Chapter 5 AIR QUALITY ASSESSMENT

5.1 Introduction

5.1.1 The air quality assessment of the Strategic Environmental Assessment (SEA) was divided into two stages. The first stage evaluated the relative environmental merits of each scenario generated during the Initial Model Runs based on an emissions inventory which aggregated emissions across the SAR as a whole. The Stage I air quality assessment indicated that air quality is likely to deteriorate overtime due principally to increases in vehicle numbers and the current limitations of emission control technologies.

5.1.2 The second stage comprised of two levels of assessment. During the first level, all transport scenarios generated during the Main Model Runs are analysed on a district by district basis using an emissions inventory (hereafter refers to as Level 1 analysis) as described in Section 5.2. During the second level of the assessment, the Recommended Transport Strategies were analysed using a territory wide air quality model (PATH), as described in Section 5.3.

5.2 Emission Inventory

Methodology

5.2.1 Ninety-nine transport scenarios were generated by the CTS-3 traffic model during the Main Model Runs. A district-by-district emissions inventory of key pollutants [Oxides of Nitrogen (NO_x), Volatile Organic Compounds (VOC) and Respirable Suspended Particulates (RSP)] were calculated for each scenario based on the distance travelled by various vehicle classes [vehicle-kilometer-travelled (vkt) data provided by the transport model and adjusted to account for minor roads] and fleet average vehicle emission factors (EF) provided by the Environmental Protection Department.

$$\textit{Pollutant Emission (tons)} = \Sigma (vkt_{\textit{vehicle type}} \times EF_{\textit{vehicle type}})_{\textit{Districts}}$$

5.2.2 The emission factors used have taken account of planned measures to control vehicle emissions and are presented in Table 5.2a.

Table 5.2a
Fleet Average Vehicle Emission Factors (gkm^{-1}) used in Stage 2 Level 1 Air Quality Assessment

Year		M/C	P/C	Taxi	PV	PLB	LGV	HGV	NFB	FBSS	FBDD
Fuel		P	P	D →LPG	D	D	D	D	D	D	D
1997	NO_x	0.55	1.75	1.55	2.37	2.27	1.78	7.76	12.66	12.06	12.06
	VOC	11.93	1.01	0.36	0.74	0.72	0.70	2.22	2.39	2.33	2.33
	RSP	0.03	0.04	0.65	0.74	0.72	0.54	1.42	1.56	1.49	1.49
2001	NO_x	0.55	1.22	1.51	2.17	2.05	1.62	6.74	10.72	10.73	10.73
	VOC	11.62	0.66	0.29	0.63	0.60	0.62	2.05	2.19	2.21	2.21
	RSP	0.03	0.04	0.15	0.49	0.42	0.34	1.16	1.20	1.22	1.22
2006	NO_x	0.48	0.83	0.84	1.67	1.70	1.39	5.07	7.15	9.26	9.26
	VOC	8.29	0.43	0.43	0.48	0.48	0.55	1.64	1.62	1.98	1.98
	RSP	0.03	0.03	0.01	0.22	0.18	0.15	0.81	0.74	1.01	1.01
2011	NO_x	0.37	0.71	0.73	1.53	1.54	1.23	3.84	5.54	6.80	6.80
	VOC	4.77	0.41	0.40	0.45	0.45	0.52	1.32	1.27	1.53	1.53
	RSP	0.03	0.03	0.01	0.16	0.12	0.11	0.53	0.50	0.69	0.69
2016	NO_x	0.37	0.71	0.73	1.53	1.54	1.23	3.84	5.54	6.80	6.80
	VOC	4.77	0.41	0.40	0.45	0.45	0.52	1.32	1.27	1.53	1.53
	RSP	0.03	0.03	0.01	0.16	0.12	0.11	0.53	0.50	0.69	0.69

Notes on Fleet Average Emission Factors:

Abbreviations:

M/C = Motorcycle
P/C = Private Car
Taxi = Taxi
PV = Passenger Van
PLB = Public Light Bus
LGV = Light Goods Vehicle
HGV = Heavy Goods Vehicle
NFB = Non-Franchised Bus
FBSD = Franchised Bus Single Decker
FBDD = Franchised Bus Double Decker

NO_x = Oxides of Nitrogen
VOC = Volatile Organic Compounds
RSP = Respirable Suspended Particulates
LPG = Liquefied Petroleum Gas
D = Diesel
P = Petrol

Assumptions:

- LPG taxi starts from 2001, 100% by end of 2005.
- Euro III emission standards start from 2001
- Due to lack of 2016 emission factors, 2011 emission factors are assumed to prevail.

5.2.3 Apart from emissions from vehicle engines via the exhaust (hereafter refers to as tailpipe), particulate emissions also occur whenever vehicle travels over a paved surface. A USEPA method was used for the estimation of the paved road dust (prd) emissions and this involves two key variables:

- road surface silt loading value
- average vehicle weight

5.2.4 A silt loading value of 0.02 gm^{-2} was assumed and is considered the best estimate of roads with high traffic volume. The quantity of dust emissions from vehicle traffic on a paved road may be estimated using the following expression[1]:

$$E = k * (sL/2)^{0.65} * (W/3)^{1.5}$$

[1] USEPA AP-42 5th Edition

where
E = particulate emission factor (gkm^{-1})
k = base emission factor for particle size range (where k = 4.6 for PM_{10})
sL = road surface silt loading (gm^{-2})
W = average weight (tons) of vehicles travelling the road

5.2.5 To obtain representative average weight (W) for vehicles travelling, a vkt-weighted average weight was calculated for each scenario ie

$$Average\ Vehicle\ Weight\ (W)\ for\ Scenario\ X = \Sigma(Weight_{vehicle\ type} \times vkt_{vehicle\ type})/\Sigma(vkt_{vehicle\ type})$$

5.2.6 A paved road dust (prd) emission factor (E) was estimated for each scenario. This factor is used to calculate the prd in each district from road transport. The paved road dust emissions calculated by this method represents the overall prd emissions and cannot estimate the contribution by each vehicle type.

5.2.7 The emissions of NO_x, VOC, RSP (tailpipe and prd) for each of the 18 districts (approximate to HKSAR District Boards boundaries as shown in Figure 5.2a) under different transport scenarios generated by the main transport model were compared against the corresponding emissions for the base year (1997) to assess whether there is a net benefit or a negative impact.

5.2.8 In order to compare the relative merits of each scenario for analysis by the main traffic study, a composite measure of the changes to the total inventories (ie sum of emissions from 18 districts) of NO_x, VOC, RSP (tailpipe and prd) relative to the base year is used as shown in Table 5.2b.

Table 5.2b
Composite Air Score (Sample Calculations)

Base Year = *X* tons NO_x, *Y* tons VOC, *Z* tons RSP (tailpipe + prd)
Scenario A = 1.2*X* tons NO_x, 1.2*Y* tons VOC, 0.8*Z* tons RSP (tailpipe + prd) Composite Air Score = (1.2 + 1.2 + 0.8)/3 = 1.07
Scenario B = 0.8*X* tons NO_x, 1.4*Y* tons VOC, 0.6*Z* tons RSP (tailpipe + prd) Composite Air Score = (0.8 + 1.4 + 0.6)/3 = 0.93

5.2.9 Based on the above example, the 1997 inventory would receive an air score of 1 and Scenarios A and B would receive air scores of 1.07 and 0.93 respectively. Hence, it could reasonably be assumed that Scenario B would create a general improvement in air quality relative to 1997 levels (as indicated in Section 3), whereas Scenario A would result in further deterioration. A summary of the total pollutant emissions and the composite air scores is discussed in Table 5.2h.

5.2.10 In employing this approach, no attempt has been made to weigh the relative health impacts of the three indicator pollutants. This factor is accounted for in the analysis made using the PATH model by comparing the prediction against Air Quality Objectives.

Results

5.2.11 Tables 5.2c-5.2g present a summary of the vkt and pollutant emissions for each district under different transport scenarios generated by the CTS-3 transport model.

5.2.12 Table 5.2h summarises the total pollutant emissions for each scenario and the associated composite air score. The detailed results for each distirct are shown in the spreadsheets enclosed in Appendix A.

5.2.13 In order to assist the interpretation of the analysis, the contributions to the total vkt and pollutant emissions from each vehicle type for 1997 and the base case in each design year are shown in Figures 5.2b to 5.2f. The base case for each design year consists of the High Fleet infrastructure provision for the respective design years as indicated in Tables 4.5a and 4.5b. The Run Nos. for the base cases are 2001 (Run No 48); 2006 (Run No 95); 2011 (Run No 69) and 2016 (Run No 18). Tables 5.2i to 5.21 presents these results and shows the ranking by vehicle type with 1 being the highest contribution and 10 being the least contribution. (See Para 5.2.1 for a list of the abbreviations used.)

Table 5.2i
Contribution of vkt by Vehicle Types

	1997	2001	2006	2011	2016
M/C	6=	5	5	5	5
P/C	1	1	1	1	1
Taxi	3	3	3	4	4
PV	8	8	8	8	8
PLB	5	7	7	7	7
LGV	2	2	2	2	2
HGV	4	4	4	3	3
NFB	9	9	9	9	9
FBSD	10	10	10	10	10
FBDD	6=	6	6	6	6
Note: 6= means equal contribution					

Table 5.2j
Contribution of NO_x by Vehicle Types

	1997	2001	2006	2011	2016
M/C	10	10	10	9	9
P/C	2	2	2	2	2
Taxi	5	5	5	5	5
PV	8	8	8	8	8
PLB	7	7	7	7	7
LGV	3	3	3	3	3
HGV	1	1	1	1	1
NFB	6	6	6	6	6
FBSD	9	9	9	10	10
FBDD	4	4	4	4	4

Table 5.2c - Summary of vkt Relative to 1997

Summary of Scenarios by Districts (vkt)

% vkt relative to 1997

2001 & 2006

District	1997 vkt	01/39 vkt	01/40 vkt	01/41 vkt	01/43 vkt	01/47 vkt	01/48 vkt	06/49 vkt	06/50 vkt	06/52 vkt	06/54 vkt	06/58 vkt	06/75 vkt	06/76 vkt	06/77 vkt	06/78 vkt	06/80 vkt	06/81 vkt	06/82 vkt	06/83 vkt	06/84 vkt	06/85 vkt	06/86 vkt	06/89 vkt	06/91 vkt	06/92 vkt	06/94 vkt	06/95 vkt	06/97 vkt	06/98 vkt	06/102 vkt	06/106 vkt	06/107 vkt
Central & Western	483609670	149%	167%	171%	150%	145%	149%	201%	192%	196%	189%	193%	172%	194%	196%	193%	194%	197%	194%	194%	193%	193%	175%	194%	176%	183%	176%	161%	147%	194%	176%	188%	178%
Wan Chai	447897340	104%	100%	99%	104%	104%	101%	119%	114%	116%	113%	116%	115%	114%	115%	115%	114%	115%	114%	116%	116%	114%	117%	114%	118%	111%	116%	117%	111%	114%	119%	113%	109%
Eastern	538022775	107%	104%	103%	106%	105%	105%	123%	118%	121%	116%	121%	121%	123%	123%	123%	119%	124%	122%	123%	124%	123%	120%	122%	124%	115%	123%	125%	117%	122%	121%	125%	119%
Southern	371909450	101%	101%	100%	101%	103%	101%	118%	113%	117%	113%	117%	117%	108%	109%	109%	109%	109%	109%	109%	109%	109%	119%	109%	119%	115%	118%	120%	110%	109%	121%	111%	105%
Yau Tsim Mong	566546795	108%	105%	101%	107%	114%	102%	130%	125%	127%	122%	135%	137%	139%	133%	139%	140%	133%	140%	139%	140%	136%	132%	139%	132%	125%	131%	131%	123%	139%	130%	133%	128%
Sham Shui Po	636063235	138%	138%	138%	136%	125%	126%	147%	142%	144%	137%	148%	152%	155%	154%	154%	154%	155%	154%	153%	152%	153%	154%	153%	154%	145%	153%	151%	138%	153%	149%	153%	143%
Kowloon City	697816855	104%	102%	101%	105%	105%	99%	122%	116%	119%	115%	124%	118%	119%	123%	120%	120%	119%	120%	120%	121%	119%	122%	119%	122%	116%	123%	124%	115%	120%	122%	119%	112%
Kwun Tong	818713250	105%	94%	92%	104%	107%	117%	122%	116%	119%	114%	116%	123%	125%	124%	125%	125%	123%	125%	126%	127%	127%	126%	125%	125%	110%	125%	124%	113%	125%	126%	127%	120%
Wong Tai Sin	349696645	102%	101%	100%	102%	103%	103%	109%	106%	108%	104%	100%	106%	108%	110%	108%	107%	114%	107%	108%	109%	109%	118%	107%	111%	104%	109%	108%	101%	107%	120%	103%	98%
Kwai Tsing	1416652965	82%	84%	83%	83%	87%	86%	115%	108%	112%	106%	116%	116%	116%	114%	113%	116%	115%	120%	118%	109%	116%	107%	117%	117%	111%	114%	113%	103%	115%	104%	114%	107%
Tuen Mun	983734495	105%	111%	111%	106%	107%	110%	122%	118%	121%	116%	136%	142%	144%	142%	143%	143%	141%	141%	130%	141%	141%	128%	141%	126%	125%	126%	129%	116%	143%	124%	149%	142%
Island	160018920	496%	497%	501%	493%	389%	403%	599%	578%	587%	568%	633%	642%	643%	639%	634%	642%	640%	642%	620%	641%	641%	611%	641%	621%	600%	620%	535%	491%	643%	496%	550%	524%
Yuen Long	480739310	235%	226%	227%	234%	240%	226%	315%	303%	310%	292%	319%	312%	315%	315%	316%	314%	316%	322%	331%	323%	316%	336%	316%	331%	308%	331%	327%	292%	315%	316%	308%	291%
Tai Po	769753975	72%	72%	71%	71%	74%	71%	104%	98%	100%	94%	98%	96%	98%	99%	100%	98%	99%	99%	104%	93%	99%	104%	98%	105%	100%	103%	102%	89%	97%	88%	95%	88%
North	212119750	217%	222%	218%	217%	238%	233%	227%	222%	222%	211%	216%	214%	220%	224%	225%	223%	222%	222%	229%	217%	223%	240%	219%	235%	225%	233%	230%	194%	220%	297%	219%	202%
Sha Tin	1397430970	103%	103%	102%	102%	101%	99%	116%	109%	113%	106%	111%	112%	114%	114%	114%	113%	115%	113%	116%	113%	114%	118%	113%	116%	110%	116%	116%	104%	113%	118%	112%	104%
Sai Kung	132554495	168%	166%	168%	167%	169%	171%	283%	265%	276%	260%	273%	277%	281%	292%	281%	280%	277%	280%	281%	287%	240%	241%	282%	290%	271%	289%	309%	269%	281%	228%	300%	277%
Tsuen Wan	348636320	215%	214%	218%	212%	218%	203%	242%	246%	249%	235%	240%	253%	252%	252%	259%	251%	248%	241%	258%	253%	251%	264%	249%	251%	243%	255%	242%	216%	252%	256%	246%	229%
1997 total	**10811917215**																																
% 1997 (total)		**121%**	**121%**	**121%**	**121%**	**121%**	**119%**	**147%**	**141%**	**145%**	**138%**	**147%**	**148%**	**150%**	**150%**	**150%**	**149%**	**149%**	**150%**	**150%**	**149%**	**149%**	**148%**	**149%**	**149%**	**142%**	**149%**	**147%**	**133%**	**149%**	**144%**	**147%**	**139%**

2011

District	1997 vkt	11/41 vkt	11/42 vkt	11/43 vkt	11/44 vkt	11/55 vkt	11/69 vkt	11/69p vkt	11/71 vkt	11/74 vkt	11/75 vkt	11/76 vkt	11/77 vkt	11/78 vkt	11/79 vkt	11/80 vkt	11/81 vkt	11/82 vkt	11/83 vkt	11/84 vkt	11/87 vkt	11/88 vkt	11/89 vkt	11/90 vkt	11/93 vkt	11/97 vkt	11/103 vkt	11/104 vkt	11/105 vkt	11/106 vkt	11/107 vkt
Central & Western	483609670	306%	279%	261%	291%	317%	227%	227%	186%	351%	366%	343%	325%	350%	352%	355%	351%	356%	243%	367%	349%	355%	353%	353%	228%	251%	231%	366%	320%	350%	350%
Wan Chai	447897340	143%	132%	128%	139%	143%	140%	139%	123%	133%	131%	133%	135%	133%	132%	132%	132%	133%	128%	132%	134%	133%	133%	133%	140%	137%	141%	130%	119%	133%	133%
Eastern	538022775	136%	125%	121%	132%	139%	139%	139%	120%	154%	152%	154%	140%	154%	153%	154%	155%	155%	151%	153%	155%	155%	154%	154%	140%	134%	140%	154%	139%	152%	154%
Southern	371909450	124%	115%	109%	121%	127%	127%	127%	107%	131%	132%	132%	146%	132%	132%	131%	131%	132%	128%	130%	132%	133%	132%	131%	127%	148%	129%	130%	116%	130%	131%
Yau Tsim Mong	566546795	142%	131%	127%	138%	142%	150%	151%	133%	154%	151%	156%	154%	153%	153%	153%	154%	158%	159%	149%	153%	154%	153%	153%	152%	149%	152%	145%	133%	153%	154%
Sham Shui Po	636063235	163%	147%	140%	156%	166%	171%	170%	144%	165%	165%	166%	168%	166%	165%	167%	166%	171%	180%	165%	166%	165%	166%	164%	172%	172%	177%	164%	149%	164%	165%
Kowloon City	697816855	171%	155%	149%	166%	174%	175%	175%	153%	144%	142%	145%	145%	145%	144%	145%	142%	142%	147%	140%	143%	144%	143%	143%	175%	138%	179%	139%	125%	145%	144%
Kwun Tong	818713250	156%	138%	131%	151%	158%	162%	162%	133%	159%	153%	160%	160%	159%	158%	155%	159%	137%	166%	159%	159%	159%	159%	159%	163%	146%	165%	169%	129%	161%	159%
Wong Tai Sin	349696645	114%	105%	101%	110%	113%	115%	113%	100%	114%	112%	115%	115%	113%	113%	113%	113%	117%	116%	113%	114%	114%	113%	114%	113%	134%	115%	110%	104%	110%	114%
Kwai Tsing	1416652965	128%	117%	112%	126%	130%	128%	128%	112%	122%	123%	122%	123%	120%	122%	124%	122%	128%	131%	123%	122%	122%	122%	123%	129%	119%	133%	122%	110%	121%	121%
Tuen Mun	983734495	166%	152%	145%	159%	165%	172%	172%	147%	174%	179%	175%	174%	177%	176%	180%	175%	181%	176%	179%	175%	175%	175%	175%	175%	133%	186%	190%	171%	187%	175%
Island	160018920	945%	891%	853%	915%	957%	855%	855%	773%	924%	927%	923%	919%	898%	929%	932%	944%	933%	864%	926%	928%	928%	930%	928%	862%	719%	868%	922%	842%	916%	926%
Yuen Long	480739310	402%	359%	336%	377%	418%	404%	404%	336%	395%	387%	398%	395%	396%	390%	365%	393%	369%	423%	387%	393%	392%	393%	393%	405%	356%	450%	390%	318%	374%	390%
Tai Po	769753975	143%	125%	115%	133%	145%	141%	141%	108%	116%	118%	118%	118%	117%	118%	111%	117%	110%	123%	117%	117%	116%	118%	117%	141%	102%	147%	115%	91%	115%	118%
North	212119750	217%	200%	190%	205%	218%	225%	225%	188%	230%	231%	232%	231%	229%	230%	263%	230%	248%	234%	230%	230%	231%	232%	230%	223%	341%	232%	229%	212%	216%	232%
Sha Tin	1397430970	135%	118%	111%	128%	136%	136%	136%	110%	132%	132%	132%	132%	132%	132%	128%	132%	131%	135%	132%	132%	132%	133%	132%	136%	133%	140%	130%	109%	130%	132%
Sai Kung	132554495	454%	390%	363%	427%	463%	496%	499%	373%	445%	444%	444%	441%	443%	444%	429%	442%	403%	452%	442%	445%	444%	447%	443%	498%	290%	507%	455%	337%	452%	442%
Tsuen Wan	348636320	260%	238%	223%	239%	252%	262%	260%	224%	248%	251%	255%	255%	254%	247%	254%	255%	263%	274%	245%	253%	253%	254%	249%	266%	291%	267%	245%	224%	243%	252%
1997 total	**10811917215**																														
% 1997 (total)		**184%**	**166%**	**158%**	**176%**	**186%**	**182%**	**182%**	**153%**	**183%**	**183%**	**183%**	**182%**	**182%**	**183%**	**182%**	**183%**	**182%**	**183%**	**183%**	**183%**	**183%**	**183%**	**183%**	**183%**	**169%**	**189%**	**184%**	**160%**	**182%**	**183%**

2016

District	1997 vkt	16/07 vkt	16/08 vkt	16/10 vkt	16/12 vkt	16/18 vkt	16/19 vkt	16/21 vkt	16/23 vkt	16/35 vkt	16/36 vkt	16/37 vkt	16/38 vkt	16/39 vkt	16/40 vkt	16/41 vkt	16/42 vkt	16/43 vkt	16/44 vkt	16/45 vkt	16/46 vkt	16/47 vkt	16/48 vkt	16/49 vkt	16/50 vkt	16/51 vkt	16/52 vkt	16/53 vkt	16/54 vkt	16/55 vkt	16/64 vkt	16/75 vkt	16/82 vkt	16/83 vkt	16/84 vkt	16/86 vkt	16/89 vkt	16/90 vkt
Central & Western	483609670	391%	340%	316%	365%	387%	298%	348%	410%	359%	389%	362%	379%	375%	376%	376%	265%	377%	406%	370%	376%	374%	380%	376%	379%	378%	378%	377%	377%	381%	289%	395%	388%	419%	334%	269%	409%	409%
Wan Chai	447897340	161%	141%	136%	154%	158%	130%	139%	162%	143%	140%	150%	154%	150%	152%	151%	148%	159%	151%	151%	151%	150%	154%	151%	153%	152%	151%	150%	151%	151%	148%	159%	148%	155%	139%	105%	139%	139%
Eastern	538022775	143%	124%	119%	137%	147%	120%	130%	154%	170%	166%	183%	185%	176%	177%	175%	174%	149%	178%	178%	176%	175%	178%	178%	177%	178%	179%	176%	177%	175%	140%	149%	179%	190%	131%	120%	186%	186%
Southern	371909450	171%	146%	133%	156%	176%	127%	152%	186%	154%	158%	159%	146%	163%	163%	162%	158%	167%	164%	162%	163%	162%	168%	162%	163%	163%	162%	163%	162%	163%	167%	178%	163%	170%	127%	100%	163%	163%
Yau Tsim Mong	566546795	163%	138%	135%	153%	169%	137%	153%	177%	160%	160%	162%	161%	161%	165%	162%	167%	161%	166%	166%	160%	163%	164%	160%	165%	165%	163%	160%	159%	158%	160%	170%	148%	163%	129%	121%	171%	171%
Sham Shui Po	636063235	181%	158%	144%	169%	188%	146%	168%	200%	177%	180%	177%	176%	176%	179%	178%	189%	178%	185%	179%	175%	177%	178%	177%	178%	180%	178%	176%	174%	172%	185%	192%	171%	189%	148%	132%	180%	180%
Kowloon City	697816855	188%	163%	155%	181%	193%	157%	167%	206%	181%	181%	187%	186%	190%	190%	188%	192%	187%	190%	189%	186%	187%	189%	186%	191%	190%	188%	184%	185%	197%	150%	195%	200%	215%	160%	105%	156%	156%
Kwun Tong	818713250	182%	152%	141%	172%	188%	145%	153%	203%	183%	181%	188%	188%	189%	192%	188%	197%	190%	182%	191%	189%	188%	189%	189%	188%	189%	189%	188%	190%	183%	157%	189%	190%	203%	150%	116%	184%	184%
Wong Tai Sin	349696645	122%	109%	103%	118%	123%	103%	108%	126%	212%	211%	215%	214%	215%	207%	215%	233%	219%	121%	213%	216%	213%	215%	215%	215%	214%	215%	215%	218%	188%	143%	124%	190%	199%	105%	92%	205%	205%
Kwai Tsing	1416652965	147%	128%	119%	137%	142%	114%	130%	155%	180%	194%	181%	181%	181%	174%	180%	203%	182%	140%	180%	181%	180%	182%	179%	182%	184%	181%	180%	181%	174%	127%	145%	175%	195%	114%	102%	181%	181%
Tuen Mun	983734495	184%	169%	159%	181%	205%	175%	192%	207%	205%	212%	200%	202%	195%	204%	210%	213%	198%	194%	197%	199%	198%	200%	199%	200%	199%	201%	197%	198%	198%	137%	220%	206%	219%	180%	165%	206%	206%
Island	160018920	1065%	993%	941%	1024%	676%	590%	652%	828%	1034%	1250%	1030%	1018%	1052%	1035%	1008%	914%	1042%	1117%	1063%	1018%	1036%	1032%	1049%	1034%	1041%	1052%	1055%	1034%	1035%	841%	681%	975%	1164%	887%	812%	1062%	1062%
Yuen Long	480739310	480%	424%	400%	462%	496%	402%	446%	547%	605%	591%	570%	568%	569%	541%	544%	578%	571%	593%	550%	565%	572%	566%	564%	568%	570%	574%	563%	567%	565%	382%	527%	559%	654%	459%	305%	565%	565%
Tai Po	769753975	180%	148%	131%	163%	172%	124%	147%	208%	158%	139%	137%	137%	136%	148%	138%	143%	138%	146%	138%	138%	137%	138%	136%	138%	138%	138%	137%	138%	140%	104%	178%	140%	168%	117%	82%	134%	134%
North	212119750	307%	275%	245%	281%	317%	242%	289%	425%	441%	320%	315%	314%	318%	315%	317%	320%	317%	323%	319%	321%	316%	317%	316%	316%	318%	317%	316%	321%	319%	384%	327%	320%	426%	254%	205%	314%	314%
Sha Tin	1397430970	162%	131%	120%	149%	161%	120%	136%	199%	148%	142%	142%	142%	142%	153%	143%	146%	143%	148%	143%	143%	142%	143%	141%	143%	144%	143%	143%	142%	144%	142%	165%	145%	176%	119%	96%	142%	142%
Sai Kung	132554495	554%	434%	389%	505%	602%	421%	489%	691%	594%	587%	598%	596%	600%	609%	594%	610%	601%	598%	598%	601%	599%	596%	595%	596%	601%	600%	598%	597%	586%	308%	612%	591%	677%	445%	275%	556%	556%
Tsuen Wan	348636320	283%	255%	236%	274%	285%	232%	254%	301%	263%	265%	257%	258%	253%	271%	263%	284%	259%	274%	261%	259%	261%	255%	260%	257%	257%	262%	256%	255%	259%	299%	296%	247%	274%	229%	206%	260%	260%
1997 total	**10811917215**																																					
% 1997 (total)		**215%**	**186%**	**174%**	**203%**	**213%**	**169%**	**189%**	**236%**	**226%**	**228%**	**222%**	**222%**	**222%**	**224%**	**222%**	**224%**	**222%**	**219%**	**222%**	**222%**	**222%**	**223%**	**221%**	**223%**	**224%**	**224%**	**221%**	**222%**	**220%**	**183%**	**219%**	**220%**	**248%**	**179%**	**145%**	**222%**	**222%**

Table 5.2d - Summary of NOx Relative to 1997

Summary of Scenarios by Districts (NOx)
% NOx relative to 1997

2001 & 2006

District	1997 NOx (tons)	01/39 NOx	01/40 NOx	01/41 NOx	01/43 NOx	01/47 NOx	01/48 NOx	06/49 NOx	06/50 NOx	06/52 NOx	06/54 NOx	06/58 NOx	06/75 NOx	06/76 NOx	06/77 NOx	06/78 NOx	06/80 NOx	06/81 NOx	06/82 NOx	06/83 NOx	06/84 NOx	06/85 NOx	06/86 NOx	06/89 NOx	06/91 NOx	06/92 NOx	06/94 NOx	06/95 NOx	06/97 NOx	06/98 NOx	06/102 NOx	06/106 NOx	06/107 NOx
Central & Western	1249	118%	132%	135%	119%	117%	123%	115%	112%	111%	110%	111%	103%	114%	116%	113%	114%	116%	114%	114%	113%	114%	104%	114%	105%	111%	105%	88%	83%	114%	93%	102%	98%
Wan Chai	1073	85%	82%	82%	84%	86%	83%	68%	66%	66%	65%	66%	66%	65%	66%	66%	65%	66%	65%	66%	66%	65%	67%	65%	67%	65%	66%	67%	65%	65%	67%	64%	63%
Eastern	1261	89%	87%	87%	88%	88%	87%	71%	69%	69%	68%	70%	70%	71%	71%	71%	69%	71%	70%	70%	71%	71%	69%	70%	71%	68%	70%	71%	68%	70%	70%	71%	69%
Southern	965	79%	79%	79%	79%	83%	82%	65%	64%	64%	63%	65%	65%	62%	62%	62%	62%	62%	62%	62%	62%	62%	66%	62%	67%	66%	66%	67%	63%	62%	66%	64%	61%
Yau Tsim Mong	1528	90%	88%	86%	89%	97%	88%	79%	78%	77%	76%	82%	83%	83%	81%	84%	84%	80%	84%	83%	84%	82%	79%	84%	80%	78%	80%	79%	76%	84%	78%	81%	80%
Sham Shui Po	1819	116%	116%	116%	114%	107%	107%	89%	87%	85%	84%	88%	90%	92%	92%	92%	91%	92%	91%	91%	91%	91%	91%	91%	91%	88%	91%	90%	85%	91%	89%	91%	87%
Kowloon City	1703	87%	85%	84%	87%	89%	84%	74%	72%	71%	70%	74%	71%	71%	74%	72%	71%	71%	71%	71%	72%	71%	72%	71%	73%	71%	74%	74%	70%	71%	72%	71%	67%
Kwun Tong	2069	88%	80%	79%	88%	91%	97%	73%	71%	71%	70%	69%	74%	74%	74%	74%	74%	74%	74%	74%	75%	76%	75%	74%	74%	68%	73%	73%	69%	74%	75%	74%	72%
Wong Tai Sin	912	86%	85%	85%	86%	88%	88%	66%	65%	65%	64%	60%	63%	64%	67%	65%	64%	69%	64%	64%	65%	65%	71%	64%	67%	64%	65%	66%	63%	64%	72%	61%	59%
Kwai Tsing	4587	69%	70%	69%	70%	74%	73%	70%	67%	67%	66%	70%	69%	69%	68%	67%	69%	68%	71%	70%	66%	69%	64%	70%	69%	68%	69%	69%	64%	69%	64%	68%	65%
Tuen Mun	3397	91%	95%	95%	91%	92%	95%	77%	76%	75%	76%	90%	92%	93%	92%	93%	93%	93%	91%	84%	92%	92%	81%	91%	81%	83%	80%	82%	79%	93%	76%	95%	94%
Island	472	361%	361%	363%	359%	294%	300%	377%	372%	366%	362%	389%	382%	380%	379%	377%	379%	379%	380%	379%	379%	379%	376%	380%	379%	375%	380%	347%	310%	379%	322%	347%	334%
Yuen Long	1659	217%	210%	211%	218%	226%	218%	222%	220%	217%	212%	231%	224%	227%	227%	226%	227%	227%	230%	236%	233%	227%	242%	226%	236%	228%	240%	233%	211%	225%	223%	220%	213%
Tai Po	2357	58%	58%	57%	57%	59%	56%	62%	61%	60%	58%	58%	57%	58%	59%	60%	58%	58%	59%	62%	53%	58%	61%	58%	63%	62%	60%	60%	53%	57%	51%	55%	53%
North	725	198%	204%	203%	196%	217%	210%	170%	170%	167%	162%	162%	160%	163%	165%	166%	165%	164%	164%	167%	159%	165%	173%	162%	172%	169%	169%	168%	143%	163%	207%	162%	157%
Sha Tin	4000	82%	82%	81%	80%	81%	79%	66%	65%	64%	62%	63%	64%	64%	65%	65%	64%	65%	64%	66%	63%	65%	67%	64%	67%	65%	65%	65%	59%	64%	66%	63%	60%
Sai Kung	329	139%	139%	140%	139%	140%	141%	159%	153%	153%	147%	155%	157%	159%	162%	159%	158%	156%	159%	159%	162%	136%	138%	159%	161%	155%	161%	173%	156%	159%	128%	169%	159%
Tsuen Wan	1257	172%	170%	174%	170%	175%	167%	137%	141%	138%	137%	136%	143%	143%	143%	146%	142%	142%	137%	146%	144%	143%	148%	143%	142%	142%	144%	137%	130%	144%	142%	140%	134%
1997 total	**31360**																																
% 1997 (total)		**102%**	**102%**	**102%**	**102%**	**104%**	**102%**	**92%**	**90%**	**89%**	**88%**	**92%**	**92%**	**93%**	**93%**	**93%**	**93%**	**93%**	**93%**	**93%**	**93%**	**93%**	**93%**	**93%**	**93%**	**93%**	**91%**	**92%**	**91%**	**84%**	**93%**	**89%**	**91%**	**88%**

2011

District	NOx (tons)	11/41 NOx	11/42 NOx	11/43 NOx	11/44 NOx	11/55 NOx	11/69 NOx	11/69p NOx	11/71 NOx	11/74 NOx	11/75 NOx	11/76 NOx	11/77 NOx	11/78 NOx	11/79 NOx	11/80 NOx	11/81 NOx	11/82 NOx	11/83 NOx	11/84 NOx	11/87 NOx	11/88 NOx	11/89 NOx	11/90 NOx	11/93 NOx	11/97 NOx	11/103 NOx	11/104 NOx	11/105 NOx	11/106 NOx	11/107 NOx
Central & Western	1249	140%	132%	120%	129%	145%	97%	97%	81%	157%	164%	153%	144%	156%	157%	159%	157%	159%	104%	164%	156%	160%	158%	158%	97%	112%	98%	164%	149%	156%	156%
Wan Chai	1073	67%	64%	61%	64%	66%	65%	64%	58%	62%	62%	62%	63%	62%	62%	62%	62%	63%	60%	62%	63%	63%	62%	62%	65%	63%	65%	62%	57%	63%	63%
Eastern	1261	64%	61%	58%	61%	65%	65%	65%	57%	72%	71%	71%	66%	72%	71%	72%	72%	72%	70%	71%	72%	72%	72%	72%	65%	63%	65%	71%	66%	71%	72%
Southern	965	57%	55%	52%	55%	58%	59%	59%	51%	61%	61%	61%	66%	61%	61%	61%	61%	61%	59%	60%	61%	62%	61%	61%	58%	64%	59%	60%	55%	60%	61%
Yau Tsim Mong	1528	69%	67%	64%	66%	69%	72%	72%	66%	73%	72%	74%	73%	73%	73%	73%	73%	75%	76%	71%	73%	73%	73%	73%	73%	71%	73%	70%	66%	72%	73%
Sham Shui Po	1819	79%	75%	70%	75%	80%	83%	82%	72%	79%	79%	80%	81%	80%	79%	80%	80%	82%	87%	79%	80%	79%	80%	79%	82%	84%	85%	79%	74%	79%	79%
Kowloon City	1703	80%	76%	71%	76%	81%	81%	81%	72%	68%	67%	69%	68%	68%	68%	68%	67%	67%	70%	66%	67%	68%	68%	68%	81%	66%	83%	65%	61%	68%	68%
Kwun Tong	2069	73%	68%	63%	69%	73%	74%	74%	63%	73%	71%	73%	74%	73%	73%	71%	73%	64%	77%	73%	73%	73%	73%	73%	74%	69%	75%	77%	61%	74%	73%
Wong Tai Sin	912	54%	52%	49%	51%	53%	55%	54%	49%	53%	53%	54%	54%	53%	53%	53%	53%	55%	55%	53%	54%	54%	53%	54%	54%	65%	55%	51%	50%	52%	54%
Kwai Tsing	4587	63%	61%	58%	61%	64%	63%	63%	57%	60%	61%	60%	62%	59%	61%	62%	61%	63%	64%	61%	60%	60%	60%	61%	63%	61%	65%	61%	56%	60%	60%
Tuen Mun	3397	88%	87%	82%	84%	87%	91%	91%	83%	92%	94%	92%	92%	93%	93%	95%	92%	95%	94%	94%	92%	92%	92%	92%	92%	68%	98%	103%	99%	101%	93%
Island	472	507%	499%	467%	479%	511%	473%	473%	427%	498%	499%	499%	498%	489%	499%	502%	505%	502%	479%	497%	499%	500%	501%	500%	477%	438%	483%	500%	461%	489%	499%
Yuen Long	1659	214%	204%	191%	201%	227%	220%	220%	199%	215%	212%	216%	216%	216%	213%	203%	215%	205%	227%	211%	215%	213%	214%	214%	221%	200%	249%	213%	186%	194%	213%
Tai Po	2357	62%	58%	52%	56%	62%	61%	61%	49%	51%	52%	52%	52%	51%	52%	49%	51%	48%	54%	51%	51%	51%	52%	51%	61%	46%	64%	51%	41%	49%	51%
North	725	120%	118%	112%	115%	119%	123%	123%	111%	125%	126%	127%	126%	125%	126%	139%	126%	133%	128%	126%	126%	126%	126%	126%	122%	178%	129%	125%	123%	111%	126%
Sha Tin	4000	59%	55%	51%	54%	59%	59%	59%	50%	57%	57%	57%	58%	57%	57%	55%	57%	56%	59%	57%	57%	57%	58%	57%	59%	59%	61%	56%	49%	56%	58%
Sai Kung	329	205%	187%	170%	187%	207%	222%	223%	175%	205%	205%	205%	204%	205%	206%	197%	204%	180%	210%	204%	205%	205%	207%	205%	223%	135%	230%	210%	155%	206%	204%
Tsuen Wan	1257	114%	112%	103%	104%	111%	117%	116%	106%	112%	114%	114%	114%	114%	111%	115%	114%	118%	122%	111%	114%	114%	114%	113%	117%	130%	118%	111%	106%	109%	114%
1997 total	**31360**																														
% 1997 (total)		**90%**	**87%**	**81%**	**85%**	**91%**	**89%**	**89%**	**79%**	**90%**	**90%**	**90%**	**90%**	**90%**	**90%**	**89%**	**90%**	**89%**	**90%**	**90%**	**90%**	**90%**	**90%**	**90%**	**90%**	**85%**	**93%**	**91%**	**82%**	**88%**	**90%**

2016

District	NOx (tons)	16/07 NOx	16/08 NOx	16/10 NOx	16/12 NOx	16/18 NOx	16/19 NOx	16/21 NOx	16/23 NOx	16/35 NOx	16/36 NOx	16/37 NOx	16/38 NOx	16/39 NOx	16/40 NOx	16/41 NOx	16/42 NOx	16/43 NOx	16/44 NOx	16/45 NOx	16/46 NOx	16/47 NOx	16/48 NOx	16/49 NOx	16/50 NOx	16/51 NOx	16/52 NOx	16/53 NOx	16/54 NOx	16/55 NOx	16/64 NOx	16/75 NOx	16/82 NOx	16/83 NOx	16/84 NOx	16/86 NOx	16/89 NOx	16/90 NOx
Central & Western	1249	184%	170%	152%	165%	176%	137%	165%	182%	157%	167%	157%	165%	164%	164%	165%	110%	164%	180%	167%	164%	163%	166%	164%	165%	164%	165%	165%	165%	167%	129%	179%	172%	179%	155%	126%	174%	174%
Wan Chai	1073	74%	68%	64%	68%	72%	61%	67%	72%	65%	64%	68%	70%	69%	69%	69%	67%	72%	69%	69%	69%	69%	70%	69%	70%	69%	69%	69%	69%	69%	69%	72%	68%	70%	66%	52%	64%	64%
Eastern	1261	66%	60%	56%	61%	67%	57%	63%	69%	77%	76%	85%	84%	80%	80%	80%	78%	68%	82%	82%	80%	80%	81%	81%	80%	81%	81%	80%	81%	80%	65%	68%	82%	86%	62%	58%	83%	83%
Southern	965	74%	68%	60%	66%	76%	58%	70%	80%	68%	70%	70%	65%	72%	72%	72%	70%	73%	72%	71%	72%	72%	75%	71%	72%	72%	71%	72%	72%	72%	72%	77%	72%	74%	60%	50%	72%	72%
Yau Tsim Mong	1528	76%	70%	66%	70%	78%	67%	76%	80%	74%	74%	75%	74%	74%	76%	75%	77%	74%	77%	76%	74%	75%	75%	74%	76%	76%	75%	74%	73%	72%	77%	78%	69%	73%	64%	62%	78%	78%
Sham Shui Po	1819	86%	81%	72%	77%	88%	72%	85%	91%	82%	83%	83%	83%	82%	83%	83%	88%	83%	86%	83%	82%	83%	83%	83%	83%	84%	83%	82%	81%	80%	91%	89%	79%	85%	73%	66%	84%	84%
Kowloon City	1703	86%	80%	73%	79%	87%	73%	81%	91%	80%	80%	82%	83%	84%	84%	83%	86%	83%	85%	84%	82%	83%	84%	82%	84%	85%	83%	82%	82%	89%	73%	88%	91%	95%	75%	52%	70%	70%
Kwun Tong	2069	82%	75%	67%	75%	83%	68%	74%	88%	81%	81%	84%	83%	84%	86%	84%	88%	85%	81%	85%	84%	84%	84%	84%	84%	84%	84%	84%	84%	81%	74%	84%	84%	87%	70%	57%	83%	83%
Wong Tai Sin	912	57%	54%	50%	53%	56%	50%	53%	57%	98%	99%	101%	100%	101%	98%	101%	111%	102%	55%	99%	101%	100%	101%	100%	101%	100%	100%	100%	101%	89%	70%	57%	90%	93%	50%	46%	99%	99%
Kwai Tsing	4587	71%	66%	60%	64%	69%	58%	67%	72%	85%	90%	86%	87%	87%	83%	86%	96%	87%	68%	85%	87%	86%	87%	86%	87%	88%	87%	86%	86%	84%	68%	70%	85%	91%	58%	53%	88%	88%
Tuen Mun	3397	100%	100%	94%	97%	107%	101%	109%	109%	98%	100%	96%	97%	94%	98%	104%	103%	95%	96%	103%	95%	95%	97%	96%	96%	95%	96%	96%	95%	95%	75%	115%	105%	109%	101%	93%	98%	98%
Island	472	593%	580%	535%	551%	419%	371%	419%	467%	585%	628%	583%	577%	590%	585%	566%	535%	590%	619%	588%	577%	585%	583%	591%	581%	584%	591%	595%	588%	583%	551%	424%	547%	601%	505%	457%	598%	598%
Yuen Long	1659	259%	249%	232%	245%	273%	245%	262%	279%	311%	311%	302%	302%	302%	292%	287%	305%	303%	314%	290%	299%	304%	300%	300%	301%	302%	304%	298%	302%	300%	237%	294%	299%	319%	265%	179%	299%	299%
Tai Po	2357	78%	70%	60%	68%	74%	57%	70%	84%	66%	59%	59%	59%	59%	63%	59%	61%	59%	63%	59%	59%	59%	59%	58%	59%	59%	59%	59%	60%	60%	51%	78%	61%	68%	54%	39%	58%	58%
North	725	166%	162%	144%	152%	168%	144%	166%	197%	203%	164%	164%	164%	165%	164%	166%	168%	165%	170%	168%	169%	165%	165%	165%	165%	166%	166%	165%	169%	167%	215%	176%	168%	195%	149%	127%	164%	164%
Sha Tin	4000	70%	62%	55%	62%	69%	55%	65%	80%	63%	60%	60%	61%	61%	65%	61%	62%	61%	64%	61%	61%	61%	61%	60%	61%	61%	61%	61%	61%	61%	66%	72%	62%	71%	55%	45%	60%	60%
Sai Kung	329	247%	211%	181%	214%	265%	197%	236%	296%	258%	255%	260%	260%	262%	267%	259%	268%	262%	262%	260%	261%	261%	260%	260%	260%	261%	261%	260%	260%	254%	147%	274%	262%	290%	209%	130%	248%	248%
Tsuen Wan	1257	121%	118%	108%	113%	122%	108%	118%	124%	111%	114%	110%	109%	108%	114%	111%	119%	109%	119%	112%	110%	111%	109%	110%	109%	109%	110%	109%	108%	110%	137%	127%	105%	112%	106%	96%	110%	110%
1997 total	**31360**																																					
% 1997 (total)		**105%**	**99%**	**90%**	**96%**	**104%**	**88%**	**99%**	**110%**	**108%**	**108%**	**106%**	**106%**	**106%**	**107%**	**106%**	**108%**	**107%**	**106%**	**107%**	**106%**	**107%**	**107%**	**106%**	**107%**	**107%**	**107%**	**106%**	**107%**	**106%**	**95%**	**107%**	**107%**	**114%**	**92%**	**76%**	**107%**	**107%**

Table 5.2e - Summary of VOC Relative to 1997

Summary of Scenarios by Districts (VOC)
% VOC relative to 1997

2001 & 2006

District	1997 VOC (tons)	01/39 VOC	01/40 VOC	01/41 VOC	01/43 VOC	01/47 VOC	01/48 VOC	06/49 VOC	06/50 VOC	06/52 VOC	06/54 VOC	06/58 VOC	06/75 VOC	06/76 VOC	06/77 VOC	06/78 VOC	06/80 VOC
Central & Western	571	127%	146%	148%	127%	122%	128%	138%	132%	135%	130%	134%	120%	134%	136%	134%	134%
Wan Chai	519	86%	82%	81%	85%	86%	82%	80%	76%	78%	76%	78%	77%	76%	77%	76%	76%
Eastern	627	89%	86%	85%	88%	87%	87%	83%	79%	82%	78%	82%	82%	83%	83%	82%	80%
Southern	465	84%	84%	84%	83%	86%	84%	78%	74%	77%	74%	77%	77%	71%	71%	71%	71%
Yau Tsim Mong	688	93%	90%	87%	92%	98%	87%	91%	86%	89%	85%	94%	95%	96%	92%	96%	96%
Sham Shui Po	812	120%	121%	121%	119%	108%	109%	101%	97%	98%	94%	101%	104%	105%	105%	104%	104%
Kowloon City	792	91%	89%	88%	92%	93%	86%	87%	82%	85%	82%	88%	84%	84%	87%	84%	84%
Kwun Tong	1016	90%	80%	78%	89%	92%	101%	82%	78%	81%	77%	78%	83%	84%	83%	84%	84%
Wong Tai Sin	420	87%	86%	85%	87%	88%	89%	75%	72%	74%	71%	68%	72%	73%	75%	73%	72%
Kwai Tsing	1953	72%	73%	72%	72%	75%	75%	79%	74%	76%	73%	79%	78%	78%	77%	76%	78%
Tuen Mun	1457	93%	99%	98%	94%	94%	98%	83%	80%	82%	80%	94%	98%	98%	97%	98%	98%
Island	198	427%	426%	430%	424%	317%	330%	435%	421%	427%	413%	458%	458%	458%	455%	452%	458%
Yuen Long	683	219%	211%	211%	218%	224%	213%	235%	227%	231%	220%	240%	234%	236%	236%	236%	235%
Tai Po	1088	62%	62%	61%	61%	64%	61%	69%	66%	67%	63%	65%	64%	65%	65%	66%	65%
North	302	195%	200%	198%	194%	214%	208%	169%	166%	167%	159%	161%	159%	162%	165%	166%	164%
Sha Tin	1920	87%	87%	87%	86%	85%	84%	75%	71%	74%	69%	73%	73%	73%	74%	74%	73%
Sai Kung	176	139%	138%	139%	138%	140%	142%	179%	167%	175%	164%	173%	176%	177%	183%	177%	176%
Tsuen Wan	508	186%	185%	188%	183%	188%	177%	160%	161%	164%	156%	159%	167%	166%	166%	170%	165%
1997 total	**14195**																
% 1997 (total)		**105%**	**105%**	**105%**	**105%**	**105%**	**103%**	**102%**	**97%**	**100%**	**95%**	**102%**	**102%**	**103%**	**103%**	**103%**	**103%**

District	1997 VOC (tons)	06/81 VOC	06/82 VOC	06/83 VOC	06/84 VOC	06/85 VOC	06/86 VOC	06/89 VOC	06/91 VOC	06/92 VOC	06/94 VOC	06/95 VOC	06/97 VOC	06/98 VOC	06/102 VOC	06/106 VOC	06/107 VOC
Central & Western	571	137%	135%	135%	134%	134%	121%	134%	122%	128%	122%	110%	100%	134%	118%	128%	121%
Wan Chai	519	77%	76%	77%	77%	76%	78%	76%	78%	73%	77%	78%	74%	76%	79%	74%	72%
Eastern	627	83%	82%	82%	83%	82%	81%	82%	83%	77%	82%	84%	78%	82%	81%	84%	79%
Southern	465	71%	71%	71%	71%	71%	77%	71%	77%	74%	77%	78%	71%	71%	79%	72%	68%
Yau Tsim Mong	688	91%	96%	95%	97%	94%	91%	96%	91%	86%	90%	90%	85%	96%	89%	91%	88%
Sham Shui Po	812	105%	104%	104%	103%	104%	104%	104%	105%	98%	104%	103%	94%	104%	101%	104%	97%
Kowloon City	792	84%	84%	84%	85%	84%	86%	84%	86%	81%	87%	87%	81%	84%	86%	83%	77%
Kwun Tong	1016	83%	84%	84%	86%	85%	85%	84%	84%	74%	83%	83%	76%	84%	84%	85%	80%
Wong Tai Sin	420	77%	72%	72%	74%	73%	80%	72%	75%	70%	74%	74%	68%	72%	81%	69%	65%
Kwai Tsing	1953	77%	81%	79%	74%	78%	72%	79%	79%	75%	77%	76%	69%	77%	70%	77%	72%
Tuen Mun	1457	97%	97%	89%	97%	97%	87%	97%	86%	86%	86%	88%	81%	98%	83%	102%	98%
Island	198	456%	458%	444%	457%	457%	438%	457%	445%	430%	445%	382%	343%	458%	353%	390%	372%
Yuen Long	683	236%	241%	247%	242%	236%	253%	236%	248%	232%	249%	244%	219%	235%	234%	230%	218%
Tai Po	1088	65%	66%	69%	61%	65%	68%	65%	70%	66%	68%	68%	59%	64%	58%	62%	58%
North	302	164%	164%	168%	159%	164%	175%	161%	173%	166%	171%	169%	143%	162%	215%	162%	152%
Sha Tin	1920	74%	73%	75%	73%	74%	76%	73%	75%	72%	75%	75%	67%	73%	76%	72%	67%
Sai Kung	176	174%	177%	177%	181%	151%	152%	177%	181%	170%	181%	194%	169%	177%	143%	189%	174%
Tsuen Wan	508	163%	158%	170%	167%	165%	173%	164%	165%	161%	168%	159%	144%	166%	167%	162%	151%
1997 total	**14195**																
% 1997 (total)		**103%**	**103%**	**103%**	**102%**	**102%**	**102%**	**102%**	**103%**	**98%**	**102%**	**100%**	**91%**	**102%**	**99%**	**101%**	**95%**

2011

District	VOC (tons)	11/41 VOC	11/42 VOC	11/43 VOC	11/44 VOC	11/55 VOC	11/69 VOC	11/69p VOC	11/71 VOC	11/74 VOC	11/75 VOC	11/76 VOC	11/77 VOC	11/78 VOC	11/79 VOC	11/80 VOC	11/81 VOC
Central & Western	571	169%	153%	142%	160%	173%	122%	122%	99%	195%	204%	190%	180%	195%	196%	198%	195%
Wan Chai	519	78%	72%	70%	76%	77%	75%	75%	65%	71%	70%	71%	72%	71%	71%	71%	71%
Eastern	627	74%	68%	65%	72%	75%	75%	75%	64%	83%	82%	83%	76%	83%	83%	83%	83%
Southern	465	65%	59%	57%	63%	65%	65%	65%	55%	68%	68%	68%	75%	68%	68%	67%	67%
Yau Tsim Mong	688	79%	73%	70%	76%	77%	82%	82%	73%	84%	82%	85%	84%	83%	83%	83%	83%
Sham Shui Po	812	89%	81%	77%	86%	90%	93%	92%	78%	89%	89%	90%	91%	89%	89%	90%	90%
Kowloon City	792	98%	89%	85%	95%	98%	99%	99%	86%	81%	80%	81%	81%	81%	80%	81%	79%
Kwun Tong	1016	84%	74%	71%	81%	84%	86%	86%	70%	84%	81%	84%	85%	84%	84%	82%	84%
Wong Tai Sin	420	62%	56%	55%	60%	60%	61%	61%	53%	60%	60%	61%	61%	60%	60%	60%	60%
Kwai Tsing	1953	70%	64%	62%	69%	71%	69%	69%	61%	66%	67%	66%	67%	65%	66%	67%	66%
Tuen Mun	1457	92%	86%	82%	88%	91%	95%	95%	83%	96%	99%	96%	96%	97%	97%	99%	96%
Island	198	568%	539%	515%	548%	572%	511%	511%	460%	552%	553%	552%	550%	538%	555%	557%	563%
Yuen Long	683	235%	214%	201%	222%	247%	237%	238%	205%	232%	228%	233%	233%	232%	229%	216%	231%
Tai Po	1088	73%	64%	59%	68%	73%	71%	71%	55%	59%	60%	60%	60%	59%	60%	56%	59%
North	302	126%	119%	114%	121%	126%	129%	129%	111%	131%	132%	133%	132%	131%	132%	149%	132%
Sha Tin	1920	68%	60%	57%	65%	68%	68%	68%	55%	66%	66%	66%	66%	66%	66%	64%	66%
Sai Kung	176	232%	199%	185%	218%	234%	250%	251%	189%	225%	224%	224%	223%	224%	224%	216%	224%
Tsuen Wan	508	134%	125%	116%	123%	129%	136%	135%	118%	128%	130%	131%	132%	131%	127%	132%	132%
1997 total	**14195**																
% 1997 (total)		**101%**	**92%**	**87%**	**96%**	**101%**	**99%**	**99%**	**84%**	**99%**	**99%**	**99%**	**99%**	**99%**	**99%**	**99%**	**99%**

District	VOC (tons)	11/82 VOC	11/83 VOC	11/84 VOC	11/87 VOC	11/88 VOC	11/89 VOC	11/90 VOC	11/93 VOC	11/97 VOC	11/103 VOC	11/104 VOC	11/105 VOC	11/106 VOC	11/107 VOC
Central & Western	571	199%	131%	205%	194%	198%	197%	197%	122%	135%	124%	204%	178%	195%	195%
Wan Chai	519	71%	68%	71%	71%	72%	71%	71%	75%	73%	76%	70%	63%	71%	71%
Eastern	627	84%	81%	83%	83%	84%	83%	83%	75%	72%	75%	83%	74%	82%	83%
Southern	465	68%	66%	67%	68%	68%	68%	67%	65%	76%	66%	67%	59%	67%	68%
Yau Tsim Mong	688	86%	87%	81%	83%	84%	83%	83%	83%	81%	83%	78%	72%	83%	84%
Sham Shui Po	812	92%	98%	89%	90%	89%	90%	89%	93%	93%	96%	88%	80%	89%	89%
Kowloon City	792	80%	83%	79%	80%	81%	80%	80%	99%	77%	101%	77%	69%	81%	81%
Kwun Tong	1016	72%	88%	84%	84%	84%	84%	84%	86%	77%	87%	89%	67%	85%	84%
Wong Tai Sin	420	62%	62%	60%	61%	61%	60%	61%	60%	73%	62%	58%	55%	58%	60%
Kwai Tsing	1953	69%	71%	67%	66%	66%	66%	67%	70%	66%	72%	66%	60%	66%	66%
Tuen Mun	1457	100%	97%	98%	96%	96%	96%	96%	96%	72%	103%	106%	98%	104%	97%
Island	198	558%	515%	552%	554%	555%	556%	555%	516%	446%	521%	552%	505%	545%	553%
Yuen Long	683	219%	247%	227%	231%	230%	231%	231%	239%	212%	269%	229%	192%	214%	229%
Tai Po	1088	56%	63%	59%	59%	59%	60%	59%	71%	52%	75%	58%	46%	58%	60%
North	302	141%	134%	132%	132%	132%	133%	132%	128%	192%	134%	131%	125%	120%	132%
Sha Tin	1920	65%	67%	66%	66%	66%	66%	66%	68%	67%	70%	65%	54%	65%	66%
Sai Kung	176	201%	229%	224%	225%	224%	226%	224%	251%	145%	257%	230%	167%	228%	223%
Tsuen Wan	508	136%	142%	127%	131%	131%	131%	129%	137%	151%	138%	127%	117%	125%	131%
1997 total	**14195**														
% 1997 (total)		**99%**	**99%**	**99%**	**99%**	**99%**	**100%**	**99%**	**99%**	**92%**	**103%**	**100%**	**88%**	**98%**	**99%**

2016

District	VOC (tons)	16/07 VOC	16/08 VOC	16/10 VOC	16/12 VOC	16/18 VOC	16/19 VOC	16/21 VOC	16/23 VOC	16/35 VOC	16/36 VOC	16/37 VOC	16/38 VOC
Central & Western	571	222%	193%	178%	207%	216%	165%	192%	229%	201%	215%	200%	210%
Wan Chai	519	89%	77%	75%	85%	85%	69%	74%	87%	78%	76%	81%	83%
Eastern	627	79%	68%	65%	75%	79%	64%	69%	83%	92%	91%	100%	101%
Southern	465	90%	76%	70%	82%	91%	65%	78%	96%	80%	82%	82%	76%
Yau Tsim Mong	688	90%	77%	75%	85%	92%	75%	83%	97%	87%	87%	88%	87%
Sham Shui Po	812	99%	87%	80%	93%	102%	80%	91%	108%	95%	97%	95%	95%
Kowloon City	792	109%	94%	89%	104%	109%	88%	94%	116%	102%	102%	105%	105%
Kwun Tong	1016	98%	82%	76%	93%	100%	77%	81%	108%	98%	97%	100%	100%
Wong Tai Sin	420	67%	59%	56%	64%	66%	55%	57%	68%	119%	118%	121%	120%
Kwai Tsing	1953	80%	71%	66%	75%	77%	63%	71%	83%	98%	104%	98%	98%
Tuen Mun	1457	105%	99%	94%	103%	114%	102%	109%	116%	108%	111%	106%	106%
Island	198	653%	615%	581%	626%	436%	383%	422%	519%	642%	732%	639%	632%
Yuen Long	683	284%	257%	244%	274%	295%	250%	269%	314%	349%	344%	334%	333%
Tai Po	1088	92%	77%	68%	84%	87%	64%	75%	104%	80%	70%	70%	69%
North	302	177%	163%	147%	164%	180%	145%	168%	230%	237%	180%	178%	177%
Sha Tin	1920	82%	67%	62%	76%	81%	61%	69%	99%	74%	71%	71%	71%
Sai Kung	176	283%	223%	199%	258%	303%	213%	246%	348%	299%	295%	300%	299%
Tsuen Wan	508	146%	133%	124%	141%	146%	122%	131%	153%	133%	135%	130%	130%
1997 total	**14195**												
% 1997 (total)		**119%**	**104%**	**97%**	**112%**	**117%**	**94%**	**104%**	**128%**	**124%**	**124%**	**121%**	**121%**

District	VOC (tons)	16/39 VOC	16/40 VOC	16/41 VOC	16/42 VOC	16/43 VOC	16/44 VOC	16/45 VOC	16/46 VOC	16/47 VOC	16/48 VOC	16/49 VOC	16/50 VOC	16/51 VOC
Central & Western	571	208%	208%	209%	142%	209%	227%	205%	209%	207%	210%	209%	210%	209%
Wan Chai	519	81%	82%	82%	80%	86%	82%	82%	82%	81%	83%	81%	83%	82%
Eastern	627	95%	96%	95%	94%	80%	97%	97%	95%	95%	97%	96%	96%	97%
Southern	465	84%	84%	84%	82%	87%	85%	84%	84%	84%	87%	84%	84%	84%
Yau Tsim Mong	688	88%	90%	88%	91%	88%	90%	90%	87%	89%	89%	87%	90%	90%
Sham Shui Po	812	95%	96%	96%	102%	96%	100%	96%	94%	95%	96%	95%	96%	97%
Kowloon City	792	107%	107%	105%	108%	105%	107%	106%	104%	105%	106%	104%	107%	107%
Kwun Tong	1016	101%	103%	100%	105%	101%	97%	102%	101%	100%	100%	101%	100%	101%
Wong Tai Sin	420	120%	116%	121%	131%	123%	65%	120%	121%	120%	120%	120%	120%	120%
Kwai Tsing	1953	98%	94%	98%	109%	99%	76%	98%	99%	98%	99%	97%	99%	100%
Tuen Mun	1457	103%	108%	112%	113%	104%	104%	109%	104%	104%	106%	105%	106%	105%
Island	198	650%	641%	622%	568%	646%	687%	639%	632%	642%	640%	650%	640%	643%
Yuen Long	683	333%	319%	317%	337%	334%	347%	321%	330%	335%	331%	330%	332%	333%
Tai Po	1088	69%	75%	70%	72%	70%	74%	70%	70%	69%	70%	69%	70%	70%
North	302	180%	178%	180%	182%	179%	183%	181%	183%	179%	179%	179%	179%	180%
Sha Tin	1920	71%	77%	72%	73%	72%	74%	72%	72%	71%	71%	71%	72%	72%
Sai Kung	176	301%	306%	298%	307%	302%	301%	300%	302%	301%	300%	299%	300%	302%
Tsuen Wan	508	128%	137%	133%	144%	131%	140%	134%	131%	132%	129%	131%	130%	129%
1997 total	**14195**													
% 1997 (total)		**121%**	**122%**	**121%**	**122%**	**121%**	**120%**	**121%**	**121%**	**121%**	**122%**	**121%**	**122%**	**122%**

District	VOC (tons)	16/52 VOC	16/53 VOC	16/54 VOC	16/55 VOC	16/64 VOC	16/75 VOC	16/82 VOC	16/83 VOC	16/84 VOC	16/86 VOC	16/89 VOC	16/90 VOC
Central & Western	571	210%	209%	209%	212%	155%	221%	216%	233%	185%	148%	227%	227%
Wan Chai	519	82%	81%	82%	82%	80%	86%	80%	84%	75%	56%	75%	75%
Eastern	627	97%	95%	96%	95%	76%	80%	97%	103%	70%	64%	101%	101%
Southern	465	84%	84%	84%	84%	86%	92%	84%	88%	65%	52%	84%	84%
Yau Tsim Mong	688	89%	87%	87%	86%	88%	93%	80%	88%	70%	66%	93%	93%
Sham Shui Po	812	96%	95%	94%	92%	101%	104%	92%	101%	80%	72%	97%	97%
Kowloon City	792	106%	103%	104%	112%	85%	110%	113%	122%	89%	58%	87%	87%
Kwun Tong	1016	101%	100%	101%	97%	83%	101%	101%	107%	79%	61%	98%	98%
Wong Tai Sin	420	120%	120%	122%	105%	78%	67%	106%	111%	56%	49%	115%	115%
Kwai Tsing	1953	98%	98%	98%	95%	71%	78%	95%	105%	62%	56%	98%	98%
Tuen Mun	1457	106%	105%	105%	104%	77%	123%	112%	119%	102%	94%	108%	108%
Island	198	650%	653%	643%	641%	542%	440%	598%	702%	545%	491%	659%	659%
Yuen Long	683	336%	329%	332%	331%	239%	317%	328%	369%	277%	184%	330%	330%
Tai Po	1088	70%	70%	70%	71%	54%	91%	71%	84%	60%	42%	68%	68%
North	302	180%	179%	182%	181%	222%	188%	181%	230%	150%	125%	178%	178%
Sha Tin	1920	72%	71%	71%	72%	72%	84%	73%	88%	60%	49%	71%	71%
Sai Kung	176	301%	300%	300%	294%	154%	310%	298%	341%	225%	137%	280%	280%
Tsuen Wan	508	132%	129%	129%	131%	157%	153%	125%	137%	120%	108%	131%	131%
1997 total	**14195**												
% 1997 (total)		**122%**	**121%**	**121%**	**120%**	**101%**	**121%**	**120%**	**134%**	**99%**	**80%**	**121%**	**121%**

Table 5.2f - Summary of RSP Relative to 1997

Summary of Scenarios by Districts (RSP)
% RSP (Tailpipe) relative to 1997

2001 & 2006	1997 RSP (tons)	01/39 RSP	01/40 RSP	01/41 RSP	01/43 RSP	01/47 RSP	01/48 RSP	06/49 RSP	06/50 RSP	06/52 RSP	06/54 RSP	06/58 RSP	06/75 RSP	06/76 RSP	06/77 RSP	06/78 RSP	06/80 RSP	06/81 RSP	06/82 RSP	06/83 RSP	06/84 RSP	06/85 RSP	06/86 RSP	06/89 RSP	06/91 RSP	06/92 RSP	06/94 RSP	06/95 RSP	06/97 RSP	06/98 RSP	06/102 RSP	06/106 RSP	06/107 RSP
Central & Western	232	77%	86%	87%	77%	77%	81%	55%	54%	53%	53%	53%	51%	56%	57%	56%	56%	57%	56%	56%	56%	56%	51%	56%	52%	56%	52%	39%	37%	56%	40%	45%	43%
Wan Chai	198	51%	49%	49%	50%	52%	50%	29%	28%	27%	28%	28%	28%	27%	28%	27%	27%	28%	27%	28%	28%	27%	28%	27%	28%	28%	28%	28%	27%	27%	28%	27%	26%
Eastern	234	54%	53%	53%	54%	54%	53%	31%	30%	29%	29%	30%	30%	30%	30%	30%	30%	31%	30%	30%	31%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	29%
Southern	162	54%	54%	54%	54%	57%	57%	32%	32%	31%	31%	33%	32%	31%	31%	31%	31%	31%	31%	31%	31%	31%	33%	31%	33%	33%	33%	33%	32%	31%	33%	32%	31%
Yau Tsim Mong	276	61%	59%	58%	60%	67%	61%	41%	41%	40%	40%	43%	44%	43%	42%	43%	44%	41%	44%	43%	44%	42%	41%	43%	41%	41%	41%	41%	40%	44%	40%	42%	42%
Sham Shui Po	328	87%	86%	87%	86%	82%	81%	52%	51%	49%	49%	51%	52%	53%	53%	53%	52%	53%	52%	52%	52%	52%	53%	52%	52%	51%	52%	52%	50%	52%	52%	52%	50%
Kowloon City	330	54%	52%	52%	54%	56%	52%	34%	33%	32%	32%	33%	32%	32%	34%	32%	32%	32%	32%	32%	33%	32%	33%	32%	33%	33%	34%	33%	32%	32%	33%	32%	30%
Kwun Tong	361	61%	56%	55%	60%	63%	66%	38%	38%	36%	37%	36%	38%	38%	38%	38%	38%	38%	38%	38%	39%	39%	39%	38%	38%	36%	38%	38%	36%	38%	39%	38%	37%
Wong Tai Sin	169	59%	58%	58%	60%	61%	60%	34%	34%	32%	33%	29%	32%	32%	34%	32%	32%	35%	32%	32%	32%	32%	36%	32%	34%	33%	33%	33%	32%	32%	37%	30%	29%
Kwai Tsing	800	55%	57%	56%	56%	61%	59%	46%	45%	44%	44%	46%	45%	45%	44%	44%	45%	44%	46%	45%	44%	45%	42%	45%	45%	45%	45%	45%	42%	45%	43%	44%	43%
Tuen Mun	558	78%	82%	81%	78%	79%	81%	56%	55%	54%	56%	67%	68%	68%	68%	69%	68%	69%	67%	62%	68%	68%	60%	67%	59%	62%	58%	60%	59%	69%	55%	70%	70%
Island	89	238%	238%	240%	236%	206%	209%	217%	216%	208%	209%	220%	211%	209%	209%	208%	209%	209%	209%	214%	209%	209%	213%	209%	214%	214%	215%	204%	177%	209%	192%	200%	192%
Yuen Long	297	183%	177%	178%	184%	191%	186%	161%	161%	156%	155%	169%	163%	166%	166%	164%	165%	165%	167%	172%	171%	165%	177%	164%	172%	168%	176%	170%	153%	164%	162%	160%	156%
Tai Po	400	47%	47%	47%	46%	48%	45%	42%	41%	40%	39%	39%	38%	38%	39%	40%	38%	39%	39%	41%	35%	39%	41%	38%	42%	42%	40%	40%	34%	38%	34%	36%	34%
North	129	171%	176%	176%	168%	187%	180%	126%	127%	124%	121%	119%	118%	120%	121%	122%	121%	120%	121%	122%	116%	121%	126%	119%	126%	125%	124%	123%	104%	120%	150%	119%	117%
Sha Tin	656	63%	62%	62%	61%	62%	60%	40%	40%	39%	38%	38%	39%	39%	39%	39%	39%	39%	39%	40%	38%	39%	41%	38%	40%	40%	39%	39%	35%	38%	40%	37%	36%
Sai Kung	51	109%	108%	110%	109%	110%	110%	93%	91%	88%	86%	92%	93%	93%	93%	93%	93%	91%	93%	94%	95%	80%	81%	94%	94%	92%	93%	102%	93%	93%	75%	99%	94%
Tsuen Wan	226	134%	133%	136%	133%	137%	132%	87%	90%	86%	88%	86%	91%	91%	91%	93%	90%	90%	87%	92%	92%	91%	94%	91%	90%	92%	91%	86%	85%	92%	90%	89%	86%
1997 total	**5498**																																
% 1997 (total)		**77%**	**77%**	**77%**	**77%**	**79%**	**78%**	**56%**	**56%**	**54%**	**54%**	**57%**	**57%**	**57%**	**57%**	**57%**	**57%**	**57%**	**57%**	**57%**	**57%**	**57%**	**57%**	**57%**	**57%**	**57%**	**57%**	**56%**	**52%**	**57%**	**54%**	**56%**	**54%**

2011 District	RSP (tons)	11/41 RSP	11/42 RSP	11/43 RSP	11/44 RSP	11/55 RSP	11/69 RSP	11/69p RSP	11/71 RSP	11/74 RSP	11/75 RSP	11/76 RSP	11/77 RSP	11/78 RSP	11/79 RSP	11/80 RSP	11/81 RSP	11/82 RSP	11/83 RSP	11/84 RSP	11/87 RSP	11/88 RSP	11/89 RSP	11/90 RSP	11/93 RSP	11/97 RSP	11/103 RSP	11/104 RSP	11/105 RSP	11/106 RSP	11/107 RSP
Central & Western	232	60%	58%	50%	54%	62%	38%	38%	32%	66%	69%	64%	59%	65%	66%	67%	65%	67%	41%	69%	65%	67%	66%	66%	37%	45%	38%	69%	63%	65%	65%
Wan Chai	198	26%	25%	24%	24%	25%	24%	24%	22%	24%	24%	24%	24%	24%	24%	24%	24%	24%	23%	24%	24%	24%	24%	24%	25%	24%	25%	24%	22%	24%	24%
Eastern	234	25%	24%	22%	23%	25%	25%	25%	22%	28%	27%	27%	25%	28%	28%	28%	28%	28%	27%	28%	28%	28%	28%	28%	25%	24%	25%	27%	25%	27%	28%
Southern	162	26%	26%	24%	24%	26%	26%	26%	23%	27%	27%	27%	29%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	26%	28%	26%	27%	25%	27%	27%
Yau Tsim Mong	276	32%	32%	30%	30%	31%	33%	33%	30%	33%	32%	33%	33%	33%	33%	33%	33%	34%	35%	32%	33%	33%	33%	33%	33%	32%	33%	31%	30%	33%	33%
Sham Shui Po	328	40%	39%	36%	37%	40%	42%	41%	36%	39%	40%	40%	40%	40%	39%	40%	40%	41%	44%	40%	40%	40%	40%	39%	41%	43%	42%	39%	37%	39%	40%
Kowloon City	330	32%	31%	28%	29%	32%	31%	31%	28%	26%	26%	27%	27%	27%	26%	27%	26%	26%	27%	26%	26%	27%	26%	26%	31%	26%	32%	25%	24%	26%	27%
Kwun Tong	361	33%	32%	29%	30%	32%	33%	33%	28%	32%	31%	33%	33%	33%	32%	32%	33%	28%	34%	32%	33%	33%	33%	33%	33%	32%	33%	34%	27%	33%	33%
Wong Tai Sin	169	23%	23%	21%	21%	22%	24%	23%	21%	23%	22%	23%	23%	22%	23%	23%	22%	24%	24%	22%	23%	23%	23%	23%	23%	29%	23%	22%	21%	22%	23%
Kwai Tsing	800	37%	36%	34%	35%	37%	36%	36%	33%	35%	35%	35%	36%	34%	35%	36%	35%	36%	37%	35%	35%	35%	35%	35%	36%	36%	37%	35%	33%	35%	35%
Tuen Mun	558	58%	58%	55%	55%	57%	60%	60%	55%	60%	62%	60%	60%	61%	61%	62%	60%	62%	62%	61%	60%	60%	61%	61%	60%	44%	64%	69%	67%	66%	61%
Island	89	270%	270%	249%	251%	271%	255%	255%	228%	266%	265%	266%	266%	262%	266%	267%	268%	267%	258%	264%	265%	266%	266%	266%	257%	250%	262%	267%	245%	259%	266%
Yuen Long	297	132%	128%	120%	124%	141%	136%	136%	127%	133%	131%	134%	134%	134%	132%	127%	133%	128%	140%	131%	134%	132%	133%	133%	137%	126%	156%	132%	118%	118%	132%
Tai Po	400	34%	33%	29%	30%	34%	33%	33%	27%	27%	28%	28%	28%	28%	28%	26%	28%	26%	30%	28%	28%	28%	28%	28%	33%	26%	35%	27%	22%	26%	28%
North	129	75%	75%	71%	71%	74%	75%	75%	70%	77%	77%	78%	77%	77%	77%	85%	77%	81%	78%	77%	77%	77%	77%	77%	75%	109%	79%	76%	77%	66%	77%
Sha Tin	656	30%	29%	26%	27%	30%	30%	30%	26%	29%	29%	29%	29%	29%	29%	28%	29%	28%	30%	29%	29%	29%	29%	29%	30%	31%	31%	29%	25%	28%	29%
Sai Kung	51	106%	101%	89%	93%	106%	113%	114%	91%	107%	108%	108%	107%	108%	108%	102%	107%	92%	111%	107%	108%	108%	108%	108%	114%	71%	119%	110%	78%	107%	107%
Tsuen Wan	226	62%	63%	57%	56%	60%	64%	64%	59%	61%	63%	62%	63%	63%	61%	63%	63%	65%	67%	61%	63%	63%	63%	62%	64%	72%	64%	61%	59%	60%	63%
1997 total	**5498**																														
% 1997 (total)		**48%**	**47%**	**44%**	**45%**	**48%**	**47%**	**47%**	**43%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**	**46%**	**50%**	**48%**	**44%**	**47%**	**48%**

2016 District	RSP (tons)	16/07 RSP	16/08 RSP	16/10 RSP	16/12 RSP	16/18 RSP	16/19 RSP	16/21 RSP	16/23 RSP	16/35 RSP	16/36 RSP	16/37 RSP	16/38 RSP	16/39 RSP	16/40 RSP	16/41 RSP	16/42 RSP	16/43 RSP	16/44 RSP	16/45 RSP	16/46 RSP	16/47 RSP	16/48 RSP	16/49 RSP	16/50 RSP	16/51 RSP	16/52 RSP	16/53 RSP	16/54 RSP	16/55 RSP	16/64 RSP	16/75 RSP	16/82 RSP	16/83 RSP	16/84 RSP	16/86 RSP	16/89 RSP	16/90 RSP
Central & Western	232	83%	80%	68%	72%	76%	58%	73%	77%	65%	67%	64%	68%	68%	67%	69%	42%	68%	76%	72%	68%	67%	69%	68%	68%	67%	68%	68%	68%	70%	53%	77%	72%	73%	65%	52%	70%	70%
Wan Chai	198	29%	28%	25%	25%	27%	23%	26%	27%	24%	24%	25%	26%	26%	26%	26%	25%	27%	26%	26%	26%	26%	27%	26%	26%	26%	26%	26%	26%	26%	26%	27%	26%	26%	25%	20%	24%	24%
Eastern	234	26%	24%	22%	23%	26%	21%	25%	26%	29%	29%	33%	32%	31%	31%	31%	29%	26%	32%	32%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	25%	26%	32%	33%	23%	22%	32%	32%
Southern	162	33%	32%	27%	28%	34%	26%	32%	35%	30%	31%	31%	29%	32%	32%	32%	31%	32%	32%	32%	32%	32%	34%	32%	32%	32%	32%	32%	32%	32%	32%	34%	32%	33%	27%	22%	32%	32%
Yau Tsim Mong	276	35%	33%	30%	31%	35%	30%	35%	35%	33%	33%	33%	33%	33%	33%	33%	34%	33%	34%	34%	33%	33%	33%	33%	34%	34%	33%	33%	33%	32%	35%	35%	30%	31%	29%	28%	34%	34%
Sham Shui Po	328	43%	42%	36%	38%	44%	37%	44%	44%	40%	41%	41%	41%	41%	41%	41%	44%	41%	43%	41%	40%	41%	41%	41%	41%	41%	41%	41%	40%	39%	48%	44%	39%	41%	36%	33%	41%	41%
Kowloon City	330	34%	33%	29%	30%	34%	28%	33%	34%	30%	30%	31%	31%	32%	31%	31%	32%	31%	32%	32%	31%	31%	31%	31%	31%	32%	31%	30%	31%	34%	30%	34%	35%	35%	28%	20%	26%	26%
Kwun Tong	361	37%	35%	30%	32%	36%	30%	34%	38%	35%	35%	37%	37%	37%	38%	37%	39%	37%	35%	38%	37%	37%	37%	37%	37%	37%	37%	36%	37%	35%	34%	37%	36%	37%	30%	25%	37%	37%
Wong Tai Sin	169	24%	24%	21%	22%	24%	21%	23%	24%	44%	44%	46%	45%	45%	45%	45%	51%	46%	23%	44%	46%	45%	45%	45%	45%	45%	45%	45%	46%	40%	32%	24%	41%	41%	21%	20%	46%	46%
Kwai Tsing	800	41%	40%	35%	36%	39%	34%	40%	41%	49%	51%	50%	50%	50%	48%	50%	55%	50%	39%	49%	50%	50%	50%	49%	50%	51%	50%	50%	50%	48%	41%	40%	49%	51%	34%	31%	51%	51%
Tuen Mun	558	67%	68%	64%	64%	71%	69%	74%	72%	61%	62%	60%	61%	59%	61%	66%	65%	59%	61%	68%	59%	59%	61%	60%	60%	60%	60%	60%	60%	60%	50%	76%	68%	70%	68%	63%	61%	61%
Island	89	325%	323%	293%	295%	240%	213%	243%	257%	323%	322%	322%	319%	325%	322%	311%	300%	326%	339%	319%	319%	322%	322%	325%	320%	321%	324%	328%	325%	321%	325%	244%	299%	316%	275%	245%	330%	330%
Yuen Long	297	162%	160%	148%	152%	171%	159%	168%	170%	190%	192%	187%	187%	186%	182%	176%	188%	188%	194%	179%	185%	188%	185%	185%	186%	187%	188%	184%	186%	186%	155%	186%	185%	190%	168%	113%	185%	185%
Tai Po	400	43%	41%	34%	36%	40%	32%	40%	44%	35%	32%	32%	32%	32%	34%	32%	33%	32%	34%	32%	32%	32%	32%	31%	32%	32%	32%	32%	32%	32%	30%	43%	33%	35%	30%	22%	31%	31%
North	129	103%	103%	92%	94%	104%	92%	105%	114%	117%	99%	100%	99%	101%	99%	101%	103%	100%	104%	102%	103%	100%	100%	100%	100%	101%	101%	101%	102%	101%	136%	109%	102%	111%	94%	81%	100%	100%
Sha Tin	656	37%	34%	29%	31%	36%	29%	35%	39%	32%	30%	31%	31%	31%	33%	31%	32%	31%	33%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	36%	37%	32%	34%	28%	24%	31%	31%
Sai Kung	51	128%	116%	95%	105%	134%	103%	127%	147%	129%	127%	130%	130%	131%	134%	129%	135%	131%	132%	130%	131%	130%	131%	130%	130%	130%	131%	130%	130%	127%	79%	141%	132%	142%	108%	67%	126%	126%
Tsuen Wan	226	65%	65%	59%	59%	65%	60%	65%	66%	59%	61%	58%	58%	57%	61%	58%	63%	58%	64%	60%	58%	59%	58%	58%	58%	57%	58%	58%	57%	58%	78%	69%	56%	58%	58%	53%	58%	58%
1997 total	**5498**																																					
% 1997 (total)		**57%**	**55%**	**49%**	**51%**	**55%**	**48%**	**55%**	**57%**	**57%**	**57%**	**56%**	**56%**	**56%**	**57%**	**56%**	**57%**	**56%**	**56%**	**57%**	**56%**	**56%**	**57%**	**56%**	**56%**	**57%**	**57%**	**56%**	**56%**	**56%**	**53%**	**58%**	**57%**	**59%**	**50%**	**41%**	**57%**	**57%**

Table 5.2g - Summary of Paved Road Dust Relative to 1997

Summary of Scenarios by Districts (RSP)
% RSP (Paved Road Dust) relative to 1997

2001 & 2006	1997 PRD (tons)	01/39 PRD	01/40 PRD	01/41 PRD	01/43 PRD	01/47 PRD	01/48 PRD	06/49 PRD	06/50 PRD	06/52 PRD	06/54 PRD	06/58 PRD	06/75 PRD	06/76 PRD
Central & Western	185	153%	171%	176%	153%	151%	154%	202%	201%	192%	196%	196%	174%	194%
Wan Chai	172	107%	103%	102%	106%	108%	104%	119%	119%	114%	117%	118%	116%	115%
Eastern	206	109%	106%	106%	108%	109%	108%	123%	123%	118%	121%	123%	122%	123%
Southern	142	103%	103%	103%	103%	107%	104%	119%	119%	114%	117%	119%	118%	109%
Yau Tsim Mong	217	111%	108%	104%	110%	118%	105%	131%	130%	125%	126%	137%	139%	139%
Sham Shui Po	244	141%	141%	142%	139%	130%	130%	148%	148%	141%	142%	150%	153%	155%
Kowloon City	267	107%	104%	103%	107%	110%	102%	123%	122%	117%	119%	126%	119%	120%
Kwun Tong	314	107%	96%	95%	106%	111%	120%	122%	121%	117%	118%	117%	124%	126%
Wong Tai Sin	134	104%	103%	103%	104%	107%	106%	110%	111%	106%	107%	101%	107%	108%
Kwai Tsing	543	84%	86%	85%	85%	90%	89%	116%	113%	109%	110%	117%	117%	116%
Tuen Mun	377	107%	114%	114%	108%	111%	114%	123%	124%	119%	120%	138%	144%	144%
Island	61	507%	508%	514%	503%	404%	417%	601%	605%	576%	588%	643%	648%	643%
Yuen Long	184	240%	232%	233%	238%	250%	233%	316%	318%	304%	303%	324%	315%	315%
Tai Po	295	73%	73%	73%	73%	77%	74%	104%	103%	98%	98%	99%	97%	98%
North	81	222%	227%	224%	221%	248%	241%	228%	232%	218%	219%	219%	217%	221%
Sha Tin	535	105%	105%	105%	104%	105%	103%	116%	114%	110%	110%	113%	113%	114%
Sai Kung	51	171%	170%	172%	170%	176%	176%	284%	278%	271%	269%	277%	280%	281%
Tsuen Wan	134	220%	219%	224%	217%	227%	210%	243%	257%	244%	243%	244%	255%	253%
1997 total	**4142**													
% 1997 (total)		**124%**	**124%**	**124%**	**123%**	**126%**	**123%**	**148%**	**148%**	**142%**	**143%**	**149%**	**149%**	**150%**

2001 & 2006	06/77 PRD	06/78 PRD	06/80 PRD	06/81 PRD	06/82 PRD	06/83 PRD	06/84 PRD	06/85 PRD	06/86 PRD	06/89 PRD	06/91 PRD	06/92 PRD	06/94 PRD	06/95 PRD	06/97 PRD	06/98 PRD	06/102 PRD	06/106 PRD	06/107 PRD
Central & Western	197%	194%	195%	198%	194%	195%	194%	194%	177%	194%	177%	195%	177%	161%	152%	194%	175%	186%	181%
Wan Chai	116%	115%	114%	116%	114%	116%	116%	115%	119%	114%	119%	118%	117%	117%	115%	114%	118%	112%	112%
Eastern	124%	123%	119%	125%	122%	123%	124%	124%	122%	123%	124%	122%	123%	124%	121%	122%	120%	123%	121%
Southern	110%	109%	109%	110%	109%	109%	109%	109%	121%	109%	120%	122%	119%	120%	113%	109%	121%	110%	107%
Yau Tsim Mong	134%	140%	140%	134%	140%	139%	140%	137%	134%	139%	133%	133%	132%	131%	127%	140%	130%	131%	130%
Sham Shui Po	155%	155%	154%	156%	154%	154%	152%	154%	156%	153%	156%	154%	153%	151%	142%	153%	149%	151%	146%
Kowloon City	124%	121%	120%	120%	120%	121%	122%	120%	124%	120%	123%	123%	124%	124%	119%	120%	122%	118%	114%
Kwun Tong	125%	125%	125%	124%	125%	126%	128%	128%	128%	125%	126%	117%	125%	124%	117%	125%	125%	126%	123%
Wong Tai Sin	111%	108%	108%	115%	107%	108%	110%	109%	120%	107%	112%	110%	110%	108%	105%	107%	120%	102%	100%
Kwai Tsing	115%	114%	117%	116%	120%	118%	110%	116%	108%	117%	118%	118%	115%	113%	106%	116%	103%	113%	109%
Tuen Mun	142%	144%	144%	142%	141%	131%	142%	141%	130%	141%	127%	133%	127%	129%	120%	143%	123%	147%	145%
Island	642%	637%	644%	645%	643%	623%	643%	644%	620%	642%	625%	638%	623%	534%	508%	644%	493%	544%	534%
Yuen Long	317%	317%	315%	319%	322%	332%	324%	317%	341%	316%	333%	327%	333%	326%	302%	316%	314%	305%	297%
Tai Po	99%	100%	98%	100%	99%	104%	93%	99%	105%	98%	106%	106%	104%	102%	92%	97%	87%	94%	90%
North	225%	226%	223%	224%	222%	230%	217%	224%	244%	219%	237%	239%	234%	229%	200%	220%	295%	217%	206%
Sha Tin	115%	115%	114%	116%	113%	117%	114%	115%	120%	113%	117%	117%	116%	116%	107%	113%	117%	111%	106%
Sai Kung	293%	282%	281%	279%	280%	282%	288%	241%	245%	282%	292%	288%	290%	308%	282%	281%	227%	297%	283%
Tsuen Wan	253%	260%	252%	249%	241%	259%	254%	252%	267%	250%	253%	258%	257%	242%	226%	253%	255%	244%	234%
1997 total																			
% 1997 (total)	**150%**	**150%**	**150%**	**150%**	**150%**	**151%**	**149%**	**150%**	**151%**	**149%**	**150%**	**151%**	**149%**	**146%**	**137%**	**150%**	**144%**	**146%**	**141%**

2011

District	PRD (tons)	11/41 PRD	11/42 PRD	11/43 PRD	11/44 PRD	11/55 PRD	11/69 PRD	11/69p PRD	11/71 PRD	11/74 PRD	11/75 PRD	11/76 PRD	11/77 PRD	11/78 PRD
Central & Western	185	303%	305%	275%	276%	312%	224%	224%	198%	344%	360%	336%	321%	345%
Wan Chai	172	141%	145%	135%	132%	140%	137%	137%	130%	131%	129%	130%	134%	131%
Eastern	206	134%	137%	127%	125%	137%	137%	137%	128%	152%	149%	151%	139%	152%
Southern	142	123%	126%	115%	114%	124%	125%	125%	114%	129%	130%	130%	144%	129%
Yau Tsim Mong	217	140%	144%	133%	130%	140%	148%	149%	141%	151%	149%	153%	153%	151%
Sham Shui Po	244	161%	161%	147%	148%	163%	168%	168%	153%	162%	163%	163%	166%	163%
Kowloon City	267	169%	170%	157%	157%	171%	172%	172%	163%	142%	140%	143%	143%	143%
Kwun Tong	314	154%	151%	138%	143%	156%	160%	159%	141%	157%	150%	156%	158%	156%
Wong Tai Sin	134	112%	115%	107%	104%	111%	113%	112%	106%	112%	111%	113%	114%	111%
Kwai Tsing	543	127%	128%	118%	119%	128%	126%	126%	120%	119%	121%	119%	122%	118%
Tuen Mun	377	164%	166%	153%	150%	163%	169%	169%	157%	171%	176%	171%	172%	174%
Island	61	933%	977%	897%	865%	941%	840%	842%	823%	907%	913%	905%	909%	883%
Yuen Long	184	397%	394%	353%	357%	411%	397%	398%	358%	388%	381%	390%	390%	389%
Tai Po	295	141%	137%	121%	126%	142%	138%	138%	115%	114%	116%	116%	117%	115%
North	81	214%	219%	199%	194%	214%	221%	222%	200%	226%	227%	227%	228%	226%
Sha Tin	535	133%	130%	117%	121%	134%	134%	134%	117%	129%	130%	129%	131%	129%
Sai Kung	51	449%	427%	382%	404%	455%	488%	491%	397%	437%	437%	435%	436%	436%
Tsuen Wan	134	256%	261%	221%	238%	250%	260%	259%	223%	246%	249%	254%	253%	253%
1997 total	**4142**													
% 1997 (total)		**182%**	**182%**	**166%**	**167%**	**183%**	**179%**	**179%**	**163%**	**179%**	**180%**	**180%**	**180%**	**179%**

District	11/79 PRD	11/80 PRD	11/81 PRD	11/82 PRD	11/83 PRD	11/84 PRD	11/87 PRD	11/88 PRD	11/89 PRD	11/90 PRD	11/93 PRD	11/97 PRD	11/103 PRD	11/104 PRD	11/105 PRD	11/106 PRD	11/107 PRD
Central & Western	346%	351%	344%	352%	243%	360%	343%	349%	347%	347%	224%	261%	232%	364%	338%	336%	344%
Wan Chai	130%	130%	130%	131%	128%	129%	131%	131%	130%	131%	138%	142%	142%	130%	126%	128%	131%
Eastern	151%	152%	152%	153%	151%	150%	152%	152%	151%	151%	137%	140%	141%	153%	147%	146%	152%
Southern	130%	130%	129%	130%	128%	128%	129%	131%	129%	129%	125%	153%	129%	129%	123%	125%	129%
Yau Tsim Mong	151%	152%	151%	156%	159%	146%	151%	151%	150%	151%	150%	155%	153%	144%	141%	147%	152%
Sham Shui Po	162%	165%	163%	169%	180%	162%	163%	162%	163%	162%	169%	179%	178%	163%	158%	158%	163%
Kowloon City	141%	143%	140%	141%	147%	138%	141%	142%	140%	141%	172%	143%	180%	138%	132%	139%	142%
Kwun Tong	156%	153%	156%	136%	166%	156%	157%	156%	156%	156%	160%	151%	165%	168%	137%	155%	157%
Wong Tai Sin	111%	112%	111%	115%	116%	110%	112%	112%	111%	112%	111%	139%	116%	109%	110%	105%	112%
Kwai Tsing	120%	123%	120%	126%	131%	121%	120%	120%	120%	121%	126%	124%	134%	121%	116%	116%	120%
Tuen Mun	173%	178%	172%	179%	176%	175%	172%	171%	172%	172%	172%	138%	186%	189%	181%	180%	173%
Island	913%	921%	926%	922%	864%	909%	912%	912%	913%	913%	848%	747%	870%	916%	890%	880%	911%
Yuen Long	384%	361%	386%	365%	423%	379%	386%	385%	386%	387%	398%	370%	451%	388%	336%	359%	384%
Tai Po	116%	109%	115%	109%	123%	115%	115%	114%	116%	115%	138%	106%	147%	115%	96%	110%	116%
North	226%	260%	226%	245%	234%	226%	226%	227%	228%	226%	219%	355%	232%	227%	224%	207%	228%
Sha Tin	130%	126%	129%	129%	134%	129%	130%	129%	130%	130%	133%	138%	140%	129%	115%	124%	130%
Sai Kung	436%	424%	434%	398%	451%	434%	437%	436%	438%	435%	490%	302%	508%	452%	356%	434%	435%
Tsuen Wan	245%	253%	254%	261%	272%	244%	251%	251%	253%	248%	264%	289%	266%	244%	236%	233%	248%
1997 total																	
% 1997 (total)	**180%**	**180%**	**180%**	**180%**	**183%**	**179%**	**180%**	**180%**	**180%**	**180%**	**180%**	**175%**	**189%**	**183%**	**169%**	**174%**	**180%**

2016

District	PRD (tons)	16/07 PRD	16/08 PRD	16/10 PRD	16/12 PRD	16/18 PRD	16/19 PRD	16/21 PRD	16/23 PRD	16/35 PRD	16/36 PRD	16/37 PRD	16/38 PRD	16/39 PRD
Central & Western	185	392%	396%	348%	343%	383%	333%	397%	372%	338%	359%	347%	363%	360%
Wan Chai	172	162%	164%	150%	144%	156%	145%	158%	146%	135%	130%	144%	147%	144%
Eastern	206	144%	144%	131%	128%	145%	134%	148%	140%	159%	154%	175%	177%	168%
Southern	142	171%	170%	147%	146%	174%	142%	173%	168%	145%	146%	152%	140%	156%
Yau Tsim Mong	217	163%	160%	148%	143%	167%	153%	174%	161%	151%	148%	155%	154%	155%
Sham Shui Po	244	182%	184%	159%	158%	186%	164%	192%	181%	166%	167%	169%	169%	169%
Kowloon City	267	189%	189%	171%	169%	191%	175%	191%	186%	170%	167%	179%	178%	182%
Kwun Tong	314	182%	177%	156%	162%	186%	162%	175%	184%	173%	167%	180%	180%	181%
Wong Tai Sin	134	123%	126%	113%	110%	122%	116%	123%	114%	199%	195%	206%	204%	206%
Kwai Tsing	543	148%	149%	131%	129%	140%	128%	148%	140%	170%	179%	174%	174%	173%
Tuen Mun	377	184%	197%	175%	170%	202%	196%	220%	188%	193%	196%	191%	193%	187%
Island	61	1069%	1154%	1036%	960%	669%	659%	744%	750%	972%	1155%	987%	975%	1008%
Yuen Long	184	482%	492%	441%	433%	491%	449%	509%	495%	569%	546%	546%	544%	545%
Tai Po	295	181%	171%	144%	153%	170%	139%	168%	188%	149%	128%	131%	131%	131%
North	81	308%	320%	269%	263%	313%	271%	330%	385%	414%	296%	302%	300%	305%
Sha Tin	535	162%	152%	132%	139%	160%	135%	156%	180%	139%	132%	136%	136%	136%
Sai Kung	51	556%	505%	428%	474%	595%	471%	559%	626%	559%	543%	573%	571%	575%
Tsuen Wan	134	284%	296%	260%	257%	282%	260%	290%	272%	247%	245%	246%	247%	242%
1997 total	**4142**													
% 1997 (total)		**216%**	**217%**	**191%**	**190%**	**211%**	**188%**	**215%**	**214%**	**213%**	**211%**	**212%**	**212%**	**212%**

District	16/40 PRD	16/41 PRD	16/42 PRD	16/43 PRD	16/44 PRD	16/45 PRD	16/46 PRD	16/47 PRD	16/48 PRD	16/49 PRD	16/50 PRD	16/51 PRD	16/52 PRD	16/53 PRD
Central & Western	360%	360%	257%	362%	392%	360%	360%	358%	362%	360%	361%	360%	361%	361%
Wan Chai	145%	144%	143%	153%	146%	147%	145%	144%	147%	144%	146%	145%	144%	144%
Eastern	169%	168%	169%	142%	172%	174%	168%	168%	170%	170%	169%	170%	170%	168%
Southern	156%	155%	153%	160%	158%	158%	156%	155%	160%	155%	155%	155%	154%	156%
Yau Tsim Mong	158%	155%	162%	154%	160%	161%	153%	156%	156%	153%	157%	157%	156%	153%
Sham Shui Po	171%	170%	184%	171%	178%	174%	167%	169%	170%	169%	170%	171%	170%	169%
Kowloon City	181%	179%	186%	180%	184%	184%	178%	179%	181%	178%	182%	181%	179%	176%
Kwun Tong	184%	180%	191%	182%	176%	186%	181%	180%	180%	181%	179%	180%	181%	180%
Wong Tai Sin	197%	206%	226%	210%	117%	207%	207%	204%	205%	206%	205%	204%	205%	206%
Kwai Tsing	166%	173%	196%	174%	135%	175%	173%	172%	174%	171%	173%	175%	172%	172%
Tuen Mun	195%	201%	206%	189%	187%	192%	190%	189%	191%	190%	191%	189%	192%	189%
Island	989%	965%	885%	998%	1081%	1034%	974%	992%	985%	1004%	985%	991%	1004%	1011%
Yuen Long	517%	521%	560%	547%	574%	535%	540%	547%	540%	540%	541%	542%	548%	539%
Tai Po	142%	132%	138%	132%	142%	134%	132%	131%	131%	130%	132%	132%	132%	132%
North	300%	303%	310%	304%	312%	310%	308%	303%	302%	303%	301%	303%	303%	303%
Sha Tin	146%	137%	141%	137%	143%	139%	137%	136%	136%	135%	136%	137%	137%	137%
Sai Kung	582%	569%	591%	576%	578%	581%	575%	573%	569%	570%	568%	572%	573%	573%
Tsuen Wan	259%	252%	275%	248%	265%	254%	248%	250%	244%	249%	245%	245%	250%	245%
1997 total														
% 1997 (total)	**214%**	**212%**	**217%**	**213%**	**212%**	**216%**	**212%**	**212%**	**213%**	**212%**	**213%**	**213%**	**213%**	**212%**

District	16/54 PRD	16/55 PRD	16/64 PRD	16/75 PRD	16/82 PRD	16/83 PRD	16/84 PRD	16/86 PRD	16/89 PRD	16/90 PRD
Central & Western	361%	365%	334%	399%	379%	370%	358%	296%	394%	394%
Wan Chai	145%	145%	172%	160%	145%	137%	149%	115%	134%	134%
Eastern	170%	168%	162%	150%	175%	168%	141%	133%	179%	179%
Southern	156%	156%	194%	180%	159%	150%	136%	111%	157%	157%
Yau Tsim Mong	152%	152%	186%	172%	144%	144%	138%	133%	165%	165%
Sham Shui Po	167%	165%	215%	194%	167%	167%	159%	145%	174%	174%
Kowloon City	178%	189%	174%	197%	195%	190%	172%	116%	150%	150%
Kwun Tong	182%	176%	182%	191%	185%	179%	161%	128%	177%	177%
Wong Tai Sin	208%	180%	166%	126%	185%	175%	113%	102%	197%	197%
Kwai Tsing	173%	167%	148%	147%	171%	173%	122%	112%	174%	174%
Tuen Mun	190%	190%	159%	222%	201%	194%	193%	182%	198%	198%
Island	991%	993%	975%	687%	951%	1027%	951%	893%	1023%	1023%
Yuen Long	543%	542%	443%	532%	545%	577%	492%	335%	544%	544%
Tai Po	132%	134%	120%	180%	137%	148%	126%	90%	129%	129%
North	308%	306%	445%	331%	312%	376%	272%	226%	303%	303%
Sha Tin	136%	138%	164%	167%	141%	155%	128%	105%	137%	137%
Sai Kung	573%	562%	357%	618%	576%	598%	477%	303%	536%	536%
Tsuen Wan	245%	249%	347%	299%	241%	242%	246%	226%	251%	251%
1997 total										
% 1997 (total)	**213%**	**211%**	**212%**	**221%**	**215%**	**219%**	**191%**	**159%**	**213%**	**213%**

Table 5.2h - Summary of Scenarios

Summary of Main Model Runs						% RSP		
Year	Run No.	Description	% vkt relative to 1997	% NOx relative to 1997	% VOC relative to 1997	(Tailpipe) relative to 1997	(Road Dust) relative to 1997	Composite Air Score
2001	39	LOW / Toll Scheme A	121%	102%	105%	77%	124%	1.02
2001	40	LOW / Toll Scheme B	121%	102%	105%	77%	124%	1.02
2001	41	LOW / Toll Scheme C	121%	102%	105%	77%	124%	1.01
2001	43	LOW / Toll Scheme D1	121%	102%	105%	77%	123%	1.01
2001	47	LOW / Toll Scheme D	121%	104%	105%	79%	126%	1.02
2001	48	**LOW / Budget Toll**	119%	102%	103%	78%	123%	1.01
2006	49	High Car High Goods	147%	92%	102%	56%	148%	0.96
2006	50	Medium Car High Goods	141%	90%	97%	56%	148%	0.94
2006	52	High Car Medium Goods	145%	89%	100%	54%	142%	0.93
2006	54	Medium Car Medium Goods	138%	88%	95%	54%	143%	0.92
2006	58	Scenario 2, Toll D, HVF, System Test 1	147%	92%	102%	57%	149%	0.97
2006	75	Scenario 2, Toll D, HVF, System 2 w/o Route 7	148%	92%	102%	57%	149%	0.97
2006	76	Scenario 2, Toll D, HVF, System Test 2	150%	93%	103%	57%	150%	0.98
2006	77	Scenario 2, Toll D, HVF, System Test 2, w/o CKR	150%	93%	103%	57%	150%	0.98
2006	78	Scenario 2, Toll D, HVF, System Test 2, w/o Route 9	150%	93%	103%	57%	150%	0.98
2006	80	Scenario 2, Toll D, HVF, System Test 2, w/o IEC	149%	93%	103%	57%	150%	0.97
2006	81	Scenario 2, Toll D, HVF, System Test 2, w/o T2	149%	93%	103%	57%	150%	0.98
2006	82	Scenario 2, Toll D, HVF, System Test 2, w/o Route 5	150%	93%	103%	57%	150%	0.98
2006	83	Scenario 2, Toll D, HVF, System Test 2, w/o Route 10	150%	93%	103%	57%	151%	0.98
2006	84	Scenario 2, Toll D, HVF, System Test 2, w/o Route 16	149%	93%	102%	57%	149%	0.97
2006	85	Scenario 2, Toll D, HVF, System Test 2, w/o WCR & Cross Bay Link	149%	93%	102%	57%	150%	0.97
2006	86	Scenario 2, Toll D, HVF, System Test 2, w/o all	148%	93%	102%	57%	151%	0.97
2006	89	Scenario 2, Toll D, HVF, System Test 2, w/o TM Southern Bypass & Port Expressway	149%	93%	102%	57%	149%	0.97
2006	91	Base Case for Rail Priority	149%	93%	103%	57%	150%	0.98
2006	92	Low Car, Toll B	142%	91%	98%	57%	151%	0.96
2006	94	Rail Priority	149%	92%	102%	57%	149%	0.97
2006	95	Base Case	147%	91%	100%	56%	146%	0.95
2006	97	(Sc I, Lo, Toll D) Least Demand	133%	84%	91%	52%	137%	0.88
2006	98	System Test 2 without TKO Rail Phase II	149%	93%	102%	57%	150%	0.97
2006	102	2001 Road / 2006 Rail	144%	89%	99%	54%	144%	0.94
2006	106	**Recommended Transport Strategy - High Growth**	147%	91%	101%	56%	146%	0.95
2006	107	**Recommended Transport Strategy - Medium Growth**	139%	88%	95%	54%	141%	0.91
2011	41	High Car High Goods	184%	90%	101%	48%	182%	0.99
2011	42	Medium Car High Goods	166%	87%	92%	47%	182%	0.95
2011	43	Medium Car Medium Goods	158%	81%	87%	44%	166%	0.88
2011	44	High Car Medium Goods	176%	85%	96%	45%	167%	0.93
2011	55	PT Fare Policy	186%	91%	101%	48%	183%	1.00
2011	69	ScII, Toll D, Hi, Base	182%	89%	99%	47%	179%	0.98
2011	69p	Park and Ride	182%	89%	99%	47%	179%	0.98
2011	71	(ScI, TollD, Lo) Least Demand	153%	79%	84%	43%	163%	0.86
2011	74	(ScII, TollD, Hi) System Test 4	183%	90%	99%	48%	179%	0.98
2011	75	(ScII, TollB, Hi) System Test 4	183%	90%	99%	48%	180%	0.98

Table 5.2h - Summary of Scenarios

Summary of Main Model Runs						% RSP		
Year	Run No.	Description	% vkt relative to 1997	% NOx relative to 1997	% VOC relative to 1997	(Tailpipe) relative to 1997	(Road Dust) relative to 1997	Composite Air Score
2011	76	System Test 4 without IWC	183%	90%	99%	48%	180%	0.98
2011	77	System Test 4 without Central Wanchai Bypass	182%	90%	99%	48%	180%	0.98
2011	78	System Test 4 without Lantau P1 Road	182%	90%	99%	48%	179%	0.98
2011	79	System Test 4 without IEC	183%	90%	99%	48%	180%	0.98
2011	80	System Test 4 without East-West Link	182%	89%	99%	48%	180%	0.98
2011	81	System Test 4 without Lantau Road Link	183%	90%	99%	48%	180%	0.98
2011	82	System Test 4 without Eastern Highway	182%	89%	99%	48%	180%	0.98
2011	83	(ScII, TollD,Hi) System Test 4 without HK - Lantau Link	183%	90%	99%	48%	183%	0.99
2011	84	(ScII, TollB, Hi) System Test 4 (EHX - Toll D)	183%	90%	99%	48%	179%	0.98
2011	87	System Test 4 without North Hong Kong Line (Central to North Point)	183%	90%	99%	48%	180%	0.98
2011	88	System Test 4 without West Hong Kong Line (Sheung Wan to Green Island)	183%	90%	99%	48%	180%	0.98
2011	89	System Test 4 without Hung Hom to Wan Chai (KCRC)	183%	90%	100%	48%	180%	0.98
2011	90	System Test 4 without East Kowloon Line (Tai Wai to Hung Hom)	183%	90%	99%	48%	180%	0.98
2011	93	PT Fare Intergration	183%	90%	99%	48%	180%	0.98
2011	97	with 2001 Road/ 2006 Rail	169%	85%	92%	46%	175%	0.93
2011	103	High Xborder Case	189%	93%	103%	50%	189%	1.02
2011	104	**Recommended Transport Strategy - High Growth**	184%	91%	100%	48%	183%	0.99
2011	105	**Recommended Transport Strategy - Medium Growth**	160%	82%	88%	44%	169%	0.89
2011	106	(ScII, TollD, Hi) System Test 4 with Port Rail	182%	88%	98%	47%	174%	0.96
2011	107	(ScII, TollD, Hi) System Test 4 without Rail Between Tai Wai and Diamond Hill	183%	90%	99%	48%	180%	0.98
2016	7	High Car High Goods	215%	105%	119%	57%	216%	1.16
2016	8	Medium Car High Goods	186%	99%	104%	55%	217%	1.09
2016	10	Medium Car Medium Goods	174%	90%	97%	49%	191%	0.99
2016	12	High Car Medium Goods	203%	96%	112%	51%	190%	1.06
2016	18	(ScII, TollD,Hi, Base)	213%	104%	117%	55%	211%	1.14
2016	19	(ScII, TollD, Low) Least Demand	169%	88%	94%	48%	188%	0.97
2016	21	(ScII, TollB,Base, Low Car, Hi GV)	189%	99%	104%	55%	215%	1.09
2016	23	(ScIII, TollD, Hi) Most Demand	236%	110%	128%	57%	214%	1.21
2016	35	System Test 2A - M4 Northern Bias	226%	108%	124%	57%	213%	1.18
2016	36	System Test 2A - M3 Lantau Bias	228%	108%	124%	57%	211%	1.18
2016	37	System Test 2A without IWC	222%	106%	121%	56%	212%	1.17
2016	38	System Test 2A without Route 81	222%	106%	121%	56%	212%	1.17
2016	39	System Test 2A without TST P1 Road	222%	106%	121%	56%	212%	1.17
2016	40	System Test 2A without TMS Link	224%	107%	122%	57%	214%	1.18
2016	41	System Test 2A without TM Western Bypass	222%	106%	121%	56%	212%	1.17
2016	42	System Test 2A without HK - Lantau Link	224%	108%	122%	57%	217%	1.19
2016	43	System Test 2A without HK North Bypass	222%	107%	121%	56%	213%	1.17
2016	44	System Test 2A without Kln Northern Bypass So Kwun Wat to Tai Mo Shan Link	219%	106%	120%	56%	212%	1.16
2016	45	System Test 2A without TM-CLK Link	222%	107%	121%	57%	216%	1.18
2016	46	System Test 2A without Further Widening YL HW	222%	106%	121%	56%	212%	1.17
2016	47	System Test 2A without IEC Imp	222%	107%	121%	56%	212%	1.17
2016	48	System Test 2A without Hong Kong Rail	223%	107%	122%	57%	213%	1.17

Table 5.2h - Summary of Scenarios

Summary of Main Model Runs						% RSP		
Year	Run No.	Description	% vkt relative to 1997	% NOx relative to 1997	% VOC relative to 1997	(Tailpipe) relative to 1997	(Road Dust) relative to 1997	Composite Air Score
2016	49	System Test 2A without Siu Sai Wan Station	221%	106%	121%	56%	212%	1.17
2016	50	System Test 2A without WR Yen Chow Street to TST	223%	107%	122%	56%	213%	1.17
2016	51	System Test 2A without SE KL West-East Rail	224%	107%	122%	57%	213%	1.18
2016	52	System Test 2A without Outer Western Corridor	224%	107%	122%	57%	213%	1.18
2016	53	System Test 2A without MOSR Ext	221%	106%	121%	56%	212%	1.17
2016	54	System Test 2A without XB Western Corridor	222%	107%	121%	56%	213%	1.17
2016	55	Recommended Infrastructure with New Kowloon Northern Bypass & So Kwun Wat to Tai Mo Shan	220%	106%	120%	56%	211%	1.16
2016	64	with 2001 Road and 2006 Rail	183%	95%	101%	53%	212%	1.06
2016	75	High Xborder Case	219%	107%	121%	58%	221%	1.19
*2016	82	**Recommended Transport Strategy - High Growth (Low End)**	220%	107%	120%	57%	215%	1.17
*2016	83	**Recommended Transport Strategy - High Growth (High End)**	248%	114%	134%	59%	219%	1.25
*2016	84	**Recommended Transport Strategy - Medium Growth**	179%	92%	99%	50%	191%	1.01
*2016	86	**Recommended Transport Strategy - Low Growth**	145%	76%	80%	41%	159%	0.83
2016	89	System Test 2A without Fourth Harbour Crossing	222%	107%	121%	57%	213%	1.17
2016	90	System Test 2A without T1	222%	107%	121%	57%	213%	1.17
Notes:	(i)	Scenarios in bold refers to refers to Recommended Transport Strategy of the respective design years.						
	(ii)	Scenarios marked with "*" have been tested using PATH air quality model.						

Table 5.2k
Contribution of VOC by Vehicle Types

	1997	2001	2006	2011	2016
M/C	2	1	1	3	3
P/C	1	3	3	1	2
Taxi	6	6	5	5	5
PV	9	9	9	9	9
PLB	8	8	8	8	8
LGV	4	4	4	4	4
HGV	3	2	2	2	1
NFB	7	7	7	7	7
FBSD	10	10	10	10	10
FBDD	5	5	6	6	6

Table 5.2l
Contribution of RSP (tailpipe) by Vehicle Types

	1997 tailpipe	2001 tailpipe	2006 tailpipe	2011 tailpipe	2016 tailpipe
M/C	9	10	10	9	9
P/C	6	5	4	3	3
Taxi	3	4	8=	8	8
PV	8	8	7	6	6
PLB	6	7	6	7	7
LGV	2	2	2	2	2
HGV	1	1	1	1	1
NFB	7	6	5	5	5
FBSD	10	9	8=	10	10
FBDD	4	3	3	4	4
Note: 8= means equal contribution					

Discussion

5.2.14 The Main Model Runs of the CTS-3 have conducted analysis for 99 transport scenarios (6 in 2001; 26 in 2006; 30 in 2011 and 37 in 2016). The majority of these are for the purposes of economic analysis, while the remainders are classified into sensitivity, policy, environmental and main analyses. It should be noted that the environmental analysis conducted in this SEA study is strategic in nature and the need, detailed alignment and form of infrastructure should be determined at the project feasibility study. The discussions of the findings will be organised by Design Years (2001, 2006, 2011 and 2016) and types of analysis. The Run Numbers will be referred to instead of the full description of the scenario to simplify the text. All percentages presented in section are percentage relative to 1997 unless otherwise stated, ie 200% means that the quantity of emissions is doubled that in 1997, and 50% means the quantity is halved with respect to 1997.

Year 2001

5.2.15 As year 2001 is in the very immediate future, a reasonable set of assumptions could be made in terms of population, highway infrastructures and other variables. Six analyses were conducted for 2001, mainly to assess the effect of variations in the toll structure of the tunnels and expressways in Hong Kong. Level 1 analysis has shown that air pollutant emissions (NO_x, VOC and RSP) are insensitive to the toll structure (See Table 5.2h).

5.2.16 The 1999 budget has proposed a revised toll for the Hung Hom Cross Harbour Tunnel and Lion Rock Tunnel and a scenario based on this toll was analysed (Run 48).

5.2.17 Run 48 indicates that a 19% overall increase in vkt relative to 1997 is predicted in 2001. The major increases are predicted in the Island District (403%), Yuen Long District (226%), North (233%) and Tsuen Wan (203%). Reductions in vkt are predicted in Kwai Tsing (86%) and Tai Po (71%). (ref. Table 5.2c)

5.2.18 In terms of NO_x emissions, a 2% overall increase is predicted by the Level 1 analysis. NO_x emissions in the high vkt growth districts also showed significant increase: Island District (300%), Yuen Long District (218%), North (217%) and Tsuen Wan (167%). However, in districts where the vkt remain stable, a reduction in NO_x emissions is predicted (between 10-20% relative to 1997). In districts where there are reductions in vkt, significant reductions in NO_x emissions are predicted: eg Kwai Tsing (73%) and Tai Po (56%). (ref. Table 5.2d)

5.2.19 The VOC emissions show a similar trend in high vkt growth districts: Island District (317%), Yuen Long District (224%), North (214%) and Tsuen Wan (188%). In districts where the vkt remain approximately the same, reductions in VOC emissions are predicted (between 10-20% relative to 1997). Reductions in VOC emissions are also predicted for districts with reduced vkt: Kwai Tsing (75%) and Tai Po (61%). A 3% overall increase in VOC emissions is predicted by the Level 1 analysis. (ref. Table 5.2e)

5.2.20 Significant reduction (up to 50%) of RSP (tailpipe) emissions is observed in districts where vkt remains similar to 1997. Nevertheless, significant increases are still predicted in high vkt growth districts: Island District (209%), Yuen Long District (186%), North (180%) and Tsuen Wan (132%). A reduction of up to 55% in RSP (tailpipe) emissions is predicted in the Tai Po district. Overall RSP (tailpipe) emissions is reduced by 22% mainly due to the improved emissions standards. (ref. Table 5.2f)

5.2.21 As paved road dust emissions is a function of vkt, significant increases are predicted in high vkt growth districts: Island District (417%), Yuen Long District (233%), North (241%) and Tsuen Wan (210%). An overall increase in prd emissions of 23% is predicted for Run 48.

5.2.22 The overall increase in vkt (19%) is offset by the slightly improved vehicle emissions as indicated by the emission factors (Table 5.2a). The overall pollutant emissions in

2001 remain approximately the same as that for 1997 as reflected in Air Score (1.01) for Run 48 (ref. Table 5.2h).

5.2.23 Private Car (P/C) emissions contribute to the most vkt (41%), followed by Light Goods Vehicles (LGV) (20%), Taxi (15%) and Heavy Goods Vehicles (HGV) (14%). In terms of NO_x emissions, HGV is the main contributor (38%) followed by P/C (20%), LGV (13%) and Double Decker Franchised Bus (11%). Motorcycle (M/C) and HGV are the main contributors to VOC emissions (27% and 25% respectively) and P/C contributes about 24% of the total VOC. HGV contributes to 49% of the total RSP (tailpipe) emissions and LGV and Double Decker Franchised Bus about 20% and 9% respectively. (ref. Figure 5.2c)

5.2.24 A summary of the pollutant emissions relative to 1997 in each district is shown in Figure 5.2g. Reduction in pollutant emissionsis observed in most of the developed and densely populated urban districts. Significant increases in pollutant emissions are predicted in the districts with rapidly developing new towns (Yuen Long and Lantau Island). It should be noted that the significant increase in pollutant emissions in the Island District is attributed to a major expansion of the local infrastructure.

Year 2006

5.2.25 In 2006, a reasonable estimate of the transport infrastructure can be determined. The Base Case (Run 95) showed a 47% increase in vkt relative to 1997. The pollutant emissions relative to 1997 for $NO_{x,}$, VOC, RSP (tailpipe) and RSP (prd) are 91%, 100%, 56% and 146% respectively and the Composite Air Score is 0.95. The contribution to pollutant emissions by different types of vehicle is very similar to that for 2001. Various input variables are modified for sensitivity tests for the Recommended Transport Strategy for 2006.

5.2.26 Four sensitivity analyses were conducted on the fleet sizes of cars and goods vehicles (Runs 49, 50, 52 and 54). The vkt growth varies between 147% for the High Car and High Goods Fleet scenario (Run 49) to 138% for the Medium Car and Medium Goods Fleet scenario (Run 54). The NO_x emission varies from 92% for Run 49 to 88% for Run 54. The VOC emission varies from 102% for Run 49 to 95% for Run 54. The RSP (tailpipe) emission varies from 56% for Run 49 to 54% for Run 54. The RSP (prd) emission varies from 148% for Run 49 to 143% for Run 54. The Composite Air Score for High Car High Goods Vehicle Fleet is 0.96 and the Composite Air Score for Medium Car Medium Goods Vehicle Fleet is 0.92. The results show that although there is an increase in the vehicle fleet size (both car and goods vehicle), NO_x, and RSP (tailpipe) emissions show a reduction due to the stricter emissions standards (Euro III) imposed on these vehicles. However, the Euro III standards have less effect on VOC emissions. An increase RSP (prd) emission is predicted following the increase in vkt.

Rail Priority

5.2.27 One of the analyses (Run 94) conducted for 2006 is used to accord priorities to railways. The transport model has removed all the competing bus routes for the East Rail and Tseung Kwan O (TKO) Extension. When comparing with a scenario with the competing bus routes (Run 91), it can be seen that reductions in pollutant emissions are observed. Table 5.2m presents the results in 18 districts for two scenarios in 2006 with and without the competing bus routes. The table shows the pollutant emissions for the transport scenario without the competing bus routes (Run 94) as a percentage of those with the competing bus routes (Run 91) ie Run 94 ÷ Run 91 × 100%.

Table 5.2m
Comparison of Scenarios (Rail Priority vs No Rail Priority)

District	Run 94/91 % vkt	Run 94/91 % NO_x	Run 94/91 % VOC	Run 94/91 % RSP	
				Tailpipe	Paved Road Dust
Central & Western	99.8%	100.0%	99.9%	100.2%	99.6%
Wan Chai	98.9%	98.9%	98.9%	98.9%	98.7%
Eastern	99.4%	99.0%	99.2%	98.7%	99.2%
Southern	99.4%	98.8%	99.7%	98.7%	99.2%
Yau Tsim Mong	99.1%	99.6%	99.3%	99.7%	98.9%
Sham Shui Po	98.8%	99.3%	99.0%	99.5%	98.6%
Kowloon City	101.1%	100.9%	101.2%	101.1%	101.9%
Kwun Tong	99.6%	98.6%	99.2%	98.6%	99.4%
Wong Tai Sin	98.6%	96.8%	97.9%	96.2%	98.4%
Kwai Tsing	97.8%	98.8%	98.1%	99.1%	97.6%
Tuen Mun	100.3%	99.4%	99.9%	98.8%	100.1%
Island	99.9%	100.2%	100.0%	100.2%	99.7%
Yuen Long	100.0%	101.8%	100.7%	102.3%	99.8%
Tai Po	98.5%	95.2%	97.7%	95.3%	98.3%
North	99.0%	98.1%	98.6%	98.1%	98.8%
Sha Tin	99.6%	97.1%	99.1%	96.8%	99.4%
Sai Kung	99.7%	100.0%	99.8%	99.8%	99.5%
Tsuen Wan	101.8%	101.1%	101.6%	100.9%	101.6%
Total	**99.5%**	**99.3%**	**99.5%**	**99.4%**	**99.3%**

5.2.28 A slight reduction in pollutant emissions is predicted in most districts. The reduction is more evident in districts along the East Rail - Sha Tin, Tai Po, Wong Tai Sin and North. NO_x emissions are reduced by 2.9%, 4.8% 3.2% and 1.9% in these districts respectively as Buses are one of the main contributors to the total NO_x emission (16.5%). The RSP (tailpipe) emissions showed a similar order of reductions in these districts. VOC reduction is less apparent as Buses contribute only about 7% of total emissions for this pollutant. The reduction in RSP (prd) is due to the reduced vkt of the buses serving these districts. Although the territory-wide reduction is small (<1%), it is evident that promoting rail against road transport can have notable effect at the local level.

Recommended Transport Strategy for 2006

5.2.29 A number of analyses have been conducted for 2006 to assist in the formulation of the Recommended Transport Strategy. Most of these analyses are economic analysis. The variation in terms of environmental performance for most of the scenarios analysed is largely insignificant on a territory-wide basis as reflected in Table 5.2h. The Recommended Transport Strategy in 2006 consists of two scenarios - High Growth and Medium Growth.

5.2.30 The High Growth scenario (Run 106) shows a 47% increase in vkt relative to 1997. An 9% & 44% reduction in NO_x and RSP (tailpipe) emissions respectively and a 1% and 46% increase in VOC and RSP (prd) emissions are predicted for this transport scenario relative to 1997. The Composite Air Score is 0.95.

5.2.31 The Medium Growth scenario (Run 107) shows a 39% increase in vkt relative to 1997. An 12%, 5% & 46% reduction in NO_x, VOC and RSP (tailpipe) emissions respectively and a 41% increase in RSP (prd) emissions are predicted for this transport scenario relative to 1997. The Composite Air Score is 0.91. Similar to 2001, the overall increase in vkt (47% for High Growth and 39% for Medium Growth scenarios) is offset by the improved vehicle emission standards as indicated by the reduced emission factors (Table 5.2a). Heavy Goods Vehicles (38%), Private Cars (20%) and Light Goods Vehicles (12%) are the main contributors to NO_x emissions from transportation. Heavy Goods and Light Goods Vehicles together contribute to 70% of total RSP (tailpipe) emissions from road transportation. Motorcycles are the main contributors for VOC emissions due to the lack of current standards to control motorcycle emissions. However, the Government has planned to the control of emissions from motorcycles at the end of 1999. All imported motorcycle have to meet international emission standards before they can be imported to HKSAR. The effect is less apparent due to existing motorcycles which will only be gradually phased out in the next 5 to 10 years period.

5.2.32 A summary of the pollutant emissions relative to 1997 in each district for the High and Medium Growth of the Recommended Transport Strategy of 2006 are shown in Figures 5.2h and Fig 5.2i, respectively. Pollutant emissions are lower than those in 1997 in developed urban areas due to the improved emission standards imposed on vehicles and the limited growth in vkt. However, in districts with developing new towns (Sai Kung, North, Yuen Long and Island) and Tsuen Wan district which leads to Yuen Long and North, pollutant emissions showed significant increases relative to 1997. This is mainly due to the rapid growth of vkt generated by new highways infrastructure in these districts with developing New Towns (except Tsuen Wan).

Year 2011

5.2.33 The Base Case (Run 69) considered for 2011 showed a 82% increase in vkt relative to 1997. The pollutant emissions relative to 1997 for NO_x, VOC, RSP (tailpipe) and

RSP (prd) are 89%, 99%, 47% and 179% respectively and the Composite Air Score is 0.98. The contribution to pollutant emissions by different types of vehicle is very similar to that in 2006. Heavy Goods Vehicles and Private Cars are the main contributors to emissions (ref. Figure 5.2e). It is also observed that Light Goods Vehicles show an increased contribution for all three pollutants examined.

5.2.34 Four sensitivity analyses were conducted on the fleet sizes of cars and goods vehicles (Runs 41, 42, 43 and 44). These analyses assumed the same transport infrastructure and the vehicle fleet sizes are varied. The vkt varies between 184% for the High Car and High Goods Fleet scenario (Run 41) to 158% for the Medium Car and Medium Goods Fleet scenario (Run 43). The NO_x emissions vary from 90% for Run 41 to 81% for Run 43. The VOC emissions vary from 101% for Run 41 to 87% for Run 43. The RSP (tailpipe) and RSP (prd) emissions vary from 48% and 182% for Run 41 to 44% and 166% for Run 43 respectively. The Composite Air Scores for the High Car High Goods Vehicle Fleet and Medium Car Medium Goods Vehicle Fleet are 0.99 and 0.93 respectively.

Kwai Chung Port Rail Line (Freight Transport)

5.2.35 One of the scenarios tested is the inclusion of the Kwai Chung Port Rail Line into the transport model keeping all other variables unchanged (Run 106). Table 5.2n shows changes in vkt and emissions with and without this development (Run 74).

Table 5.2n
Comparison of Scenarios (Kwai Chung Port Rail Line)

District	Run 106/74 % vkt	Run 106/74 % NO_x	Run 106/74 % VOC	Run 106/74 % RSP	
				Tailpipe	prd
Central & Western	99.9%	99.4%	99.9%	99.0%	97.6%
Wan Chai	100.2%	100.2%	100.2%	100.0%	97.9%
Eastern	98.4%	98.3%	98.3%	97.9%	96.2%
Southern	99.0%	99.3%	99.1%	99.4%	96.8%
Yau Tsim Mong	99.3%	99.3%	99.4%	99.1%	97.1%
Sham Shui Po	99.8%	99.7%	99.8%	99.6%	97.6%
Kowloon City	100.4%	100.1%	100.3%	99.4%	98.1%
Kwun Tong	101.1%	101.0%	101.1%	100.7%	98.8%
Wong Tai Sin	96.6%	96.7%	96.6%	96.3%	94.4%
Kwai Tsing	99.7%	99.6%	99.7%	99.5%	97.5%
Tuen Mun	107.4%	109.1%	108.2%	110.0%	105.0%
Island	99.2%	98.1%	98.7%	97.5%	97.0%
Yuen Long	94.6%	90.2%	92.3%	88.3%	92.4%
Tai Po	98.6%	96.9%	98.0%	95.7%	96.4%
North	93.8%	88.6%	91.3%	86.5%	91.7%
Sha Tin	98.5%	97.9%	98.2%	97.0%	96.3%
Sai Kung	101.7%	100.6%	101.4%	99.5%	99.4%
Tsuen Wan	98.0%	97.5%	97.8%	97.1%	94.6%
Total	**99.5%**	**98.6%**	**99.2%**	**97.9%**	**97.2%**

5.2.36 The scenario with the Kwai Chung Port Rail Line showed an overall reduction in vkt and pollutant emissions when compared with the scenario without the railway. The most significant reductions are observed in the North District, where reductions in vkt, NO_x, VOC, RSP (tailpipe) and RSP (prd) are 6.2%, 11.4%, 8.7%, 13.5% and 8.3% respectively. This is probably attributable to the reduction in goods vehicle traffic in this district. Significant reductions in vkt and pollutant emissions are also observed Yuen Long where there is usually more journeys made by goods vehicles. However, increases are observed in Tuen Mun where vkt increases by 7.4% and NO_x, VOC, RSP (tailpipe) and RSP (prd) emissions increase by 9.1%, 8.2%, 10% and 5.0% respectively. Although the overall reduction in pollutant emissions is relatively small, significant reductions are observed at local levels.

High Cross Boundary Scenario

5.2.37 One of the scenarios tested by the transport model is to test the sensitivity when the cross boundary traffic is high (Run 103). Table 5.2o shows the results of the transport scenario with the high cross boundary traffic as a percentage of the scenario with normal cross boundary traffic (Run 69).

Table 5.2o
Comparison of Scenarios (High Cross Boundary Scenario)

District	Run 103/69 % vkt	Run 103/69 % NOx	Run 103/69 % VOC	Run 103/69 % RSP	
				Tailpipe	prd
Central & Western	101.7%	101.2%	101.7%	101.0%	103.8%
Wan Chai	101.3%	101.2%	101.3%	101.4%	103.3%
Eastern	100.9%	100.6%	100.9%	100.4%	103.0%
Southern	101.2%	101.0%	101.2%	101.0%	103.2%
Yau Tsim Mong	101.3%	101.0%	101.3%	101.0%	103.4%
Sham Shui Po	103.5%	102.5%	103.4%	102.2%	105.6%
Kowloon City	102.5%	102.5%	102.6%	102.6%	104.5%
Kwun Tong	101.3%	101.6%	101.5%	102.1%	103.4%
Wong Tai Sin	100.4%	99.3%	100.1%	98.3%	102.5%
Kwai Tsing	103.9%	103.1%	103.9%	103.1%	106.0%
Tuen Mun	108.0%	107.0%	108.6%	107.4%	110.2%
Island	101.6%	102.3%	101.9%	102.7%	103.6%
Yuen Long	111.6%	113.2%	113.2%	114.3%	113.8%
Tai Po	104.4%	105.8%	105.0%	106.7%	106.5%
North	103.1%	104.9%	103.9%	105.6%	105.2%
Sha Tin	102.4%	103.4%	102.8%	104.2%	104.5%
Sai Kung	102.0%	103.3%	102.5%	104.7%	104.1%
Tsuen Wan	102.1%	100.9%	102.0%	100.9%	102.1%
Total	**103.7%**	**104.3%**	**104.3%**	**105.2%**	**105.7%**

5.2.38 An overall increase in the pollutant emissions is predicted for the transport scenario with high cross boundary traffic. The most significant increases are observed at Yuen Long (Lok Ma Chow) and North District (Man Kam To) where the cross boundary traffic start and end within the territory of HKSAR and Tuen Mun district where it is a usual route to reach the boundary crossings.

Park and Ride

5.2.39 Park and Ride facilities have been incorporated in one of the scenarios (Run 69p). When compared with the base case (Run 69) with no provision of Park and Ride facilities, no apparent effect on the vkt or the pollutant emissions are observed probably due to the small scale of the Park and Ride facilities assumed for testing. The effects may be more apparent when these facilities are more widely used.

Public Transport Fare Policy

5.2.40 Run 93 assumed a public transport fare integration where there is a rebate when the journey is continued in other modes of public transport eg rail to bus. The results showed that there is very little difference (<1%) in terms of vkt and pollutant emissions for this scenario.

Recommended Transport Strategy

5.2.41 Various input variables are modified for sensitivity tests for the Recommended Transport Strategy for 2011. Most of these analyses are economic in nature. The variation in terms of environmental performance for most of the scenarios tested is insignificant, as reflected in Table 5.2h. The Recommended Transport Strategy in 2011 consists of two scenarios - High Growth and Medium Growth.

5.2.42 The High Growth scenario (Run 104) shows a 84% increase in vkt relative to 1997. A 9% and 52% reduction in NO_x and RSP (tailpipe) respectively and an 89% increase in RSP (prd) emissions are predicted relative to 1997. The VOC emissions remain the same as 1997. The Composite Air Score is 0.99. The Medium Fleet scenario (Run 105) shows a 60% increase in vkt relative to 1997. A 18%, 12% & 56% reduction in NO_x, VOC and RSP (tailpipe) emissions respectively and a 69% increase in RSP (prd) emissions are predicted relative to 1997. The Composite Air Score is 0.89. Figure 5.2p shows the trends in vkt and pollutant emissions for all design years. It appears that the effects of improved emission standards are becoming less effective in 2011 due to the increases in vkt.

5.2.43 Summaries of the pollutant emissions relative to 1997 in each district for the High and Medium Growth of the Recommended Transport Strategy of 2011 are shown in Figures 5.2j and 5.2k, respectively. The NO_x and VOC emissions in developed urban districts remained lower than those in 1997. RSP (prd) emissions exceed the 1997 levels. Pollutant emissions in districts with developing new towns continue to increase mainly due to the provision of new highway infrastructure.

Year 2016

5.2.44 The Base Case (Run 18) considered for 2016 showed a 113% increase in vkt relative to 1997. The pollutant emissions relative to 1997 for NO_x, VOC and RSP (prd) show increases of 4%, 17% and 111% respectively and reduction of 45% in RSP (tailpipe) emissions. The contribution to pollutant emissions by different types of vehicle is very similar to that in 2011. Heavy Goods Vehicles and Private Cars are the main contributors to NO_x and VOC emissions (ref. Figure 5.2f) and Heavy Goods and Light Goods Vehicles are the main contributors to RSP (tailpipe) emissions.

5.2.45 Four sensitivity analyses were conducted on the fleet size of cars and goods vehicles (Runs 7, 8, 10 and 12). These analyses assumed the same transport infrastructure but the vehicle fleet sizes are varied. The vkt varies between 215% for the High Car and High Goods Fleet scenario (Run 7) to 174% for the Medium Car and Medium Goods Fleet scenario (Run 10). The NO_x emissions vary from 105% for Run 7 to 90% for Run 43. The VOC emissions vary from 119% for Run 7 to 97% for Run 10. The RSP (tailpipe) and RSP (prd) emissions vary from 57% and 216% for Run 7 to 49% and 191% for Run 10 respectively. The Composite Air Score for High Car High Goods Vehicle Fleet is 1.16 and the Composite Air Score for Medium Car Medium Goods Vehicle Fleet is 0.99. The results show that the pollutant emissions for VOC exceed the levels in 1997 except the Medium fleet sizes. NO_x emission exceed the 1997 level under the High Car High Goods Fleet scenario and is within 10% of the 1997 level for the other three fleet sizes.

High Cross Boundary Scenario

5.2.46 A scenario was developed for 2016 to test the traffic conditions when the cross boundary traffic is assumed high (Run 75). Run 75 shows increases relative to 1997 in vkt (119%) and most pollutants (NO_x 7%; VOC 21%; RSP (prd) 121%). Table 5.2p shows the results of the transport scenario with the high cross boundary traffic as a percentage of the scenario with normal cross boundary traffic (Run 18) in 2016.

Table 5.2p
Comparison of Scenario (High Cross Boundary Traffic)

District	Run 75/18 % vkt	Run 75/18 % NOx	Run 75/18 % VOC	Run 75/18 % RSP	
				Tailpipe	prd
Central & Western	102.0%	101.5%	102.4%	101.5%	104.1%
Wan Chai	100.7%	100.8%	100.7%	101.0%	102.8%
Eastem	101.3%	101.4%	101.4%	101.9%	103.3%
Southem	101.1%	101.1%	101.3%	101.3%	103.2%
Yau Tsim Mong	100.6%	100.0%	100.5%	99.6%	102.7%
Sham Shui Po	102.3%	101.6%	102.3%	101.3%	104.4%
Kowloon City	101.3%	101.2%	101.4%	101.4%	103.3%
Kwun Tong	100.6%	101.2%	100.8%	102.1%	102.7%
Wong Tai Sin	101.1%	101.7%	101.5%	102.7%	103.2%
Kwai Tsing	102.4%	102.2%	102.5%	102.4%	104.5%
Tuen Mun	107.7%	106.6%	108.2%	106.7%	109.9%
Island	100.6%	101.1%	101.0%	101.5%	102.7%
Yuen Long	106.2%	107.7%	107.5%	108.6%	108.4%
Tai Po	104.0%	105.9%	104.7%	107.3%	106.1%

District	Run 75/18 % vkt	Run 75/18 % NOx	Run 75/18 % VOC	Run 75/18 % RSP	
				Tailpipe	prd
North	103.3%	104.5%	103.9%	105.0%	105.5%
Sha Tin	102.5%	103.6%	102.9%	104.5%	104.6%
Sai Kung	101.8%	103.4%	102.3%	105.1%	103.8%
Tsuen Wan	103.7%	104.1%	104.5%	104.9%	105.9%
Total	**102.9%**	**103.6%**	**103.5%**	**104.3%**	**105.0%**

5.2.47 To identify the contribution by cross boundary traffic, a scenario is developed to test the contribution of cross boundary traffic alone. Table 5.2q shows the pollutant emissions in each district by cross boundary traffic.

Table 5.2q
Contribution by Cross Boundary Traffic

District	% vkt	% NOx	% VOC	% RSP	
				Tailpipe	prd
Central & Western	5%	9%	6%	14%	5%
Wan Chai	1%	1%	1%	1%	1%
Eastern	2%	1%	1%	1%	2%
Southern	1%	1%	1%	1%	1%
Yau Tsim Mong	1%	1%	1%	1%	1%
Sham Shui Po	2%	2%	2%	3%	2%
Kowloon City	1%	3%	2%	4%	2%
Kwun Tong	1%	2%	1%	3%	1%
Wong Tai Sin	3%	4%	3%	5%	3%
Kwai Tsing	6%	9%	7%	11%	6%
Tuen Mun	12%	18%	14%	22%	12%
Island	8%	11%	9%	13%	8%
Yuen Long	20%	37%	29%	45%	21%
Tai Po	5%	13%	8%	18%	5%
North	17%	35%	26%	43%	18%
Sha Tin	2%	6%	3%	8%	2%
Sai Kung	2%	5%	3%	8%	2%
Tsuen Wan	4%	6%	5%	9%	4%

5.2.48 The results given in Table 5.2p showed that when the cross boundary traffic is high, vkt and pollutant emissions showed increases in all districts (except for RSP (tailpipe) in Yau Tsim Mong). Increases are most evident in districts with a high percentage of cross boundary traffic (Tuen Mun, Yuen Long and North) as shown in Table 5.2q. These scenarios demonstrated that the variation of cross boundary traffic could have notable effect on air pollutant emissions both locally and territory-wide.

Recommended Transport Strategy

5.2.49 Various input variables are modified for sensitivity tests for the Recommended Transport Strategy for 2016. The variation in terms of their environmental performance is insignificant for most of the transport scenarios tested, as reflected in Table 5.2h. The Recommended Transport Strategy in 2016 consists of four scenarios - High Growth (High End), High Growth (Low End), Medium Growth and Low Growth..

5.2.50 The High Growth (High End) scenario (Run 83) shows a 148% increase in vkt relative to 1997. A 14%, 34% and 119% increase in NO_x, VOC and RSP (prd) emissions respectively and 41% reduction of RSP (tailpipe) are predicted for this transport scenario relative to 1997. The Composite Air Score is 1.25. The High Growth (Low End) (Run 82) shows a 120% increase in vkt relative to 1997. A 7%, 20% and 115% increase in NO_x, VOC and RSP (prd) emissions respectively and a 43% reduction of RSP (tailpipe) emissions are predicted for this transport scenario relative to 1997. The Composite Air Score is 1.17. The Medium Growth scenario (Run 84) shows a 79% increase in vkt relative to 1997. An 8%, 1% and 50% reduction in NO_x, VOC and RSP (tailpipe) emissions respectively and a 91% increase in RSP (prd) emissions are predicted for this transport scenario relative to 1997. The Composite Air Score is 1.01. The Low Growth scenario shows a 45% & 59% increase in vkt and RSP (prd) respectively and reduction in three pollutants relative to 1997 (NO_x 24%; VOC 20%; RSP 59%). The Composite Air Score of Low Growth scenario is 0.83.

5.2.51 The results indicated that the pollutant emissions would increase from 2011. It appears that the effect of emission standards (Euro III) to control vehicle emissions is offset by the increases in vkt. Figure 5.2p shows the trends in vkt and pollutant emissions for all design years.

5.2.52 A summary of the pollutant emissions relative to 1997 in each district for the four scenarios of the Recommended Transport Strategy in 2016 are shown in Figure 5.21 to Fig 5.2o. The NO_x, VOC and RSP (tailpipe) emissions in developed urban districts remained lower than that of 1997 for Low and Medium Growth scenarios. In all four scenarios of the Recommended Transport Strategy for 2016, significant increase in pollutant emissions are predicted in districts with rapidly developing new towns (Sai Kung -Tseung Kwan O, Island - Tung Chung, Tuen Mun and Yuen Long - Tin Shui Wai, Hung Shui Kiu).

Summary of Changes of Pollutant Emissions for Recommended Transport Strategy

5.2.53 Figure 5.2p presents the trends of pollutant emissions from 1997 and Table 5.2r summaries the changes relative to 1997 for the Recommended Transport Strategy.

Table 5.2r
Summary of Pollutant Emissions for Recommended Transport Strategy

Scenario	vkt relative to 1997	NO_x relative to 1997	VOC relative to 1997	RSP (Tailpipe) relative to 1997	RSP (Paved Road Dust) relative to 1997	Composite Air Score
2001	119%	102%	103%	78%	123%	1.01
2006 High Growth	147%	91%	101%	56%	146%	0.95
2006 Medium Growth	139%	88%	95%	54%	141%	0.91
2011 High Growth	184%	91%	100%	48%	183%	0.99
2011 Medium Growth	160%	82%	88%	44%	169%	0.89
2016 High Growth (High End)	248%	114%	134%	59%	219%	1.25
2016 High Growth (Low End)	220%	107%	120%	57%	215%	1.17
2016 Medium Growth	179%	92%	99%	50%	191%	1.01
2016 Low Growth	145%	76%	80%	41%	159%	0.83

5.3 PATH Model Analysis

5.3.1 The PATH Modelling System

5.3.1.1 Overview

The air quality assessment undertaken in this assignment has utilised the PATH (Pollutants in the Atmosphere and their Transport over Hong Kong) modelling system. PATH is a state-of-the-art, comprehensive regional air quality modelling system specifically designed for the simulation of air quality in Hong Kong.

The modelling system incorporates the following components:

- a multi-scale, non-hydrostatic numerical meteorological model (MM5);
- a multi-scale, multi-species air quality model (SAQM);
- a state-of-the-art emission modelling system (EMS-95) coupled with a two-tiered comprehensive emissions inventory for Hong Kong and, at lower resolution, for southern China;
- a relational database and pre-processor system for storing and managing data and generating databases for model operation and validation;
- a post-processing module for analysis, interpretation and display of model outputs, including visualisation capabilities; and
- an intelligent, user-friendly interface with an on-line help system, which makes extensive use of Graphical User Interface (GUI) and GIS technology.

5.3.1.2 Modelling grids

Both the meteorological and air quality models employ the same five-level hierarchy of nested grids and the emissions model is set up to compute appropriate emissions for every cell of each grid. The use of grid-nesting enables higher resolution simulations to be embedded in the larger-scale flows generated by the model run with the coarse resolution. The horizontal resolutions are 40.5, 13.5, 4.5, 1.5, and 0.5 km. The largest grid (40.5km) extends over a wide area of South-East Asia and the 1.5 km grid covers the whole SAR. All modelling domains have the same vertical structure with 26 unequally spaced levels ranging from 10 to 20,870 m above the ground.

5.3.1.3 Emissions Model

The emissions are modelled in PATH by the Emissions Modelling System version 1995 (EMS-95). EMS-95 is a publicly available, state-of-art modelling system which is maintained and distributed by Alpine Geophysics. EMS-95 has gained a growing acceptance and an installed base including the Lake Michigan Air Directors Consortium, the California Air Resources Board Technical Support Division, United States Environmental Protection Agency (US EPA) Atmospheric Research and Exposure Assessment Laboratory, the Texas Natural Resource Conservation Commission (TNRCC), the Michigan Department of Natural Resources and the Carnegie Mellon University.

EMS-95 has been adopted for the MODELS 3 air quality modelling system of the USEPA and has been used in connection with MM5 and SAQM in the Southern California Air Quality Study (SCAQS-97).

The emission modelling system is coupled in PATH with a two-tiered, comprehensive emissions inventory, dealing with all of the key primary pollutants. Depending on the modelling grid in use, emissions can be determined for a region of southern China at resolutions of 13.5 or 4.5 km and for Hong Kong, at resolutions of 1.5 or 0.5 km. The former allows the air quality model to predict regional background concentrations of both primary and secondary pollutants. The latter are used for the prediction of SAR and urban-scale air quality.

5.3.1.4 Meteorological Model

A state-of-the-art, multi-scale, non-hydrostatic numerical meteorological model (MM5) has been selected for the PATH system. A *two-way* nesting mode is used for all nested grids, except between the 40.5 and 13.5 km grids where one-way nesting is employed. The initial conditions for the largest grid are derived from analyses of European Centre for Medium Range Weather Forecasts (ECMWF). The necessary geophysical data for all model domains have been assembled and included in the system database. The meteorological fields predicted by MM5 form one of the primary inputs to the air quality model.

5.3.1.5 Air Quality Model

A multi-scale, multi-species air quality model (SAQM) has been incorporated in PATH for running air quality simulations at regional, SAR-wide and urban scales. The intention of the regional-scale modelling is to provide estimates of the background concentrations of photochemical smog species and smog precursors, and sulphate and nitrate aerosols arising from emissions in Mainland China. This methodology has been selected in preference to explicitly prescribing boundary conditions for the model because the latter is likely to be based on a small number of measurements for a limited set of meteorological conditions and hence, likely to lack reliability. The intention of the local-scale modelling is to provide air quality predictions for Hong Kong. Thus, the model is able to consider both the transport and production of photochemical smog within a regional background generated from emissions within southern China, and the urban build-up of primary and secondary air pollutants within the SAR.

5.3.2 Methodology

5.3.2.1 Grids and episodes selected for simulations

Precomputed data and the 1.5km grid

The modular structure of PATH allows it to be rerun with modified assumptions but with the majority of settings left unaltered. For example, in this assignment the majority of simulations examined changes in vehicle emissions, meteorological parameters were left unaltered. The simulations performed under this study involved air quality model (SAQM) runs on the 49 x 49 grid with 1.5 km horizontal resolution that covers the whole SAR and some adjacent areas. All necessary input data related to other grids or other components of the system were derived from the available pre-computed "base case" data sets.

Annual average concentrations

Among the pre-computed meteorological episodes available in PATH six have been carefully selected by the system designers to reproduce annual average concentrations of pollutants. Each scenario represents a typical category of the Hong Kong weather patterns, and the annual averages can be estimated as weighted averages of the concentrations simulated by the model for each episode day. Those "annual average" episode days are:

- November 1995 (Category A)
- November 1994 (Category B1)
- January 1995 (Category B2)
- November 1995 (Category C)
- June 1995 (Category E)
- August 1993 (Category F)

The meteorological conditions prevailing on those "annual average" days are summarised below.

Day	Date	Description
A	24/11/95	This day is typical of a cold outbreak from the continent to the north of Hong Kong (the maximum temperature was 4° lower than the previous day), leading to north to northeast winds at most stations all day. This direction prevailed throughout from the surface to 850 mb, with a nocturnal and morning jet of 15 m s^{-1} at 900 mb weakening to less than 5 m s^{-1} by 1400 h. Morning and evening temperature profiles showed a slightly stable layer up to 900 mb, capped by a strongly stable layer to at least 700 mb.
B1	23/11/94	Surface winds on this fine and sunny winter monsoon day start out from north to northeast but become northwesterly in the western part of the Territory and southeasterly in the east as the day progresses. Upper winds veer from east to north-northeast between 0200 h and 1400 h, but return to an easterly direction below 850 mb by 2000 h. Morning and evening temperature profiles indicate relatively stable layers from the ground to 900 mb, but it is not possible to speculate as to whether conditions have been stable all day. This day seems to be a winter's day with typical secondary circulations (sea breezes etc.), as described by Wai *et al.* (1996).
B2	20/01/95	Surface winds are mostly east to northeast on this day with some coastal perturbations in the afternoon. Upper winds are steady in direction from east-southeast up to 850 mb in the morning ascents, with a backing towards south in the afternoon and evening. A strongly stable layer exists between 950 and 900 mb throughout, with fairly strong stability between the ground and 900 mb as well, indicating that stable conditions may have prevailed throughout the day.
C	19/11/95	An interesting day on which surface winds are generally northeasterly, but on which a southeasterly sea breeze seems to penetrate halfway across the Territory before nightfall. Winds with a westerly component develop at coastal sites in the west for a short period. Over the 18 hours, winds between 1000 and 800 mb veer from northeast towards north, with a jet at 900 mb present at all times, although its speed at 1400 h is only half as much as at other times. There is more warming on this day below 950 mb than on any of the previous winter days and the evening temperature profile indicates that a mixed layer developed to this level during the day.
E	28/06/95	A trough parallel to the coastline lies to the northwest of Hong Kong. A day of generally southwesterly monsoonal flow, with total rainfall of 9.3 mm and 85% cloud cover. The southwesterly flow extends to at least 700 mb with speeds greater than 10 m s^{-1} above 950 mb. Stability is strong throughout from the surface to 700 mb.'
F	31/08/93	Surface winds generally easterly during the morning, but by mid-afternoon a western and a southern sea breeze have become well-established with a convergence line running approximately north-south somewhere through the Territory. East-northeasterly winds up to 850 mb in the morning have attained a westerly component by 1400 h and have veered even further to the west by 2000 h. As with most of the days from other categories, a morning low-level jet has disappeared by 1400 h, only to return by 2000 h. The potential temperature profiles indicate a stable profile above 950 mb throughout the period, but also show that the early-morning mixed layer between 1000 mb and 950 mb becomes quite stable under the influence of the sea breeze.

Annual average concentrations are computed with separate events contributing by the following weights: 12.5% (A), 17.5% (B1); 17.5% (B2), 19% (C), 27% (E) and 6.5% (F) according to actual frequencies of occurrence of each category.

Episodes

Two additional episode days for which simulations were carried out under this study were:

- October 1994 (S - photochemical smog episode)
- December 1995 (R - high RSP day)

These episode days were used in the analysis to represent conditions considered indicative of the worst case and in order that compliance with regard to short-term (ie one hour and twenty four hour Air Quality Objectives) can be appraised.

The October 1994 episode has been selected for PATH because of high ozone readings measured by instrumented aircraft west of the Lantau Island. The day is considered as typical of conditions for photochemical smog formation. It was characterised by predominantly northerly surface winds.

The December 1995 episode was chosen due to its high RSP readings and availability of dense measurement data. Similar to day S, it was characterised by predominantly northerly surface winds.

Grid nesting

As stated above, the SAQM meteorological input data were derived from the available output of meteorological model run performed for each particular episode. Similarly, the SAQM initial and boundary conditions for each 1.5 km grid run were derived from the base case SAQM output from a run on the coarser, 4.5 km grid. For some episodes (i.e. the B1, B2, C and F days) the 4.5 km base case SAQM output was not available in the August 1998 PATH version, and for those episodes the SAQM initial and boundary pollutant concentrations was based on standard concentration profiles.

5.3.2.2 Emissions – overview

The EMS-95 emission modelling system and the PATH emissions inventory treat different categories of emissions independently, i.e. those from the point sources, motor vehicles, ocean-going shipping, as well as biogenic emissions and those from all other area type sources. The assumptions and methods used in this study in relation to each of these categories are discussed in the following sections.

The existing comprehensive PATH emission inventory represents the PATH base case, i.e. the best estimate of the 1995 emissions. Note that this has to be modified in order to create the "base case" for this study which is 1997.

There are two basic means of modifying PATH emissions. The graphical user interface (GUI) allows the user to apply various scaling factors to the base case inventory. Alternatively, if a more detailed approach is necessary, the underlying EMS-95 data sets can be modified. The latter is a much more complicated and time consuming approach and was used in this study to introduce the revised assumptions for motor vehicle emissions. All other emission categories were dealt with by the application of appropriate scaling factors.

As the SAQM runs were performed on the 1.5 km grid, only the corresponding 1.5 km grid emissions (i.e. basically those originating from SAR) were modified under this study. The initial/boundary conditions files derived, where possible, from the 4.5 km grid simulations were neither modified nor scaled in any way. This approach is equivalent to assuming that the Mainland China emissions remain at their 1995 levels. As will be discussed in the subsequent sections of this report, emissions from the mainland have a marked impact of air quality in the SAR. Maintaining emissions at 1995 levels could result in under prediction of air quality impacts in the SAR, if economic activity in the mainland continues to develop rapidly and if the growth in emissions outstrips the rate at which emissions reduction programmes can be implemented.

5.3.2.3 Emissions scenarios

Several emissions scenarios were assumed for this study. They include the 1997 base case scenario, and four different future scenarios for the 2016 emissions:

- Low Growth Scenario - (Population I, Low Fleet)
- Medium Growth Scenario - (Population II, Medium Fleet)
- High Growth Scenario (Low End) - (Population II, High Fleet)
- High Growth Scenario (High End) - (Population III, High High Fleet)

The details are discussed in the following sections

In order to estimate the importance of the traffic related emissions, additional PATH simulations were performed with all traffic-related sources removed. By comparing the results of these simulations with those from the simulations that included the traffic related emissions, it is possible to estimate the contribution of Hong Kong traffic to air quality in the SAR.

5.3.2.4 Motor vehicle emissions

As mentioned above, motor vehicle emissions were processed in detail on the EMS-95 level. For each cell of the model domain the emissions of NO_x, VOCs, and Respirable Suspended Particulates were computed according to the gridded vkt data for ten motor vehicle classes assumed under each emission scenario and the fleet averaged emission factors for the same ten vehicle classes based on the Euro III emission standards.

Since the yearly estimates of the emissions factors were not available beyond 2011, the fleet averaged Euro III emission factors from that year were used in computing emissions for the 2016 scenarios.

The assumed emissions of the broad pollutant categories (such as NOx or VOCs) were then split into particular pollutant species carried out by SAQM using the standard speciation assumptions of PATH.

Thus, for each of the five scenarios considered (1997, Low, Medium and High (High and Low End)) a detailed gridded EMS-95 motor vehicle emissions data set was prepared, enabling to take into account not only the expected effects of the tighter emission standards and a general growth in traffic, but also the assumed redistribution of traffic and changes in the fleet composition.

5.3.2.5 Area source emissions

Area emissions, i.e. emissions that do not belong to any other category, were based on the existing 1995 PATH emissions data sets. Since no detailed information on the expected changes in these emissions was available, it has been assumed that they will increase according to the expected SAR population growth. The appropriate scaling factors were introduced using the PATH graphical user interface (GUI). Emissions of paved road dust were treated independently of this general scaling approach and were related to the growth in traffic.

The scaling factors used were 1.04 for 1997 (based on the real 1995 to 1997 population increase) , 1.32 for the Low Growth scenario, 1.44 for the Medium and High (Low end) Growth scenarios, and 1.64 for the High (High end) Growth scenario. The latter factors were based on the "low", "medium" and "high" population growth forecasts and are consistent with the assumptions used in the transport model.

5.3.2.6 Point source emissions

As the point source emissions play only a secondary role in this study, they were not modified and were assumed to remain at their 1995 levels. It was assumed that any possible increases resulting from the population growth would be offset by the trend over the past decade which has seen manufacturing facilities relocate to the mainland. The only exceptions were the power plants operated by China Light & Power (CLP) and the Hongkong Electric Co. (HEC), for which total emission forecasts for 2012, based on the expected plant extensions and partial change of fuel from coal to gas, were available. Extrapolating those estimates to 2016 led to the following NO_x scaling factors that were applied to the emissions from those plants for all four 2016 scenarios:

NO_x: 1.25 (HEC), 0.52 (CLP)

5.3.2.7 The expected Biogenic emissions

Emissions from natural or agricultural sources were held constant for all simulations.

5.3.2.8 Marine emissions.

The marine emissions category included in PATH only explicitly covers large, ocean-going vessels. All other marine emissions belong to the general area source category and as such were scaled according to the expected population growth as described in Section 5.3.2.5. These include local ferry services and other operations based solely in SAR waters.

The growth in ocean-going shipping was estimated according to the container port development forecast. Thus, for all four 2016 scenarios the marine emissions were scaled up using a factor of 1.71. The 1997 emissions were assumed to remain at 1995 levels.

5.3.3 Results

As described in Sections 5.3.1 and 5.3.2 the PATH modelling system has been used to assess the SAR-wide changes in air quality that would be anticipated under each of the following four scenarios:

- Low Growth Scenario - (Population I, Low Fleet)
- Medium Growth Scenario - (Population II, Medium Fleet)
- High Growth Scenario (Low End) - (Population II, High Fleet)
- High Growth Scenario (High End) - (Population III, High High Fleet)

As described in the following sections the results of this analysis have been presented by a variety of means and using a variety of indicators of the impacts to air quality. The principal indicator is the change in the concentration of pollutants relative to the baseline year, which for this assignment was 1997. Details of the baseline conditions are presented in CTS-3 SEA *Working Paper 1 - Baseline Environmental Conditions*. Although increases in pollutant concentrations may not necessarily create non-compliances of the Air Quality Objectives (AQO), a change in this direction may not be deemed acceptable by some parties. Public sentiment is such that the emphasis is now upon creating improvements in air quality in the SAR, although maintaining compliance with the AQOs is also a major consideration. The AQOs are also used as indicators as these are the statutory assessment criteria used in the SAR.

The following section provides a summary of baseline air quality data for 1997 and the subsequent sections provide a summary of the results for each of the four scenarios and a discussion of the findings for each pollutant.

5.3.3.1 Baseline Conditions

As presented in *Working Paper 1: Baseline Environmental Conditions*, air quality in the SAR in 1997 was such that a variety of non-compliances of the Air Quality Objectives (AQO) were reported at the Air Quality Monitoring Stations (AQMS) operated by the Environmental Protection Department (EPD).

Such exceedances of the AQOs included a variety of averaging times and pollutants and occurred at stations across the SAR. For example, eight exceedances of the one-hour AQO for nitrogen dioxide were reported at three locations and the annual average AQO for respirable suspended particulates (RSP) was non-compliant at five locations. A summary of the general level of compliance with the AQOs at the AQMS is presented in Tables 5.3a, b and c for nitrogen dioxide, RSP and ozone respectively. AQMS that failed to meet the conditions for compliance defined in the Air Pollution Control Ordinance (APCO) are denoted in **bold**.

Table 5.3a

Summary of Reported Concentrations of Nitrogen Dioxide

AQMS	Maximum 1-hr Concentration (μgm-3)	Number of Exceedances of AQO (a)	Maximum 24-hr Concentration (μgm-3)	Number of Exceedances of AQO (b)	Annual Average (μgm-3)
Central/ Western	205	0	131	0	58
Kwai Chung	238	0	147	0	49
Kwun Tong	323	2	179	**2**	74
Mong Kok	342	4	186	**6**	**85(c)**
Sham Shui Po	322	2	172	3	71
Sha Tin	203	0	140	0	49
Tai Po	244	0	157	1	50
Tsuen Wan	208	0	138	0	68
Yuen Long	202	0	134	0	61

Notes:
(a) Concentrations in excess of 300 μgm-3
(b) Concentrations in excess of 150 μgm-3
(c) Reported concentration is in excess of the AQO of 80 μgm-3

Three AQMS are out of compliance with the AQOs for nitrogen dioxide, ie Kwun Tong, Mong Kok and Sham Shui Po. The principal concerns relate to one and twenty four-hour average concentrations and, as noted in *Working Paper 1*, the observation that the prevailing levels of nitrogen dioxide appear to have increased relative to 1996.

Table 5.3b

Summary of Reported Concentrations of Respirable Suspended Particulates

AQMS	Maximum 24-hr Concentration (μgm-3)	Number of Exceedances of Maximum 24-hr AQO (a)	Annual Average (μgm-3)
Central/Western	147	0	51
Kwai Chung	153	0	47
Kwun Tong	194	1	**58(b)**
Mong Kok	177	0	**60(b)**
Sham Shui Po	149	0	**57(b)**
Sha Tin	180	1	49
Tai Po	132	0	**59(b)**
Tsuen Wan	168	0	**54(b)**
Yuen Long	155	0	**58(b)**

Notes:
(a) Concentrations in excess of 180 μgm-3
(b) Reported concentration is in excess of the AQO of 55 μgm-3

Five of the nine AQMS reported non-compliant of the annual average AQO for RSP, individual exceedances were reported for the twenty-four hour AQO at two locations.

Table 5.3c
Summary of Reported Concentrations of Ozone

AQMS	Maximum 1-hr Concentration (μgm^{-3})	Number of Exceedances of AQO [a] (μgm^{-3})
Sha Tin	270	3
Kwun Tong	128	0
Yuen Long	231	0
Central/Western	243	1
Tai Po	116	0
Tsuen Wan	90	0
Kwai Chung	224	0

Notes:
(a) Concentrations in excess of 240 μgm^{-3}

Three exceedances of the one-hour AQO were reported at the Sha Tin AQMS in 1997. This does not mean that the station is out of compliance with the ozone standard, as a maximum of three exceedances is permitted under the APCO.

It is evident from the data summarised in these tables that the principal focus of concern across the SAR is the prevailing concentrations of RSP and nitrogen dioxide. Ozone levels are also considered to be an emerging concern and have been observed to be increasing over the last decade. In 1997, five AQMS reported non-compliances with the statutory air quality objectives.

5.3.3.2 High Growth Scenario (High End)

This scenario is taken to represent the worst case conditions and, as such, may represent an upper bound estimate for vehicle and population growth in the SAR in 2016. An appropriate level of infrastructure is assumed in order to meet the objectives for mobility of goods and people within the SAR and between the SAR and its hinterland. The scenario assumes no constraints on vehicle growth.

Annual Average Concentrations of Nitrogen Dioxide and RSP

Tables 5.3d and 5.3e present the changes in annual average concentrations of nitrogen dioxide and RSP predicted at each of the AQMS in the SAR in 2016. The results from the Mong Kok AQMS should be treated with caution as the observations are taken from a location within what is widely referred to as a street canyon, whereas the predictions generated by the PATH modelling system are considered more representative of conditions at the ambient AQMS.

Table 5.3d

Annual Average Concentrations of Nitrogen Dioxide (μgm^{-3})

AQMS	1997	Increment	Total
Central/Western	58	3.5	61.5
Mong Kok	85	5.2	90.2
Sha Tin	49	6.8	55.8
Yuen Long	61	10.2	71.2
Tsuen Wan	68	3.1	71.1
Kwai Chung	49	6.9	55.9
Sham Shui Po	71	4.1	75.1
Kwun Tong	74	6.0	80.0
Tai Po	50	0.6	50.6

The assessment indicates that the predicted air quality under this scenario is likely to deteriorate at all AQMS. Air quality is predicted to remain approximately the same as in 1997 at Tai Po. The most significant deterioration is predicted at the Yuen Long AQMS, where annual average concentration of nitrogen dioxide is predicted to increase by about 17%, relative to levels observed in 1997. Levels at Sha Tin and Kwai Chung are predicted to increase by 14%. Non-compliance with the AQO is only anticipated at the Mong Kok AQMS, although for the reasons given above, this conclusion needs to be treated with a degree of caution and it should also be noted that the station was already out of compliance in 1997.

Figure 5.3a presents a contour map of the predicted changes in annual average concentrations of nitrogen dioxide on a territory-wide basis. The figure indicates a general increase in concentrations (>5μgm^{-3}) in the western half of the SAR. Such increases are predicted to be particularly marked in the vicinity of Tsuen Wan, Tuen Mun and Yuen Long and Sheung Shui with increases in the range of 5 to 7.5 μgm^{-3} anticipated. Smaller (~2.5μgm^{-3}) increases are predicted across most of Hong Kong. Reductions in concentrations are predicted to occur in the southern tip of Kowloon, the central part of Hong Kong Island and most of Lamma Island. These reductions are anticipated to be by between 1 and 5 μgm^{-3}. Similar reductions are also predicted in an area south-east of Sha Tin. These predictions are considered to be attributable to the relatively slow growth in traffic volumes due to limited space for new infrastructure and the introduction of tighter emission standards for vehicles. Those areas in which generalised increases in nitrogen dioxide levels are anticipated are typically subject to a rate of vehicle growth that negates the improvements anticipated due to the introduction of more stringent vehicle emission standards. Areas in which improvements are anticipated are typically already highly congested and hence the rate of traffic growth is not anticipated to be particularly significant. This allows the improvements associated with tighter vehicle emission standards to be realised.

It should be noted that this scenario is included in the analysis in order to represent the upper bound conditions and is therefore considered to be representative of the worst case. Nevertheless, even under these severe conditions, improved vehicle emission standards will still result in beneficial impacts to air quality in some areas.

Table 5.3e
Annual Average Concentrations of RSP (μgm^{-3})

AQMS	1997	Increment	Total
Central/Western	51	4.1	55.1
Mong Kok	60	8.3	68.3
Sha Tin	49	7.8	56.8
Yuen Long	58	8.5	66.5
Tsuen Wan	54	2.3	56.3
Kwai Chung	46	4.9	51.9
Sham Shui Po	57	5.5	62.5
Kwun Tong	56	5.0	63.0
Tai Po	59	1.5	60.5

Under the worst case conditions simulated in this scenario, the total number of AQMS deemed to be out of compliance with the annual average AQO for RSP will increase to eight, from the five stations observed to be out of compliance in 1997. Concentrations are predicted to increase at all of the AQMS. At Yuen Long and Mong Kok, the annual average is anticipated to increase by 15% to approximately 67 and 68 μgm^{-3} (20 and 24% higher than the AQO) respectively.

Figure 5.3b shows the predicted changes in RSP levels on a territory-wide basis. Increases of about 7.5 μgm^{-3} are predicted in the Mong Kok, Tuen Mun and Yuen Long areas. In most of the western part of the SAR, concentrations are predicted to increase by between 2.5 and 7.5 μgm^{-3}. As predicted for nitrogen dioxide, decreases in the predicted concentrations are anticipated in the southern most tip of the Kowloon Peninsula. Concentrations are also predicted to decline in the Wan Chai and Causeway Bay areas on Hong Kong Island. The reduction in the Wan Chai and Causeway Bay areas should be interpreted with caution as the results do not reflect the air quality at street level.

Daily Average Concentrations of Nitrogen Dioxide and RSP

Table 5.3f presents the changes in the daily average concentrations of nitrogen dioxide and RSP predicted to occur under conditions typical of a photochemical smog episode in the SAR. As episodes of photochemical smog are all slightly different from each other and attributable to slightly different factors, the results presented in this analysis should not be taken as being applicable to all episodes. The table also shows the threshold concentration for observations in 1997. The threshold concentration is used to estimate the number of exceedances of the AQO anticipated in 2016. For example, at the Central/Western AQMS, an increase of 18.8 μgm^{-3} is predicted in 2016 for nitrogen dioxide. In order to result in a exceedance of the AQO, the concentration reported in 1997 would therefore have to be greater than 131.2 μgm^{-3}. The database is therefore searched to identify the number of days in 1997 on which the daily average concentration was in excess of 131.2 μgm^{-3} and this statistic is used as the basis for estimating the number of exceedances.

Table 5.3f
Changes in Daily Average Concentrations (μgm^{-3})
under Typical Photochemical Smog Conditions

AQMS	Nitrogen dioxide	Threshold	RSP	Threshold
Central/Western	18.8	131.2	6.5	173.5
Mong Kok	8.2	141.8	13.4	166.6
Sha Tin	4.6	145.4	10.0	170.0
Yuen Long	1.5	148.5	1.9	178.1
Tsuen Wan	3.0	147.0	3.2	176.8
Kwai Chung	4.8	145.2	8.5	171.5
Sham Shui Po	8.1	141.9	7.8	172.2
Kwun Tong	7.3	142.7	11.8	168.2
Tai Po	3.6	146.4	3.1	176.9

As presented in Table 5.3a, in 1997 the AQMS at Kwun Tong, Mong Kok and Sham Shui Po all reported non-compliances for nitrogen dioxide (daily average greater than 150 μgm^{-3}). The predictions indicate that concentrations at these stations would all be likely to increase under photochemical smog conditions, relative to levels reported in 1997. Analysis of the complete set of AQMS data for 1997 indicates that additional exceedances of the AQO can be anticipated at the Kwai Chung and Tai Po stations. The number of exceedances reported at Kwun Tong is expected to increase from 2 to 4 respectively, while the number of exceedance at Sham Shui Po will remain at 3. The largest increases are predicted to arise at the Central/Western AQMS. The Central/Western AQMS was in compliance with the standard in 1997. For the Central/Western AQMS, the threshold concentration is approximately the same as the maximum reported in 1997, indicating that exceedances of the AQO may occur.

Figure 5.3c presents the predicted changes in nitrogen dioxide concentrations during a photochemical smog event. The most significant increases in the daily average concentration are predicted to arise in the Central/Western area, with an increase of approximately 15 μgm^{-3}. Increases of greater than 7.5 μgm^{-3} are predicted across the whole of Hong Kong Island and most of Kowloon.

Exceedances of the daily average AQO for RSP (180 μgm^{-3}) were reported for the Mong Kok and Sha Tin AQMS in 1997 and under typical photochemical smog conditions, levels of RSP at these two locations are anticipated to increase by 13.4 and 11.8 μgm^{-3} respectively. The most significant increases in concentration are predicted to occur at the Mong Kok, Kwun Tong and Sha Tin AQMS. Non-compliances with the daily average AQO for RSP have been predicted at the Mong Kok, Sha Tin and Kwun Tong AQMS in 2016. For all of the remaining AQMS, whilst increases in the RSP concentration are anticipated, it is not predicted that these will lead to exceedances of the AQO.

Figure 5.3d presents the predicted changes in RSP concentrations over the SAR. The most significant increases are predicted to arise in the Wan Chai and Causeway Bay areas. In these areas, the daily average RSP concentration is predicted to increase by over 15 μgm^{-3}. Increases of daily average RSP concentrations of over 2.5 μgm^{-3} are predicted across most of the urban areas.

In addition to photochemical smog episodes, air quality in Hong Kong is also influenced by periods in which high levels of RSP prevail. These are typically associated with northerly or north-easterly winds which create a general increase in background concentrations.

Table 5.3g
Changes in Daily Average Concentrations (μgm^{-3}) under Typical Episodes of High Levels of RSP

AQMS	Nitrogen dioxide	Threshold	RSP	Threshold
Central/Western	11.8	138.2	5.8	174.2
Mong Kok	3.1	146.9	3.6	176.4
Sha Tin	2.9	147.1	3.8	176.2
Yuen Long	1.1	148.9	1.7	178.3
Tsuen Wan	1.2	148.8	2.2	177.8
Kwai Chung	1.7	148.3	2.2	177.8
Sham Shui Po	2.8	147.2	2.3	177.7
Kwun Tong	2.2	147.8	2.2	177.8
Tai Po	0.4	149.6	0.5	179.5

With reference to the data presented in Table 5.3b, it is evident that the Kwun Tong and Sha Tin AQMS would continue to report exceedances of the AQO for daily average concentrations of RSP. Although the increase is relatively small (2% above 1997 levels), exceedances at Mong Kok AQMS are also predicted in 2016. For all of the remaining stations, it is anticipated that the AQO would not be exceeded under these conditions.

Maximum Hourly Average Concentrations of Nitrogen Dioxide and Ozone

Table 5.3h presents the predicted changes in the maximum hourly average concentrations of nitrogen dioxide and ozone under typical photochemical smog conditions. In addition to the presentation of predictions at each of the AQMS, the table also shows the threshold concentration and the maximum increase predicted in the model domain. The latter is considered particularly important for the ozone predictions as these are likely to be at a maximum some distance downwind of the urban areas in which the AQMS are located. Emissions of nitric oxide from the urban areas would tend to reduce local ozone concentrations. As the AQMS are intentionally sited in densely populated areas, it is probable that increases in emissions from sources such as motor vehicles would create local reductions on ozone concentrations but increases in the areas downwind.

Table 5.3h
Changes in Maximum Hourly Average Concentrations (μgm^{-3}) under Typical Photochemical Smog Conditions

AQMS	Nitrogen dioxide	Threshold	Ozone	Threshold
Central/Western	20.1	279.9	-19.8	259.8
Mong Kok	11.6	288.4	-7.0	247.0
Sha Tin	6.2	293.8	-2.9	242.9
Yuen Long	6.0	294.0	-0.7	240.7
Tsuen Wan	9.3	290.7	0.2	239.8
Kwai Chung	10.6	289.4	-0.4	240.4
Sham Shui Po	11.7	288.3	-11.3	251.2
Kwun Tong	18.0	282.0	-2.5	242.5
Tai Po	11.1	222.9	-0.9	240.9
Maximum	41.5 East of Chai Wan	N/A	7 South of Lamma	N/A

Increased peak nitrogen dioxide concentrations are predicted at all AQMS. As described in Table 5.3a, the AQMS at Kwun Tong, Mong Kok and Sham Shui Po reported exceeedances of the AQO in 1997 and it is predicted that these will continue. The largest increases are predicted to be at the Central/Western and Kwun Tong AQMS but Central/Western is not anticipated to result in exceedances of the AQO. For example, the maximum reported nitrogen dioxide concentration at the Central/Western AQMS in 1997 was 205 μgm^{-3}, the predicted increase of approximately 20 μgm^{-3} (~10%) would result in a concentration of 225 μgm^{-3} in 2016, well within the AQO of 300 μgm^{-3}. The number of exceedances reported at Kwun Tong could increase from two to three; nevertheless, the stations would still remain compliant with the AQO. Figure 5.3e presents the predicted changes in peak nitrogen dioxide concentrations on a territory-wide basis. It is evident from the figure that increases in concentrations are predicted in most areas. The most significantly impacted areas are in Chai Wan and Lei Yuen Mun, where increases of at least 30 μgm^{-3} are predicted. Maximum hourly nitrogen dioxide concentrations are predicted to increase by at least 2.5 μgm^{-3} across the whole of SAR under these type of conditions.

Peak ozone concentrations are predicted to decrease at all AQMS except Tsuen Wan, although for the reasons stated above, it is anticipated that increases in concentrations would arise down wind of the urban areas. As anticipated, reductions in ozone concentrations are predicted for those AQMS that are predicted to record increased nitrogen dioxide concentrations. It is possible that this phenomenon will result in the Central/Western AQMS being fully compliant with this AQO; however, the predicted decrease in concentrations at the Sha Tin AQMS is not expected to reduce the number of non-compliances reported. The reduction in peak concentrations at Central/Western has reduced the number of exceedances from one to zero. Figure 5.3f shows the predicted changes in maximum hourly ozone concentrations. In many respects, this figure can be considered to be a "mirror image" of the data presented in Figure 5.3e, areas which are predicted to have significant increases in nitrogen dioxide levels are shown to have reduced levels of ozone. The most significant decreases in ozone concentrations are predicted to arise in the vicinity of Central and Causeway Bay and over the Hong Kong Island, the Western Harbour and West Kowloon Reclamation. Reductions of approximately 20 to 30 μgm^{-3} are predicted along the north shore of Hong Kong Island and Kowloon.

Conclusions

As stated in the introduction, this case is considered to represent the worst case scenario in terms of air quality impacts. The following general conclusions can be drawn from the analysis presented above.

Annual average concentrations of nitrogen dioxide and RSP

- Annual average concentrations of nitrogen dioxide and RSP are predicted to increase in most areas. Increases are anticipated to be most marked in the North-west New Territories, Sha Tin and West Kowloon.
- Reductions in annual average concentrations of nitrogen dioxide and RSP are predicted in the southern tip of Kowloon, Central, Wan Chai and Causeway Bay. These results should be interpreted with caution, as the modelling results do not reflect air quality at street level.
- The increases in nitrogen dioxide concentrations are not anticipated to create additional non-compliance at the AQMS. Increased RSP concentrations are anticipated to result in non-compliances at eight out of the nine AQMS.

Maximum daily average concentrations of nitrogen dioxide and RSP

- Under conditions considered typical of photochemical smog episodes, the twenty four hour average concentrations of nitrogen dioxide were predicted to increase at all AQMS. Three AQMS reported non-compliances with the AQO in 1997, and it is anticipated that a two additional AQMS (Kwai Chung and Tai Po) would report exceedances in 2016. This will not lead to additional non-compliances.
- Concentrations of RSP are anticipated to increase at all AQMS. Exceedances of the AQO were reported at the Kwun Tong and Sha Tin AQMS in 1997 and these are expected to continue. In addition, the Mong Kok AQMS is also predicted to be non-compliant with the AQO in 2016. Although increases at all of the remaining AQMS are also predicted, it is not anticipated that these will result in exceedances.

Maximum hourly average concentrations of nitrogen dioxide and ozone

- Under conditions typically resulting in the formation of photochemical smog, significant increases in peak hourly average concentrations of nitrogen dioxide are predicted at the Central/Western and Kwun Tong AQMS. Peak concentrations at the former are expected to increase by approximately 10%.
- Continued exceedances of the AQOs at the Mong Kok, Sham Shui Po and

emission standards for vehicles.

A comparison between Figures 5.3a and 5.3g indicates that the areas of reduced nitrogen dioxide concentrations are more extensive under this scenario and are more clearly associated with the densely populated urban areas in Kowloon and the Hong Kong Island.

Table 5.3j
Annual Average Concentrations of RSP (μgm^{-3})

AQMS	1997	Increment	Total
Central/Western	51	2.3	53.3
Mong Kok	60	5.6	65.6
Sha Tin	49	5.7	54.7
Yuen Long	58	6.5	64.5
Tsuen Wan	54	1.6	55.6
Kwai Chung	46	3.6	50.6
Sham Shui Po	57	3.7	60.7
Kwun Tong	56	3.7	61.7
Tai Po	59	0.5	59.5

The total number of AQMS deemed to be out of compliance with the annual average AQO for RSP is predicted to increase to six, from the five stations observed to be out of compliance in 1997. Concentrations are predicted to increase at all AQMS. At Yuen Long the annual average is anticipated to increase by 11%, to approximately 64.5 μgm^{-3}, 17% higher than the AQO. At Sha Tin, the RSP concentration is predicted to be within 1 μgm^{-3} of the AQO and exceedance at this AQMS cannot be ruled out.

Figure 5.3h shows the predicted increases in RSP on a territory-wide basis. Increases of 2.5 to 7.5 μgm^{-3} are predicted in the western half of the SAR, particularly in the Mong Kok, Tsuen Wan, Tuen Mun, Yuen Long and Fanling areas. Concentrations in the vicinity of Pokfulam are predicted to increase by approximately 5 μgm^{-3}. Decreases in predicted concentrations are most marked in the Kowloon Peninsula and Wan Chai/Causeway Bay areas, thereby demonstrating that if vehicle growth is constrained, the improved emission standards assumed under this analysis are sufficient to bring about reductions in ambient levels of RSP.

Daily Average Concentrations of Nitrogen Dioxide and RSP

Table 5.3k presents the daily average concentrations of nitrogen dioxide and RSP predicted to occur under conditions typical of photochemical smog in the SAR. The table also shows the threshold concentration for observations in 1997, beyond which there is a strong probability that the AQMS would exceedance the AQO for either nitrogen dioxide or RSP.

Table 5.3k
Changes in Daily Average Concentrations (μgm^{-3}) under Typical Photochemical Smog Conditions

AQMS	Nitrogen dioxide	Threshold	RSP	Threshold
Central/Western	14.4	135.6	4.3	175.7
Mong Kok	5.2	144.8	9.0	171.0
Sha Tin	2.5	147.5	6.4	173.6
Yuen Long	0.8	149.2	1.3	178.7
Tsuen Wan	1.6	148.4	2.0	178.0
Kwai Chung	2.6	147.4	5.6	174.4
Sham Shui Po	5.0	145.0	5.1	174.9
Kwun Tong	4.6	145.4	7.9	172.1
Tai Po	2.0	148.0	2.0	178.0

As presented in Table 5.3a, in 1997 the AQMS at Kwun Tong, Mong Kok and Sham Shui Po all reported non-compliances for nitrogen dioxide (concentrations greater than 150 μgm^{-3}). At these AQMS, it is predicted that the peak twenty four-hour nitrogen dioxide concentrations will increase and hence these stations will remain non-compliant. The number of non-compliant stations is anticipated to remain at three (as reported in 1997) but a single exceedance is predicted at Tai Po which was not reported in 1997. The largest increases are predicted to arise at the Central/Western AQMS which was in compliance with the standard in 1997. The threshold for Central/Western is within 4% of the maximum reported concentration for this AQMS in 1997 and hence it is possible that exceedances would occur.

Figure 5.3i presents the predicted changes in nitrogen dioxide concentrations during a photochemical smog event. Increases of at least 7.5 μgm^{-3} are predicted across whole of Hong Kong Island and in some parts of Kowloon.

Exceedances of the daily average AQO for RSP (180 μgm^{-3}) were reported for the Kwun Tong and Sha Tin AQMS in 1997 and under photochemical smog conditions, levels of RSP at these two locations are anticipated to increase by 7.9 and 6.4 μgm^{-3} respectively. On this basis, it can reasonably be predicted that continued exceedances of the AQOs at these two AQMS are probable. In addition, a non-compliance has been predicted at the Mong Kok AQMS. The most significant increases in concentration are predicted to occur at the Mong Kok, Kwun Tong and Sha Tin AQMS which are predicted to be non-compliant with the AQO in 2016. For all of the remaining locations, whilst increases in the RSP concentration are anticipated, it is not predicted that these will lead to exceedances of the AQO.

As presented in Figure 5.3j, large areas of the SAR are predicted to experience increases in the daily average levels of RSP under photochemical smog conditions. The most severely impacted areas are in Kowloon and central part of Hong Kong Island with increases of over 7.5 μgm^{-3} anticipated in these areas.

Table 5.3l summarises the predicted concentrations of nitrogen dioxide and RSP under conditions which typically give rise to high levels of RSP across the SAR.

Table 5.3l
Changes in Daily Average Concentrations (μgm^{-3}) under Typical Episodes of High Levels of RSP

AQMS	Nitrogen dioxide	Threshold	RSP	Threshold
Central/Western	8.7	141.3	3.8	176.2
Mong Kok	1.7	148.3	2.4	177.6
Sha Tin	1.6	148.4	2.6	177.4
Yuen Long	0.5	149.5	1.1	178.9
Tsuen Wan	0.6	149.4	1.4	178.6
Kwai Chung	0.9	149.1	1.4	178.6
Sham Shui Po	1.5	148.5	1.4	178.6
Kwun Tong	1.3	148.7	1.5	178.5
Tai Po	0.2	149.8	0.3	179.7

With reference to the data presented in Table 5.3b, it is evident that the Kwun Tong and Sha Tin AQMS would continue to report exceedances of the AQO for RSP. In addition, an exceedance is also predicted at the Mong Kok AQMS.

Maximum Hourly Average Concentrations of Nitrogen Dioxide and Ozone

Table 5.3m presents the changes in the predicted maximum hourly average concentrations of nitrogen dioxide and ozone under typical photochemical smog conditions. In addition to the presentation of predictions at each of the AQMS, the table also shows the threshold concentrations and the maximum increase predicted in the model domain. The latter is considered particularly important for the ozone predictions, as these are likely to be at a maximum some distance downwind of the urban area.

Table 5.3m
Changes in Maximum Hourly Average Concentrations (μgm^{-3}) under Typical Photochemical Smog Conditions

AQMS	Nitrogen dioxide	Threshold	Ozone	Threshold
Central/Western	16.1	283.9	-15.6	255.6
Mong Kok	7.9	292.1	-5.9	245.9
Sha Tin	3.5	296.5	-1.1	241.1
Yuen Long	3.0	297.0	-0.4	240.4
Tsuen Wan	5.1	294.9	0.2	239.8
Kwai Chung	6.1	293.9	-0.1	240.1
Sham Shui Po	7.8	292.2	-7.2	247.2
Kwun Tong	12.6	287.4	-1.8	241.8
Tai Po	2.3	297.7	-0.4	240.4
Maximum	29 East of Chai Wan	N/A	4.4 South of Lamma	N/A

Increased peak nitrogen dioxide concentrations are predicted at all AQMS. As described in Table 5.3a, the AQMS at Kwun Tong, Mong Kok and Sham Shui Po reported exceedances of the AQO in 1997 and it is predicted that these will continue. However, the number of non-compliant AQMS will remain at one (Mong Kok). The largest increases are predicted to be at the Central/Western and Kwun Tong AQMS but are not anticipated to result in exceedances of the AQO at the Central/Western

AQMS. For example, the maximum reported nitrogen dioxide concentration at the Central/Western AQMS in 1997 was 205 μgm^{-3}, the predicted increase of approximately 16 μgm^{-3} (8%) would result in a concentration of 221 μgm^{-3} in Central/Western in 2016, well within the AQO of 300μgm^{-3}. Figure 5.3k presents the predicted changes in peak nitrogen dioxide concentrations on a territory-wide basis. Increases in excess of 20 μgm^{-3} are predicted in areas such as Chai Wan, Lei Yue Mun and the south Tseng Kwan O areas.

Peak ozone concentrations are predicted to decrease at all AQMS except Tsuen Wan, although for the reasons stated above, it is anticipated that the most significant increases in concentrations would arise downwind of the urban areas. As anticipated, reductions in ozone concentrations are predicted for those AQMS that are expected to record increased nitrogen dioxide concentrations. The predicted decrease in concentrations at the Sha Tin AQMS is not expected to reduce the number of non-compliances reported. The reduction in concentrations predicted at Central/Western has reduced the number of exceedances from one to zero. Figure 5.31 shows the predicted changes in ozone concentrations across the SAR. The figure shows marked reductions (approximately 20 μgm^{-3}) in ozone concentrations in those areas predicted to encounter significantly increased concentrations of nitrogen dioxide, these reductions are most marked along the northern shore of the central sector of Hong Kong Island.

Conclusions

The following general conclusions can be drawn from the analysis presented in this section.

Annual average concentrations of nitrogen dioxide and RSP

- Annual average concentrations of nitrogen dioxide are predicted to increase in some areas. Increases are anticipated to be most marked in the North West New Territories. RSP levels are predicted to increase in similar areas, and particularly so in Yuen Long and in West Kowloon.
- Reductions in annual average concentrations of nitrogen dioxide and RSP are predicted in the central part of Hong Kong Island.
- The increases in nitrogen dioxide concentrations are not anticipated to create additional non-compliances with the AQO at the AQMS. Increased RSP concentrations are anticipated to result in non-compliances with the AQO at six out of the nine AQMS.

Maximum daily average concentrations of nitrogen dioxide and RSP

- Under conditions considered typical of photochemical smog episodes, the twenty four hour average concentrations of nitrogen dioxide were predicted to increase at all AQMS. The Kwun Tong, Mong Kok and Shum Shui Po AQMS reported non-compliances with the AQO in 1997, and it is anticipated that this situation will continue to arise.

- Concentrations of RSP are anticipated to increase at all AQMS. Exceedances of the AQO were reported at the Kwun Tong and Sha Tin AQMS in 1997 and these are expected to continue. In addition, the Mong Kok AQMS is also predicted to become non-compliant. Although increases at all of the remaining AQMS are also predicted, it is not anticipated that these will result in non-compliances.

Maximum hourly average concentrations of nitrogen dioxide and ozone

- Significant increases in peak hourly average concentrations of nitrogen dioxide are predicted at the Central/Western and Kwun Tong AQMS. Peak concentrations at the Central/Western AQMS are expected to increase by approximately 8%.
- Continued exceedances of the nitrogen dioxide AQO at the Mong Kok, Sham Shui Po and Kwun Tong AQMS are predicted and will result in Mong Kok becoming non-compliant.
- All AQMS should continue to meet the AQO for ozone. Concentrations may reduce by approximately 20 μgm^{-3} in some instances.

5.3.3.4 Medium Growth Scenario

This scenario is a modified version of the High Growth (Low End) scenario assessed in Section 5.3.3.3 but it includes policy measures to restrain the vehicle growth rate and an associated reduced level of infrastructure provision.

Annual Average Concentrations of Nitrogen Dioxide and RSP

Tables 5.3n and 5.3o present the changes in annual average concentrations of nitrogen dioxide and RSP predicted at each of the AQMS in the SAR in 2016.

Table 5.3n

Annual Average Concentrations of Nitrogen Dioxide (μgm^{-3})

AQMS	1997	Increment	Total
Central/Western	58	1.0	59.0
Mong Kok	85	2.2	**87.2**
Sha Tin	49	4.2	53.2
Yuen Long	61	7.9	68.9
Tsuen Wan	68	1.3	69.3
Kwai Chung	49	4.6	53.6
Sham Shui Po	71	1.2	72.2
Kwun Tong	74	3.7	77.7
Tai Po	50	-1.0	49.0

With the exception of the AQMS at Tai Po, the predictions indicate an increase in nitrogen dioxide concentrations at all stations. Increases of up to 13 % are predicted at the Yuen Long AQMS. The Mong Kok AQMS is predicted to continue to be out of compliance. The territory-wide changes of nitrogen dioxide concentrations are presented in Figure 5.3m. Increased levels of this pollutant are predicted across most of the SAR and in particular the North-west New Territories and Tsuen Wan. The most marked increases are in the order of 5 to 7.5 μgm^{-3} and are predicted to arise in Yuen Long area. This repeats a pattern observed in the other scenarios presented so far and is considered to be attributable to increased cross boundary traffic flows and the provision of an enhanced road network in this area, which includes Route 3 and Route 10. As indicated by the results presented in Table 5.3n, reduced levels of nitrogen dioxide are predicted in some of the urban areas, including the Kowloon, Central and Wan Chai/Causeway Bay. In these areas, reductions in the order of 7.5 to 1 μgm^{-3} are predicted.

Predicted changes in annual average RSP concentrations are presented in Table 5.3o for each of the AQMS in the EPD network.

Table 5.3o

Annual Average Concentrations of RSP (μgm^{-3})

AQMS	1997	Increment	Total
Central/Western	51	1.7	52.7
Mong Kok	60	4.3	64.3
Sha Tin	49	4.7	53.7
Yuen Long	58	5.6	63.6
Tsuen Wan	54	1.3	55.3
Kwai Chung	46	3.0	50.0
Sham Shui Po	57	2.9	59.9
Kwun Tong	56	3.1	61.1
Tai Po	59	0.1	59.1

RSP concentration at the AQMS which showed non-compliances with the AQO for annual average RSP concentration in 1997 are predicted to increase. In addition, RSP concentrations at Tsuen Wan are anticipated to increase to 55.3 μgm^{-3}, thereby rendering this AQMS out of compliance with the AQO. The most marked change is anticipated at the Yuen Long AQMS, where RSP levels are expected to increase by about 10%, to approximately 63.6 μgm^{-3}.

Territory-wide changes in RSP levels are presented in Figure 5.3n. It is evident that concentrations in the NWNT, West Kowloon and North Point are predicted to increase by between 2.5 and 5 μgm^{-3}. Reductions in RSP levels are predicted in Tsim Sha Tsui/Hung Hom, Central, Wan Chai and Causeway Bay areas.

Daily Average Concentrations of Nitrogen Dioxide and RSP

Table 5.3p presents the changes in the daily average concentrations of nitrogen dioxide and RSP predicted to occur under conditions typical of photochemical smog in the SAR. The table also shows the threshold concentration for observations in 1997, beyond which there is a strong probability that the AQMS would exceed the AQO for either nitrogen dioxide or RSP.

Table 5.3p
Changes in Daily Average Concentrations (μgm^{-3}) under Typical Photochemical Smog Conditions

AQMS	Nitrogen dioxide	Threshold	RSP	Threshold
Central/Western	12.9	137.1	3.9	176.1
Mong Kok	0.7	149.3	7.1	172.9
Sha Tin	-1.0	151.0	4.9	175.1
Yuen Long	-0.7	150.7	1.0	179.0
Tsuen Wan	-1.5	151.5	1.5	178.5
Kwai Chung	-1.6	151.6	4.2	175.8
Sham Shui Po	0.4	149.6	3.9	176.1
Kwun Tong	1.1	148.9	6.3	173.7
Tai Po	-1.0	151.0	1.5	178.5

As presented in Table 5.3a, in 1997 the AQMS at Kwun Tong, Mong Kok and Sham Shui Po all reported non-compliances for nitrogen dioxide (greater than 150 μgm^{-3}). The predictions indicate that concentrations at these stations would all be likely to increase under photochemical smog conditions, relative to levels reported in 1997. Analysis of the complete set of AQMS data for 1997 indicates that the number of exceedances reported at Mong Kok is expected to remain at six per annum, an indication that this station will remain out of compliance with the AQO. At the Sham Shui Po AQMS, three exceedances of the AQO are anticipated, the same as reported in 1997. An additional exceedance is predicted at the Kwun Tong AQMS relative to 1997. The largest increases are predicted to arise at the Central/Western AQMS which was in compliance with the standard in 1997. The threshold for Central/Western is in excess of the maximum reported concentration for this AQMS in 1997 and hence it is anticipated that there is a low probability that exceedances would be reported, even though concentrations could increase by approximately 10%.

Figure 5.3o presents the predicted territory-wide changes in nitrogen dioxide concentrations during a photochemical smog event. Increases in the daily average concentration are predicted to arise in the Western Harbour / West Kowloon, North and East Shore of Hong Kong Island and East Lamma Channel. The most significant increase of betweens 5 and 7.5 μgm^{-3} are predicted in these areas. Nitrogen dioxide levels in the majority of the New Territories are predicted to decrease by up to 5 μgm^{-3}.

Exceedances of the daily average AQO for RSP (180 μgm^{-3}) were reported for the Kwun Tong and Sha Tin AQMS in 1997 and under photochemical smog conditions, levels of RSP at these two locations are anticipated to change by 6.3 and 4.9 μgm^{-3} respectively. Two exceedances of the AQO are predicted at Mong Kok AQMS which renders this station non-compliant. The most significant increases in concentration are predicted to occur at the Mong Kok and Kwun Tong AQMS.

Figure 5.3p presents the predicted changes in RSP levels across the SAR. RSP concentrations in the Tuen Mun, Tai Po, Sha Tin, Tsuen Wan and most of Kowloon and Hong Kong Island are predicted to rise by at least 2.5 μgm^{-3}. The most significant increases are predicted to arise in the vicinity of Wan Chai and Causeway Bay.

Maximum Hourly Average Concentrations of Nitrogen Dioxide and Ozone

Table 5.3q presents the predicted maximum hourly average concentrations of nitrogen dioxide and ozone under typical photochemical smog conditions. In addition to the presentation of predictions at each of the AQMS, the table also shows the threshold concentration and the maximum increase predicted in the model domain.

Table 5.3q
Changes in the Maximum Hourly Average Concentrations (μgm^{-3}) Under Typical Photochemical Smog Conditions

AQMS	Nitrogen dioxide	Threshold	Ozone	Threshold
Central/Western	15.7	284.3	-12.2	252.2
Mong Kok	4.8	295.2	0.1	239.9
Sha Tin	-1.2	301.2	3.2	236.8
Yuen Long	-3.2	303.2	0.4	239.6
Tsuen Wan	-4.9	304.9	1.0	239.0
Kwai Chung	-2.9	302.9	0.0	240.0
Sham Shui Po	2.1	297.9	-1.5	241.5
Kwun Tong	9.3	290.7	0.8	239.2
Tai Po	-2.2	302.2	0.3	239.7
Maximum	25.9 East of Chai Wan	N/A	6.0 Junk Island	

Increased peak nitrogen dioxide concentrations are predicted at four of the AQMS, ie: Central/Western, Mong Kok, Shum Shui Po and Kwun Tong. As described in Table 5.3a, the AQMS at Kwun Tong, Mong Kok and Sham Shui Po reported exceedances of the AQO in 1997 and it is predicted that these will continue. However, the number of non-compliant AQMS will remain at one (Mong Kok). It is predicted that Kwun Tong and Sham Shui Po AQMS would continue to report three and two exceedances of the AQO per annum respectively, thereby remaining in compliance. The largest increases are predicted to be at the Central/Western AQMS but are not anticipated to result in exceedances of the AQO. For example, the maximum reported nitrogen dioxide concentration at the Central/Western AQMS in 1997 was 205 μgm^{-3}, the predicted increase of approximately 16 μgm^{-3} (8%) would result in a concentration of 221 μgm^{-3} in 2016, well within the AQO of 300 μgm^{-3}.

Figure 5.3q presents the predicted changes in peak nitrogen dioxide concentrations on a territory-wide basis. It is evident from the figure that both significant decreases and increases in the concentrations are predicted over quite large areas of the SAR. Increases of more than 15 μgm^{-3} are predicted in the Chai Wan and Lei Yue Mun areas. The most significant improvements in air quality are in the New Territories. In these areas, reductions in nitrogen dioxide concentrations of up to 7.5 μgm^{-3} are predicted.

Peak ozone concentrations are predicted to increase at six of the AQMS, although for the reasons stated above, it is anticipated that the most significant increases in concentrations would arise down wind of the urban areas. As anticipated, reductions in ozone concentrations are predicted for those AQMS that are expected to record significantly increased nitrogen dioxide concentrations, ie Central/Western. It is possible that this phenomenon will result in the Central/Western AQMS being fully compliant with this AQO; however, the predicted O_3 concentrations at the Sha Tin AQMS is not expected to reduce the number of non-compliances reported.

Figure 5.3r shows the predicted changes in ozone concentrations, most notable are the significant reductions in ozone levels in the central and western sector of Hong Kong Island and along the East Lamma Channel. Increases in ozone concentrations in the order of 5 μgm^{-3} are predicted in Sha Tin, Ngau Chi Wan and Chep Lap Kok.

Conclusions

The following general conclusions can be drawn from the analysis presented above.

Annual average concentrations of nitrogen dioxide and RSP

- Annual average concentrations of nitrogen dioxide are predicted to decrease at Sha Tin, West Kowloon and most part of Hong Kong Island. Localised increases are predicted in the Northwest New Territories and Tsuen Wan areas.
- RSP concentrations are predicted to increase in North-west New Territories, Tsuen Wan and West Kowloon and decrease in south Kowloon and central part of Hong Kong Island. All AQMS concentrations are likely to increase and it is anticipated that six would remain out of compliance.

Maximum daily average concentrations of nitrogen dioxide and RSP

- Under conditions considered typical of photochemical smog episodes, the twenty four-hour average concentrations of nitrogen dioxide were predicted to decrease at five out of nine AQMS, although increases were predicted at the Central/Western, Mong Kok, Shum Shui Po and Kwun Tong AQMS. Three AQMS reported non-compliances of the AQO in 1997, it is anticipated that the number of non-compliant AQMS stations will be the same in 2016.
- Concentrations of RSP are anticipated to increase at all AQMS. Exceedances of the AQO were reported at the Kwun Tong and Sha Tin AQMS in 1997 and these are expected to continue. As only one exceedance was predicted at each station, they are anticipated to remain in compliance with the AQO. Two exceedances were predicted at Mong Kok AQMS which will render this station out of compliance in 2016.

Maximum hourly average concentrations of nitrogen dioxide and ozone

- Under conditions typically resulting in the formation of photochemical smog, significant increases in peak hourly average concentrations of nitrogen dioxide are predicted at the Central/Western AQMS, peak concentrations are expected to increase by approximately 8%.
- Continued exceedances of the AQOs at the Mong Kok, Sham Shui Po and Kwun Tong AQMS are predicted. However, Mong Kok AQMS continued to be the only station deemed non-compliant.
- All AQMS should continue to meet the AQO for ozone. Concentrations may decrease by approximately 20 μgm^{-3}.

5.3.3.5 Low Growth Scenario

This scenario represents the lower bound assumption used in the analysis. Under this scenario, both population growth and vehicle growth are limited. Infrastructure provision is limited but considered sufficient to meet the objectives for mobility.

Annual Average Concentrations of Nitrogen Dioxide and RSP

Tables 5.3r and 5.3s present the changes in annual average concentrations of nitrogen dioxide and RSP predicted at each of the AQMS in the SAR in 2016.

Table 5.3r
Annual Average Concentrations of Nitrogen Dioxide (μgm^{-3})

AQMS	1997	Increment	Total
Central/Western	58	-0.9	57.1
Mong Kok	**85**	-0.1	**84.9**
Sha Tin	49	2.2	51.2
Yuen Long	61	6.1	67.1
Tsuen Wan	68	0.1	68.1
Kwai Chung	49	2.9	51.9
Sham Shui Po	71	-1.0	70.0
Kwun Tong	74	2.0	76.0
Tai Po	50	-2.2	47.8

The predictions indicate that four out of nine AQMS will show improvements in 2016 under this scenario. Although a slight reduction is predicted for Mong Kok AQMS, it will still be non-compliant with the AQO in 2016.

The territory-wide changes in nitrogen dioxide concentrations are presented in Figure 5.3s. Increased levels of this pollutant are predicted in the Northwest New Territories and the eastern sector of the Hong Kong Island South district. The most marked increases are in the order of 5 μgm^{-3} and are predicted to arise in Yuen Long and Fanling. This repeats a pattern observed in the other scenarios presented so far and is considered to be attributable to increased cross boundary traffic flows and the provision of an enhanced road network in these areas. As indicated by the results presented in Table 5.3r, reduced levels of nitrogen dioxide are predicted in the urban areas, including the Kowloon Peninsula, Wan Chai/Causeway Bay and Tai Po.

Predicted changes in annual average RSP concentrations are presented in Table 5.3s for each of the AQMS in the EPD network.

Table 5.3s
Annual Average Concentrations of RSP (μgm^{-3})

AQMS	1997	Increment	Total
Central/Western	51	-0.1	50.9
Mong Kok	**60**	1.0	**61.0**
Sha Tin	49	2.2	51.2
Yuen Long	**58**	3.2	**61.2**
Tsuen Wan	54	0.5	54.5
Kwai Chung	46	1.4	48.4
Sham Shui Po	57	0.8	**57.8**
Kwun Tong	**56**	1.6	**59.6**
Tai Po	**59**	-0.9	**58.1**

For the majority of AQMS that were deemed non-compliant in 1997, concentrations are predicted to increase, the exception being Tai Po. Although a reduction in RSP levels is predicted at Tai Po AQMS, the predicted concentration will still be deemed non-compliant in 2016. The most marked change is anticipated at the Yuen Long AQMS, where RSP levels are expected to increase to approximately 61 μgm^{-3}.

Territory-wide changes in RSP levels are presented in Figure 5.3t. The most significant increases (approximately 2.5 μgm^{-3}) are predicted in Yuen Long and Tuen Mun. Reductions in RSP levels are predicted in southern Kowloon, Kwai Chung, Kowloon City, Sha Tin and for the majority of Hong Kong Island.

Daily Average Concentrations of Nitrogen Dioxide and RSP

Table 5.3t presents the changes in the daily average concentrations of nitrogen dioxide and RSP predicted to occur under conditions typical of photochemical smog in the SAR. The table also shows the threshold concentration for observations in 1997, beyond which there is a strong probability that the AQMS would exceed the AQO for either nitrogen dioxide or RSP.

Table 5.3t
Changes in Daily Average Concentrations (μgm^{-3}) under Typical Photochemical Smog Conditions

AQMS	Nitrogen dioxide	Threshold	RSP	Threshold
Central/Western	8.8	141.2	2.1	177.9
Mong Kok	-5.2	155.2	2.0	178.0
Sha Tin	-5.3	155.3	0.8	179.2
Yuen Long	-2.3	152.3	0.2	179.8
Tsuen Wan	-4.9	154.9	0.0	180.0
Kwai Chung	-6.9	156.9	0.8	179.2
Sham Shui Po	-5.5	155.5	0.8	179.2
Kwun Tong	-3.7	153.7	1.9	178.1
Tai Po	-4.4	154.4	0.1	179.9

In 1997 the AQMS at Kwun Tong, Mong Kok and Sham Shui Po all reported non-compliances for nitrogen dioxide (greater than 150 μgm^{-3}). The predictions indicate that concentrations at these stations would all be likely to decrease under photochemical smog conditions, relative to levels reported in 1997. Analysis of the complete set of AQMS data for 1997 indicates that the number of exceedances reported at Mong Kok is expected to reduce to four per annum, and hence this station will still be non-compliant with the AQO. At the Sham Shui Po AQMS, two exceedances of the AQO are anticipated, a reduction from the three reported in 1997. The situation for Kwun Tong will remain the same as that of 1997 where 1 exceedance of daily RSP and 2 exceedance of NO_2 are predicted. The only increase is predicted to arise at the Central/Western AQMS which was in compliance with the standard in 1997 and is expected to remain so under this scenario.

Figure 5.3u presents the predicted territory-wide changes in nitrogen dioxide concentrations during a photochemical smog event. Reductions of 5 to 15 μgm^{-3} are predicted in large areas of the New Territories, including the urban areas of Tai Po, Sha Tin, Kowloon, Kwun Tong and Tseung Kwan O, and the central and southern regions of Hong Kong Island. Increased nitrogen dioxide concentrations are predicted along the north shore of Hong Kong Island, the Western Harbour, Lamma Island and the East Lamma Channel. Increases in excess of 7.5 μgm^{-3} are predicted in the Central/Western and Green Island areas.

Exceedances of the daily average AQO for RSP (180 μgm^{-3}) were reported for the Kwun Tong and Sha Tin AQMS in 1997 and under photochemical smog conditions, levels of RSP at these two locations are anticipated to increase by 1.9 and 0.8 μgm^{-3} respectively. Increase in concentration is predicted to occur at the Mong Kok AQMS and the threshold value is within 1 μgm^{-3} of the maximum concentration recorded in 1997 and hence the possibility of an exceedance cannot be eliminated.

Figure 5.3v presents the predicted changes in RSP levels across the SAR. The changes range from -1 μgm^{-3} to +2.5 μgm^{-3}. Increases of 2.5 μgm^{-3} are predicted in Tsim Sha Tsui, Wan Chai and Causeway Bay areas.

Maximum Hourly Average Concentrations of Nitrogen Dioxide and Ozone

Table 5.3u presents the changes in predicted maximum hourly average concentrations of nitrogen dioxide and ozone under typical photochemical smog conditions.

Table 5.3u
Changes in Maximum Hourly Average Concentrations (μgm^{-3}) under Typical Photochemical Smog Conditions

AQMS	Nitrogen dioxide	Threshold	Ozone	Threshold
Central/Western	12.5	287.5	-7.5	247.5
Mong Kok	-1.1	301.1	7.3	232.7
Sha Tin	-7.6	307.6	7.5	232.5
Yuen Long	-10	310.0	1.1	238.9
Tsuen Wan	-17.8	317.8	2.7	237.3
Kwai Chung	-15.4	315.4	-0.4	240.4
Sham Shui Po	-7.7	307.7	5.4	234.6
Kwun Tong	2.5	297.5	7.7	232.3
Tai Po	-13.2	313.2	0.9	239.1
Maximum	17.2 Chai Wan	N/A	14.9 Junk Island	N/A

Increased peak nitrogen dioxide concentrations are predicted at only one of the AQMS, i.e.: Central/Western. As described in Table 5.3a, the AQMS at Kwun Tong, Mong Kok and Sham Shui Po reported exceedances of the AQO in 1997 and it is predicted that these will continue. The number of exceedances reported at Mong Kok remains at four instances thereby is the only station deemed non-compliant. It is predicted that Kwun Tong and Sham Shui Po AQMS would continue to report two exceedances of the AQO per annum, remaining in compliance. The largest increase is predicted to be at the Central/Western AQMS but is not anticipated to result in exceedance of the AQO.

Figure 5.3w presents the predicted changes in peak nitrogen dioxide concentrations across the SAR. It is evident from the figure that both significant decreases and increases in the concentrations are predicted over quite large areas, however many areas predicted to encounter increased concentrations are over Hong Kong Waters. Increases of more than 7.5 μgm^{-3} are predicted in the Chai Wan, Lei Yue Mun and south of Tseung Kwan O. Central/Western and North Lamma Island are similarly impacted. Significant reductions in nitrogen dioxide concentrations are predicted in most parts of the New Territories. An extensive area of reduced concentrations is also predicted for much of Lantau Island.

Peak ozone concentrations are predicted to increase at all AQMS with the exception of Central/Western and Kwai Chung. The most significant increases are predicted at the Kwun Tong, Mong Kok and Sha Tin AQMS, although exceedances of the AQO are not predicted in Kwun Tong and Mong Kok. Figure 5.3x shows the predicted changes in ozone concentrations, most notable are the significant reductions in ozone concentrations in an area defined by the West Kowloon Reclamation, the western sector of Hong Kong Island and along the East Lamma Channel. Increases in ozone concentrations in the order of 10 μgm^{-3} are predicted in San Po Kong and Tseung Kwan O.

Conclusions

As stated in the introduction, this scenario is considered to represent the scenario with the least potential to adversely impact air quality in the SAR. The following general conclusions can be drawn from the analysis presented above.

Annual average concentrations of nitrogen dioxide and RSP

- Annual average concentrations of nitrogen dioxide are predicted to decrease in Kowloon and most parts of Hong Kong Island. Localised increases are predicted in the Northwest New Territories, Tuen Mun and Tsuen Wan areas. Under this scenario, all of the AQMS except Mong Kok are in compliance with the AQO for this pollutant.
- Changes in RSP concentrations also reflect the same pattern with general increases in the west of the SAR and reductions in the central and eastern areas. All five AQMS which were out of compliance in 1997 will continue to be so in 2016.

Maximum daily average concentrations of nitrogen dioxide and RSP

- Under conditions considered typical of photochemical smog episodes, the twenty four hour average concentrations of nitrogen dioxide were predicted to decrease at all AQMS except Central/Western. Three AQMS reported non-compliances with the AQO in 1997, it is anticipated that the number of exceedances will fall in 2016 but that the number of non-compliances is likely to remain the same.
- Concentrations of RSP are anticipated to increase at all AQMS. Exceedances of the AQO were reported at the Kwun Tong and Sha Tin AQMS in 1997 and these are expected to continue but as only one exceedance was predicted at each station they are expected to remain in compliance.

Maximum hourly average concentrations of nitrogen dioxide and ozone

- Under conditions typically resulting in the formation of photochemical smog, decreases in peak hourly average concentrations of nitrogen dioxide are predicted at all AQMS except Central/Western and Kwun Tong, peak concentrations at the Central/Western AQMS are expected to increase by approximately 13 μgm^{-3}.
- The number of exceedances of the nitrogen dioxide AQO at the Mong Kok, Sham Shui Po and Kwun Tong AQMS are predicted to be the same as in 1997.
- All AQMS should continue to meet the AQO for ozone. Concentrations may increase by approximately 10 μgm^{-3} at same stations.

5.3.4 Discussion

The following general conclusions were drawn for the PATH air quality modelling:

- Air quality in the North West New Territories is predicted to undergo significant deterioration. Continued non-compliance with the annual average AQO for RSP is predicted at the Yuen Long AQMS under all scenarios. The deterioration in air quality in this area is considered to be attributable to the growth in cross boundary and local traffic and the associated provision of extensive new highway infrastructure.

- In the urban areas of Tai Po, Sham Shui Po, Tsuen Wan, Sha Tin and Kwun Tong, air quality is also predicted to deteriorate under most scenarios due to the anticipated growth in vehicle numbers, which off-sets the benefits from improved emission control technologies and tighter emission standards.

- Anticipated increases in RSP concentrations remain a major concern in Mong Kok, Sham Shui Po, Kwun Tong, Tai Po, Tsuen Wan and Yuen Long.

Analyses were undertaken to determine which areas of the SAR are most heavily impacted by vehicle emissions. The assessment demonstrated that the importance of vehicle emissions varies significantly across the SAR. Areas such as eastern side of the SAR are predicted to be far less heavily impacted by vehicle emissions than areas such as North-west New Territories. These findings could be used as the basis for focusing local air quality management strategies. It should also be noted that cross boundary fluxes of pollutants have marked impacts on air quality in the SAR, especially during the winter months.

The results of the assessment are provided in Tables 5.3v and 5.3w, summarising the exceedances and general level of compliance with the AQOs in the year 2016 at each of the existing AQMS operated by the EPD. It should be noted that for some pollutants such as ozone, these stations are unlikely to detect the highest concentrations. It should also be emphasised that the areas likely to record the most significant increases in pollutant concentrations are located in areas of the SAR not particularly well monitored at present.

Table 5.3v
Predicted Numbers of Non-compliant AQMS in the Year 2016

	Ozone	RSP		Nitrogen dioxide			Total
Averaging time	1-hr	24-hr	1 year	1-hr	24-hr	1 year	
1997	0	0	*5 (KT, MK, SSP, TP, YL)*	*1 (MK)*	*3 (KT, MK, SSP)*	*1 (MK)*	10
Low Growth	0	0	5 (KT, MK, SSP, TP, YL)	1 (MK)	3 (MK, SSP, KT)	1 (MK)	10
Medium Growth	0	1 (MK)	6 (MK, SSP, KT, TW, YL, TP)	1 (MK)	3 (MK, SSP, KT)	1 (MK)	12
High Growth (Low End)	0	1 (MK)	6 (MK, SSP, KT, TW, YL, TP)	1 (MK)	3 (MK, SSP, KT)	1 (MK)	12
High Growth (High End)	0	1 (MK)	8 (CW, MK, SSP, KT, TW, S, YL, TP)	1 (MK)	3 (MK, SSP, KT)	1 (MK)	14

Notes:
(i) CW - Central/Western, MK - Mong Kok, SSP - Sham Shui Po, KT - Kwun Tong, KC - Kwai Chung, TW - Tsuen Wan, S - Sha Tin, YL - Yuen Long, TP - Tai Po
(ii) Hourly concentrations which exceed the AQO more than three times per year will be considered as non-compliant;
(iii) Daily concentrations which exceed the AQO more than once per year will be considered as non-compliant.

Table 5.3w
Predicted Numbers of Exceedances at AQMS in the Year 2016

	Ozone	RSP		Nitrogen dioxide			Total
Averaging time	1-hr	24-hr	1 year	1-hr	24-hr	1 year	
1997	3 (S) 1 (CW)	1(S) 1(KT)	*5 (KT, MK, SSP, TP, YL)*	*4 (MK) 2 (KT) 2 (SSP)*	*6(MK) 3(SSP) 2(KT) 1(TP)*	*1 (MK)*	32
Low Growth	3 (S)	1(S) 1(KT)	5 (KT, MK, SSP, TP, YL)	4 (MK) 2 (KT) 2 (SSP)	4 (MK) 2 (SSP) 2 (KT) 1 (TP)	1(MK)	28
Medium Growth	3 (S)	2 (MK) 1(S) 1(KT)	6 (MK, SSP, KT, TW, YL, TP)	4 (MK) 3 (KT) 2 (SSP)	6 (MK) 3 (SSP) 3 (KT) 1 (TP)	1(MK)	36
High Growth (Low End)	3 (S)	2 (MK) 1(S) 1(KT)	6 (MK, SSP, KT, TW, YL, TP)	4 (MK) 3 (KT) 2 (SSP)	6 (MK) 3 (SSP) 3 (KT) 1 (TP)	1(MK)	36
High Growth (High End)	3 (S)	3 (MK) 1(S) 1(KT)	8 (CW, MK, SSP, KT, TW, S, YL, TP)	5 (MK) 3 (KT) 2 (SSP)	6 (MK) 3 (SSP) 4 (KT) 1 (TP) 1 (KC)	1(MK)	42

Notes:
(i) CW - Central/Western, MK - Mong Kok, SSP - Sham Shui Po, KT - Kwun Tong, KC - Kwai Chung, TW - Tsuen Wan, S - Sha Tin, YL - Yuen Long, TP - Tai Po
(ii) Hourly concentrations which exceed the AQO more than three times per year will be considered as non-compliant;
(iii) Daily concentrations which exceed the AQO more than once per year will be considered as non-compliant.

It is evident from the results presented in these tables that under all scenarios there would continue to be non-compliances with the AQOs in the SAR. In 1997, ten such non-compliances were recorded. This is expected to increase to 14 under the High Growth (High End) Scenario and to 12 under the High Growth (Low End) Scenario. Under the Low Growth scenario the number of non-compliances is predicted to be the same as in 1997.

All scenarios under the Recommended Transport Strategies exceeded Air Quality Objectives. The predicted air quality under the Low Growth Scenarios is similar to that of 1997.

A series of model runs were undertaken to ascertain the contribution of traffic emissions to air quality in the SAR. For illustrative purposes, the predictions for daily and annual average concentrations of nitrogen dioxide and annual average concentrations of RSP have been selected for analysis. The year 2016 was selected and the High Growth (Low End) and Medium Growth scenarios were used.

Figures 5.3y and 5.3z present territory-wide daily average concentrations of nitrogen dioxide attributable to traffic emissions under typical photochemical smog conditions for the High Growth (Low End) and Medium Growth scenarios, respectively. Under the High Growth (Low End) scenario, concentrations in excess of 30 μgm^{-3} are predicted to be generated from traffic, this is similar for the Medium Growth scenario.

Annual average concentrations of NO_2 and RSP attributable to vehicle emissions are presented in Figures 5.3aa to 5.3ad for the High Growth (Low End) and Medium Growth scenarios. Predictions of the NO_2 and RSP annual average concentrations at each of the AQMS were repeated but with all vehicle emissions set to zero. The percentage contributions to annual average concentrations of NO_2 and RSP attributable to traffic emissions at each of the existing AQMS are presented in Tables 5.3x and y, respectively.

Table 5.3x
Traffic contributions to annual average NO_2 concentrations

AQMS	High Growth (Low End) % traffic contribution	Medium Growth % traffic contribution
Central/Western	14%	13%
Mong Kok	18%	17%
Sha Tin	27%	24%
Yuen Long	22%	20%
Tseun Wan	11%	10%
Kwai Chung	22%	20%
Sham Shui Po	20%	18%
Kwun Tong	14%	13%
Tai Po	16%	15%
Note: Contribution from traffic are in terms of general air quality, traffic contributions to road-side air quality are expected to be higher.		

Table 5.3y
Traffic contributions to annual average RSP concentrations

AQMS	High Growth (Low End) % traffic contribution	Medium Growth % traffic contribution
Central/Western	34%	33%
Mong Kok	50%	48%
Sha Tin	48%	47%
Yuen Long	42%	40%
Tseun Wan	23%	23%
Kwai Chung	37%	36%
Sham Shui Po	37%	36%
Kwun Tong	37%	37%
Tai Po	27%	26%

Note: Contribution from traffic are in terms of general air quality, traffic contributions to roadside air quality are expected to be higher.

- Central/Western, Mong Kok, Sha Tin, Yuen Long, Kwai Chung, Kwun Tong and Shum Shui Po AQMS: The percentage of annual average nitrogen dioxide concentrations attributable to traffic emissions from within the SAR were estimated in the range from 14% to 27%. The percentage of annual average RSP concentrations attributable to traffic emissions from within the SAR were estimated to range from 37% to 50%. The relatively high contribution of vehicle emissions to the predicted annual average RSP concentrations is considered to reflect the relatively high traffic volumes in these areas and could be used as the basis for prioritising these areas for the introduction of measures to further reduce vehicle emissions.

- Tsuen Wan and Tai Po AQMS: The percentage of annual average nitrogen dioxide concentrations attributable to traffic emissions from within the SAR was estimated to be approximately 11% and 16% respectively. The percentage of annual average RSP concentrations attributable to traffic emissions from within the SAR was estimated to be 23% and 27% respectively and hence further measures to reduce vehicle emissions in these localities are given high to medium priority.

The values reported in this section are produced by PATH model which uses a 1.5km grid size to generate air quality predictions a territory-wide basis. The numbers generated are indicative of ambient air quality and not air quality at roadside locations. The implications for this study is that the percentage contribution could be expected to be significantly greater at the roadside and hence the concentrations would be greater than those presented in this document.

The roadside air quality generally differs from the general air quality as illustrated by Air Pollution Index (API) published by the EPD. The roadside API is, in general, higher than the general API. The main contributing pollutants to high roadside API are Respirable Suspended Particulates and Oxides of Nitrogen - pollutants typically emitted from diesel vehicles. The roadside air quality is also influenced by surrounding buildings which form "street canyons" and so limit the dispersion of pollutants emitted from traffic. In addition, the main emission sources are located very close to the sensitive receivers (eg pedestrians, street level shops) which further limits the potential for pollutant dispersion. Nevertheless, the future deterioration of roadside air quality is not envisaged to be as significant as general air quality due to limited traffic growth potential in developed urban areas compared to developing new towns and improved vehicle emissions control standards (eg Euro III). Other measures such as introduction of LPG taxis and heavier fines on smoky vehicles will further enhance the roadside air quality.

The most effective way to tackle roadside air quality is to eliminate or reduce the emission sources. This can be achieved by "zero emissions" vehicles eg electric vehicles, trolley buses or controlling the number of vehicles using the roads. Alternatively, in some instances it may be possible to separate the sources from sensitive receivers by means such as areas restrictions, enclosed pedestrian walkways. This will not reduce the overall pollutant emissions from traffic but may provide a partial local relief in heavily polluted areas. Air quality mitigation measures are further discussed in Chapter 8 of this report.

It is evident that even under a scenario in which stringent vehicle emission standards are assumed, traffic represents a significant source of pollutants in many areas. Nevertheless, it is evident that other sources may also be important and it is acknowledged that these may be located both within and outside the SAR and hence would require control by the HKSAR Government and north of the boundary.

A detailed analysis of air quality monitoring and meteorological data has indicated that daily average concentrations of RSP are two to three times greater when the prevailing winds have a northerly component. Table 5.3z summarises the results of this analysis.

Table 5.3z
Effects of Wind Direction on Ambient Daily Average Concentrations of RSP (μgm^{-3}) at the Sha Tin AQMS

Wind direction	Average concentration	Standard deviation
Northerly	65	26
North-easterly	58	26
Southerly/south-westerly	26	7

The relative contribution of vehicle emissions to the ambient levels of pollutants in the SAR can therefore be expected to decline significantly during the winter monsoon period and to increase significantly during the summer monsoon period.