-19:00	74.8	70.8	73.0		18:00-19:00	73.8	70.8	72.5
19:00-20:00	72.3	68.8	70.5		19:00-20:00	71.8	68.3	70.3
20:00-21:00	72.8	68.8	70.9		20:00-21:00	71.8	67.8	69.8
21:00-22:00	72.3	68.3	70.8		21:00-22:00	72.3	68.8	70.9
22:00-23:00	71.8	68.3	70.3		22:00-23:00	71.8	68.3	70.3
23:00-00:00	71.8	68.3	70.6		23:00-00:00	71.8	68.3	70.3

Table F2.5

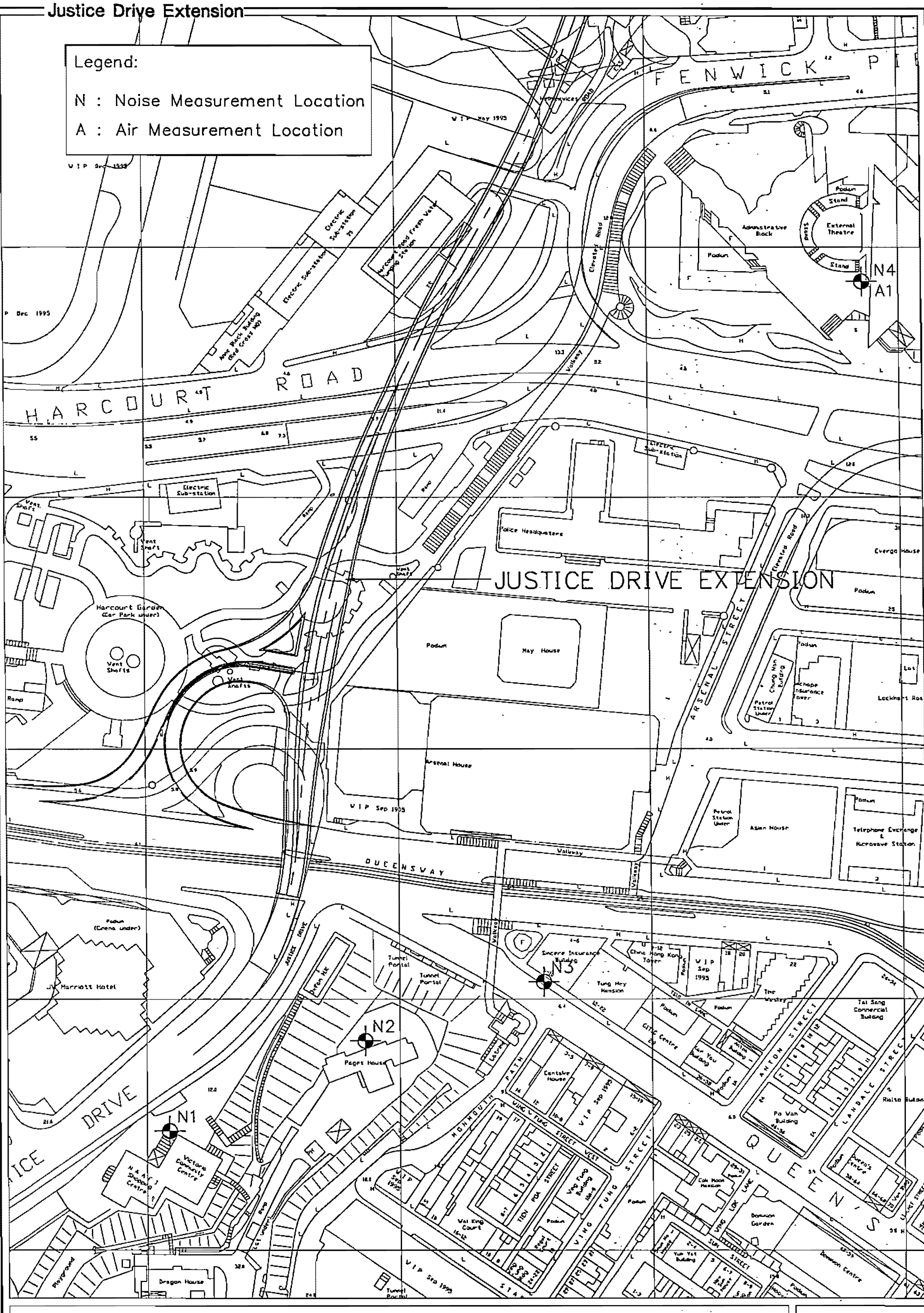
Date:	19/03/97				Date:	20/03/97		
Time	L10	L90	Leq		Time	L10	L90	Leq
00:00-01:00	71.8	67.8	70.2		00:00-01:00	72.3	67.8	70.4
01:00-02:00	70.8	65.3	68.8		01:00-02:00	71.3	66.3	69.2
02:00-03:00	69.3	62.8	66.9		02:00-03:00	69.8	64.3	67.7
03:00-04:00	68.8	62.8	66.4		03:00-04:00	69.8	63.3	67.3
04:00-05:00	68.3	61.8	65.5		04:00-05:00	69.3	62.3	66.4
05:00-06:00	68.3	61.3	65.4		05:00-06:00	69.3	61.3	66.2
06:00-07:00	70.8	62.8	67.7		06:00-07:00	70.8	62.8	68.1
07:00-08:00	72.3	66.3	70.0		07:00-08:00	72.8	66.8	70.5
08:00-09:00	74.3	69.8	72.4		08:00-09:00	74.8	70.3	72.9
09:00-10:00	74.3	70.8	73.0		09:00-10:00	75.8	72.3	74.3
10:00-11:00	74.8	71.3	73.3		10:00-11:00	77.3	72.3	75.1
11:00-12:00	75.3	71.3	73.6		11:00-12:00	75.8	71.8	74.2
12:00-13:00	75.3	71.8	73.6		12:00-13:00	75.8	71.3	73.7
13:00-14:00	74.3	71.3	73.0		13:00-14:00	74.8	70.8	73.2
14:00-15:00	74.8	71.8	73.4		14:00-15:00	75.3	71.8	73.8
15:00-16:00	74.8	71.8	73.3		15:00-16:00	74.8	71.3	73.4
16:00-17:00	74.8	71.3	73.1		16:00-17:00	75.8	71.3	74.0
17:00-18:00	73.8	70.8	72.4		17:00-18:00	75.3	70.8	73.5
18:00-19:00	73.3	69.8	71.8		18:00-19:00	75.3	71.3	73.5
19:00-20:00	72.3	68.3	70.7		19:00-20:00	72.3	68.3	70.5
20:00-21:00	72.3	68.8	70.7		20:00-21:00	71.8	67.8	70.1
21:00-22:00	72.3	68.8	70.9		21:00-22:00	72.8	68.8	71.2
22:00-23:00	71.8	68.3	70.2		22:00-23:00	72.3	68.8	70.9
23:00-00:00	71.8	68.3	70.4		23:00-00:00	72.3	68.8	70.6

Date:	21/03/97		
Time	L10	L90	Leq
00:00-01:00	72.3	67.8	70.4
01:00-02:00	71.8	65.8	69.4
02:00-03:00	70.8	64.3	68.1
03:00-04:00	69.8	62.8	67.0
04:00-05:00	69.3	62.3	66.7
05:00-06:00	69.3	61.3	66.1
06:00-07:00	70.8	62.8	68.1
07:00-08:00	72.8	66.8	70.7
08:00-09:00	74.8	70.3	72.8
09:00-10:00	75.3	71.3	73.4
10:00-11:00	75.3	71.3	73.4
11:00-12:00	74.8	71.3	73.3
12:00-13:00	73.8	70.3	72.1
13:00-14:00	73.3	69.8	71.7
14:00-15:00	74.3	70.8	72.7
15:00-16:00	73.8	70.3	72.3
16:00-17:00	73.8	70.3	72.4
17:00-18:00	73.3	70.3	71.8
18:00-19:00	72.8	69.3	71.2
19:00-20:00	71.8	68.3	70.4
20:00-21:00	71.8	68.3	70.2
21:00-22:00	72.3	69.3	71.0
22:00-23:00	72.3	68.8	70.7
23:00-00:00	72.3	68.8	70.6

Numerical Results of NO2 Monitoring at Hong Kong Academy for Performing Arts																
Time	24/3/97	25/3/97	26/3/97	27/3/97	28/3/97	29/3/97	30/3/97	31/3/97	1/4/97	2/4/97	3/4/97	4/4/97	5/4/97	6/4/97	7/4/97	8/4/97
00:00-01:00		26.3	22.6	26.3	18.8	22.6	27.5	18.8	16.6	16.6	23.0	19.6	50.4	48.2	16.2	28.6
01:00-02:00		15.1	16.9	15.8	15.4	14.7	24.8	12.4	10.9	9.0	18.1	18.4	50.4	48.5	10.5	41.0
02:00-03:00		12.4	14.3	12.4	16.9	13.5	35.4	10.9	9.4	8.3	15.4	19.6	49.3	52.7	9.4	20.7
03:00-04:00		10.2	9.4	12.8	8.7	12.4	34.2	7.5	10.5	10.9	21.8	19.6	42.1	62.8	6.8	12.0
04:00-05:00		9.4	10.9	10.2	14.3	23.0	24.5	7.5	11.3	9.4	16.6	19.6	39.9	76.0	10.2	21.8
05:00-06:00	Note 1	16.6	8.3	12.8	16.6	26.3	32.4	11.3	22.2	16.9	17.7	22.2	36.9	33.1	7.5	29.3
06:00-07:00		30.5	28.6	13.9	20.7	31.2	34.6	21.1	27.8	28.2	22.6	18.4	40.3	20.3	21.1	63.2
07:00-08:00		36.1	29.3	19.6	30.5	33.9	32.7	31.6	32.7	32.0	24.8	39.9	45.2	41.0	35.4	71.9
08:00-09:00		35.4	33.5	30.5	32.0	33.1	26.0	37.6	36.1	33.1	24.8	47.8	59.8	54.6	36.1	78.3
09:00-10:00		36.9	36.1	31.2	31.6	30.5	25.6	29.7	32.0	33.9	26.7	64.0	59.8	62.8	35.0	51.9
10:00-11:00		33.9	33.9	31.2	38.8	32.4	25.6	31.2	34.2	Note2	36.9	75.6	63.6	65.8	31.2	80.1
11:00-12:00	30.9	Note2	31.6	27.8	32.7	34.2	27.5	28.2	32.4	35.7	47.4	93.7	72.6	64.0	32.0	
12:00-13:00	35.4	38.0	27.8	32.4	30.5	29.7	24.1	33.5	32.0	35.7	26.3	45.2	74.1	56.8	35.4	
13:00-14:00	38.4	29.0	24.5	35.0	32.0	33.9	22.2	31.6	35.0	36.1	29.7	51.2	68.1	59.8	32.0	
14:00-15:00	42.1	39.9	31.6	45.5	35.4	39.9	30.5	30.5	41.8	31.2	28.2	59.8	114.4	61.3	36.1	
15:00-16:00	48.9	42.1	41.0	42.5	34.2	40.6	30.5	36.1	44.4	46.7	35.0	56.4	141.1	70.0	35.4	
16:00-17:00	50.0	44.8	33.9	48.2	40.3	39.1	33.5	39.9	45.2	44.0	28.6	55.3	139.6	51.2	41.4	
17:00-18:00	47.0	46.3	39.5	45.5	43.6	37.6	35.4	35.4	39.1	47.4	30.9	54.6	149.0	36.1	44.0	Note 3
18:00-19:00	45.5	45.9	40.6	38.8	47.4	39.5	36.5	35.4	38.4	44.4	32.0	57.6	78.6	31.2	43.6	
19:00-20:00	37.6	44.4	45.2	33.5	44.0	38.4	35.0	34.2	39.1	42.5	28.6	51.2	79.4	30.5	40.6	
20:00-21:00	40.3	34.2	44.0	29.7	43.3	37.3	36.5	26.0	24.5	37.3	26.0	50.0	60.2	27.8	28.6	
21:00-22:00	35.4	36.9	44.4	26.3	40.6	40.3	30.5	29.3	30.5	34.6	25.2	50.4	67.4	27.8	31.6	
22:00-23:00	38.4	37.6	26.3	26.0	38.8	29.7	25.6	27.1	24.1	30.1	24.5	50.4	62.8	25.2	29.3	
23:00-00:00	37.6	41.4	32.7	23.3	38.4	31.6	21.4	25.2	21.1	26.3	21.4	50.4	57.9	24.1	28.2	
Daily Average	40.6	32.3	29.5	28.0	31.1	31.1	29.7	26.3	28.8	30.0	26.3	45.5	71.0	47.2	28.2	45.4
Note:	1. Monitoring stated at 11:00															
	2. Performance check															
	3. Monitoring stopped at 11:00															
	4. The results are presented in the unit of ug/m3 and corrected to 298 K & 101.325 kpa															

Table F3.2

TSP & RSP Results for the Baseline Dust Monitoring				
Date	24 hour Average TSP value (ug/m3)	24 hour Average RSP value (ug/m3)	1 hour Average TSP value (ug/m3)	
			1 reading	2 reading
15/3/97	81.1	53.1	97.8	87.3
16/3/97	90.5	52.9	104.5	98.6
17/3/97	87.3	51.6	95.4	103.7
18/3/97	85.3	59.4	96.5	98.4
19/3/97	124.1	75.1	105.7	117.2
20/3/97	89.5	60.3	102.3	95.3
21/3/97	92.7	60.7	92.3	94.5
22/3/97	80.4	56.6	89.4	88.1
23/3/97	98.7	58.7	97.5	102.5
24/3/97	106.0	66.3	110.7	100.7
25/3/97	107.9	64.9	105.8	101.9
26/3/97	96.6	60.6	110.3	99.7
27/3/97	103.5	62.3	111.6	105.2
28/3/97	84.4	65.6	95.6	88.5



Noise and Air Measurement Locations

Mouchel

Figure No. **F1**

Cad File: C:\F90558\EIA\BASEMON\FIG-1

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