AIR QUALITY
IN HONG KONG 1999

Air Services Group

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Environmental Protection Department

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The Government of the Hong Kong
Special Administrative Region

A report on the results from the Air Quality Monitoring Network (1999) (AQMN)

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Summary

Hong Kong's air quality in 1999 was poorer than that in 1998. There were substantial drops in both the short-term and long-term compliance rates. Among the major air pollutants, nitrogen dioxide, ozone and respirable suspended particulates continued in the increasing trend for the past decade. Total suspended particulates also remained at a very high level in 1999.

It was good to continue to see for the year that the ambient levels of sulphur dioxide, carbon monoxide and lead were well within their respective AQO limits.

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1. Introduction

The Environmental Protection Department (EPD) set up two new monitoring stations in 1999, one in the new town of Tung Chung and the other in the urban centre of Eastern District, to monitor the general air quality. This made altogether 11 stations for monitoring general air quality and 3 stations for roadside air quality across the territory (please refer to Table B1 in Appendix B for area type classification of monitoring stations).

The network also collects samples at the Tsuen Wan and Central/Western monitoring stations to measure the ambient levels of potentially important Toxic Air Pollutants in Hong Kong, in addition to monitoring the major air pollutants.

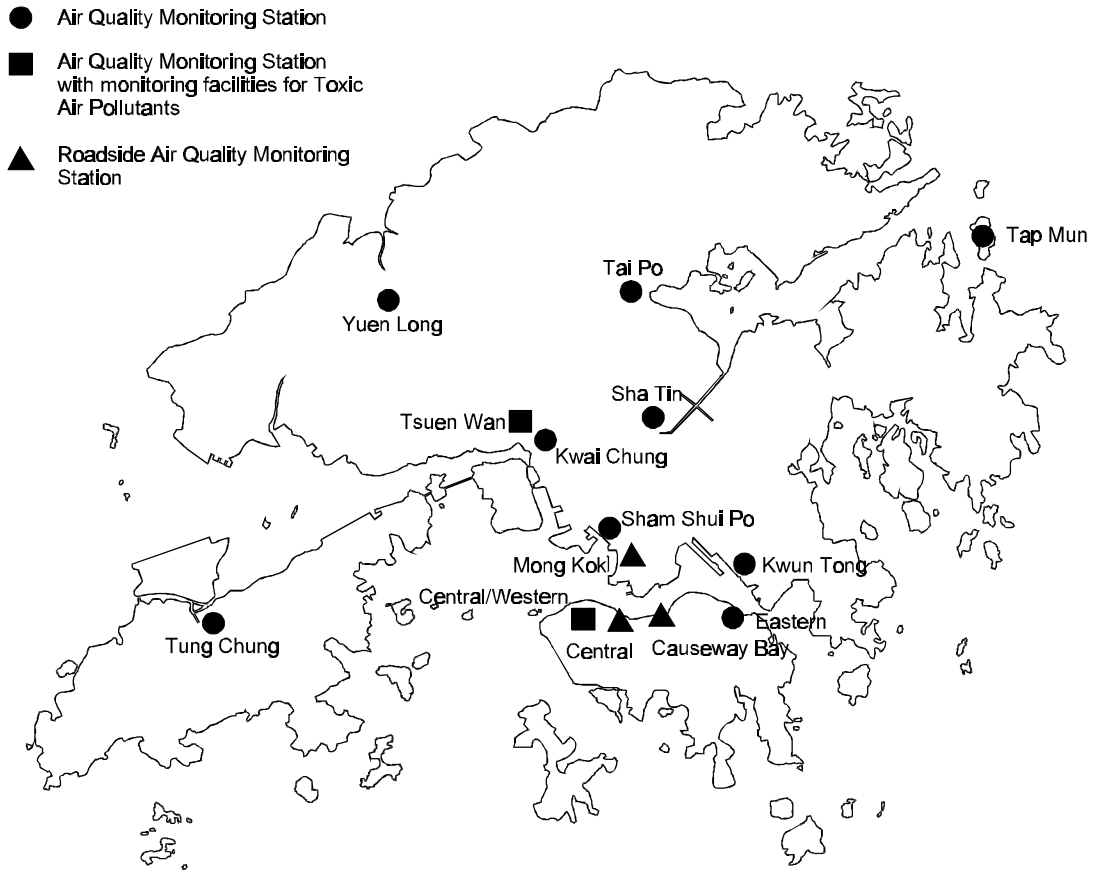


FIGURE 1 LOCATION OF EPD's AIR QUALITY MONITORING STATIONS (1999)

Apart from EPD's network, the Hongkong Electric Co. Ltd. (HEC) and the China Light & Power Co. Ltd. (CLP) also operate a number of monitoring stations to assess the ambient levels of sulphur dioxide and nitrogen dioxide in the vicinity of their power generating stations. The locations of these monitoring stations and the relevant monitoring results in 1999 are at Appendix A.

2. Air Quality Objectives and their Compliance Status

Established in 1987, the Hong Kong Air Quality Objectives (HKAQO) for 7 major air pollutants were set at levels to protect the public health. Over the years, the compliance status of the AQO has been used as the indicator of the air quality in different districts in Hong Kong.

Table 1: Hong Kong Air Quality Objectives

Concentration in micrograms per cubic metre [1]

Pollutant	Averaging Time				
	1 hr[2]	8 hrs[3]	24 hrs[3]	3 mths[4]	1 yr[4]
Sulphur dioxide (SO_2)	800		350		80
Total suspended particulates (TSP)			260		80
Respirable suspended particulates (RSP) [5]			180		55
Nitrogen dioxide (NO_2)	300		150		80
Carbon monoxide (CO)	30000	10000			
Photochemical oxidants (as ozone (O_3) [6])	240				
Lead (Pb)				1.5	

[1] Measured at 298K (25°C) and 101.325 kPa (one atmosphere).
[2] Not to be exceeded more than three times per year.
[3] Not to be exceeded more than once per year.
[4] Arithmetic means.
[5] Respirable suspended particulates means suspended particulates in air with a nominal aerodynamic diameter of 10 micrometres or smaller.
[6] Photochemical oxidants are determined by measurement of ozone only.

Table 2: Compliance Status of Air Quality Objectives in 1999@

Station	Ozone	Nitrogen Dioxide			Total Suspended Particulates		Respirable Suspended Particulates	
	1-hour	1-hour	24-hour	1-year	24-hour	1-year	24-hour	1-year
Central/Western	✓	✓	✓	✓	✓	✗	✗	✓
Eastern #	~	~	~	~	--	--	✓	✓
Kwai Chung	✓	✓	✗	✓	✓	✗	✓	✗
Kwun Tong	✓	✓	✗	✓	✓	✗	✓	✓
Sham Shui Po	✓	✓	✗	✓	✓	✗	✗	✗
Tsuen Wan	✓	✗	✗	✓	✓	✓	✓	✓
Sha Tin	✗	✓	✓	✓	✓	✓	✓	✓
Tai Po	✓	✓	✓	✓	✓	✓	✓	✓
Tung Chung *	✗	~	✗	~	~	~	✗	~
Yuen Long	✓	✓	✗	✓	✓	✗	✗	✗
Tap Mun	✗	✓	✓	✓	--	--	✓	✓
Causeway Bay	--	✗	✗	✗	--	--	✗	✗
Central	--	✓	✗	✗	--	--	✗	✗
Mong Kok	--	✓	✗	✗	✓	✗	✓	✗

Notes: *"✓" Complied with the AQO* *"✗" Violated the AQO* *"--" Not measured*
" ~" Insufficient data for assessment of compliance
"@" For those stations with sufficient data, sulphur dioxide, carbon monoxide and lead all complied with the relevant AQO.
"#" The data capture rates of gaseous pollutants at the Eastern station are slightly lower than the QC requirement of 66%.
"" The Tung Chung station has only three representative quarters of air quality data.*

The year 1999 saw a substantial drop in the compliance rate of the short-term (i.e. 1-hour, 8-hour or 24-hour) AQO as compared with 1998. During the year, non-compliance with the 24-hour AQO for NO_2 was recorded at 9 out of 13 stations. Among them, the Tsuen Wan and Causeway Bay stations also violated the 1-hour AQO for NO_2. The situation for RSP was slightly better, with only 6 stations out of 14 stations violating the 24-hour AQO. They are Central/Western, Sham Shui Po, Tung Chung, Yuen Long, Causeway Bay and Central. While all stations fully complied with the short-term AQO for SO_2, CO and TSP as in 1998 and the year before, violation of the 1-hour AQO for O_3 had been observed at Sha Tin, Tung Chung and Tap Mun.

In Hong Kong, fine and hot weather with stagnant atmospheric conditions, which favours the trapping of air pollutants, often arises when the territory is under the influence of a tropical cyclone located at about 700 to 1000 kilometres southeast of Hong Kong. Preliminary analysis of past air quality and weather data indicates that the unexpected drop in short-term AQO compliance rate in 1999 was mainly due to the more than average number of tropical cyclones and storms approaching Hong Kong in the year.

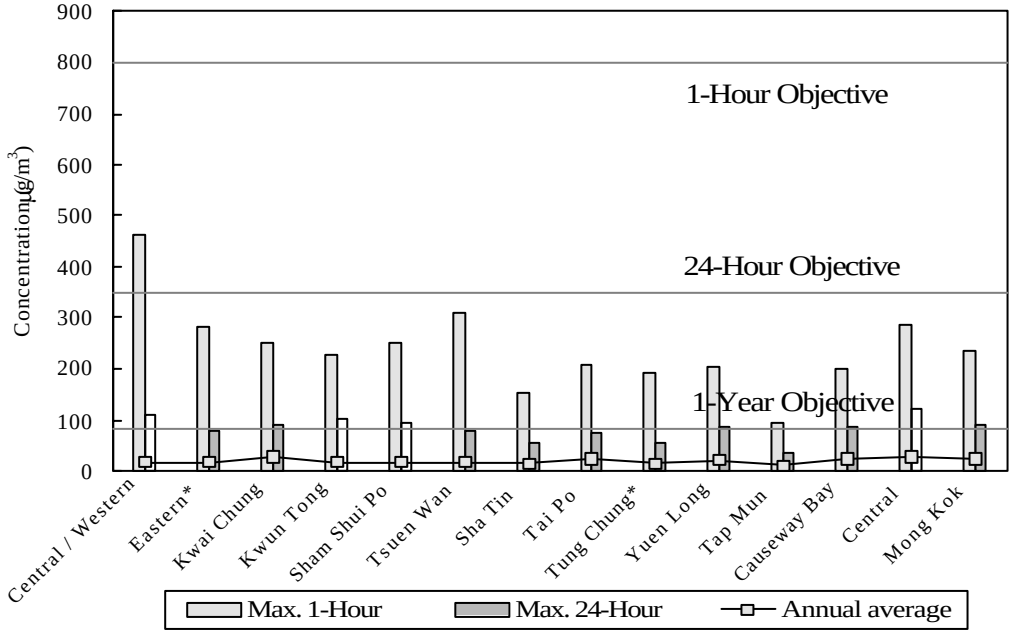
Non-compliance with the long-term (annual) AQO for NO_2 and RSP was observed at all 3 roadside stations during 1999. The compliance rate was much better for the general stations, with altogether 7 out of 10 meeting the annual AQO for RSP and all meeting that for NO_2. The overall average concentration of NO_2 in 1999 was 65 $\mu g/m^3$, which was slightly higher than the level in 1998 (63 $\mu g/m^3$), while the annual overall RSP concentration (59 $\mu g/m^3$) remained at the same level of 1998. Among the 9 stations with adequate TSP data for compliance assessment, only 3 of them complied with the annual AQO in 1999 as compared to 5 stations in 1998.

3. Gaseous Pollutants

3.1 Sulphur Dioxide (SO_2)

Sulphur dioxide (SO_2) is formed primarily from combustion of sulphur-containing fossil fuels. In Hong Kong, power stations are the major source of SO_2 followed by fuel combustion, marine

Figure 2: Sulphur Dioxide Monitoring 1999



Note: The asterisked stations do not have adequate data for assessment of AQO compliance in the year. Please refer to Table 2 for details.

vessels and vehicles. Vehicles are the more important source of SO_2 in terms of roadside air quality because of their close proximity to the pedestrians. SO_2 is known to contribute significantly to the regional acid rain problem.

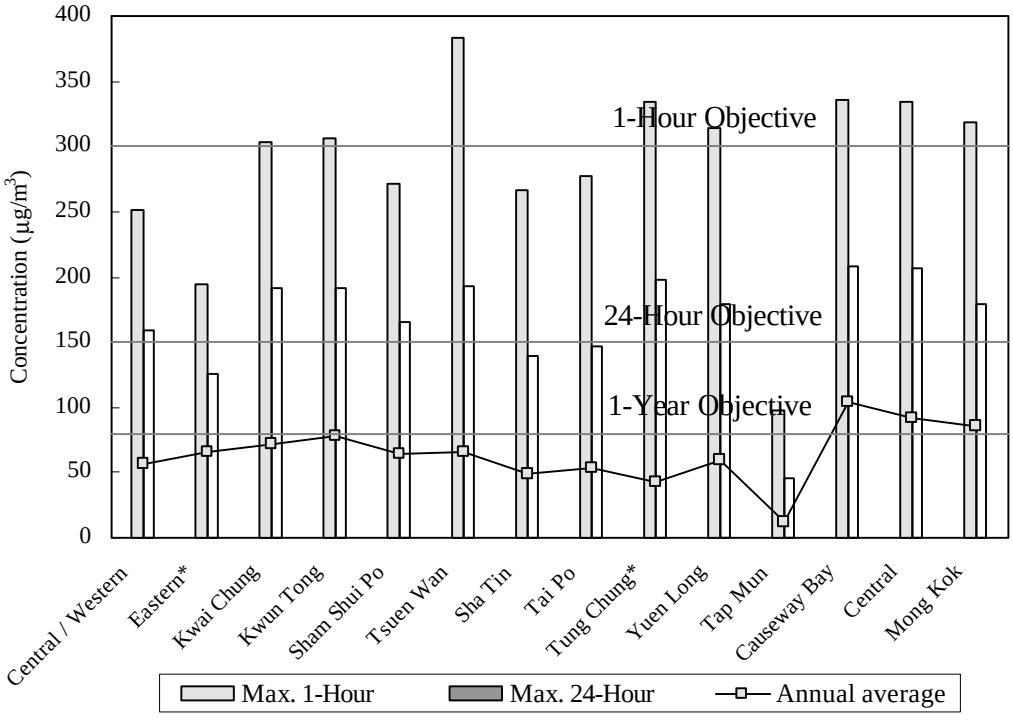
Exposure to high levels of SO_2 may cause impairment of respiratory function and aggravate existing respiratory and cardiac illnesses. Prolonged exposure at lower levels may also increase the risk of developing chronic respiratory diseases.

Due to past control efforts, the ambient concentrations of SO_2 still maintained at very low levels in 1999. None of the stations in the monitoring network had recorded any AQO exceedance for SO_2 during the year. The highest 1-hour average (464 $\mu g/m^3$) and the highest annual average (29 $\mu g/m^3$) were measured at the urban stations in Central/Western and Kwai Chung respectively, while the Central roadside held the record of the highest 24-hour average (119 $\mu g/m^3$).

3.2 Nitrogen Dioxide (NO_2)

Nitrogen dioxide (NO_2) is formed primarily from oxidation of nitric oxide (NO) emitted from fuel combustion. Power stations and motor vehicles (diesel vehicles in particular) are the two main sources of NO_2 in Hong Kong. Similar to SO_2, NO_2 emission from motor vehicles are of much greater concern because of their direct influence on the roadside air quality, especially in windless days. Health study results indicate that long term exposures to NO_2 can lower a person's resistance to respiratory infections and aggravate existing chronic respiratory diseases.

Figure 3: Nitrogen Dioxide Monitoring 1999



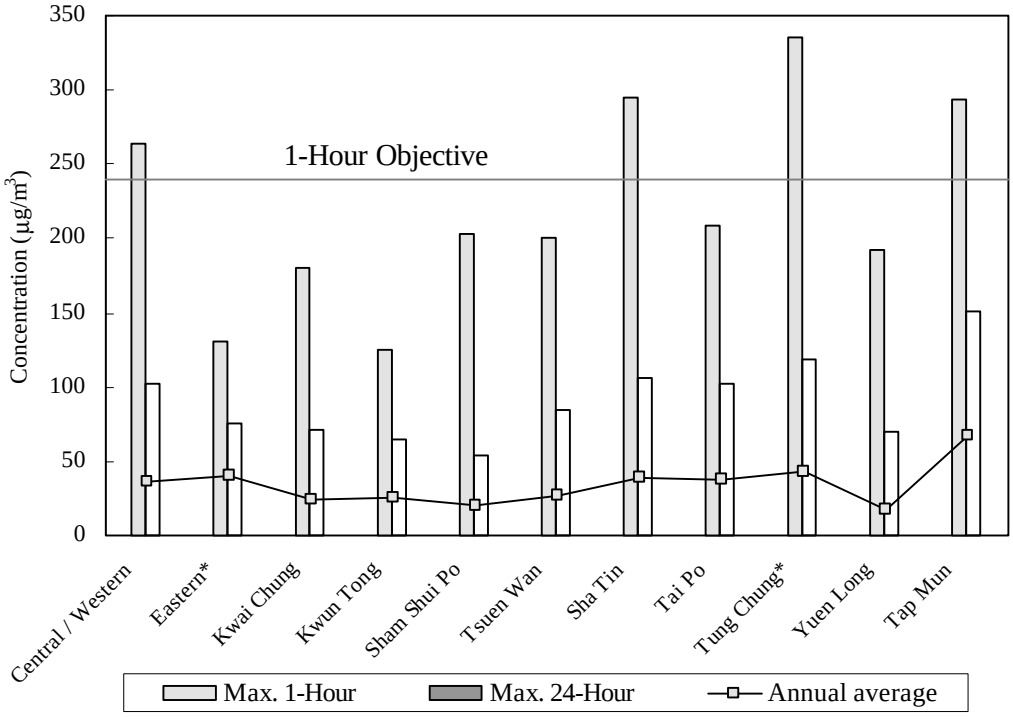
Nitrogen dioxide was measured at all 14 stations in the monitoring network during 1999. The annual levels of NO_2 varied widely across the territory, with values ranging from as low as 15% of the AQO level (12 $\mu g/m^3$) in the rural area of Tap Mun to the very high level of 131% (105 $\mu g/m^3$) at the busy roadside of Causeway Bay. For general stations, the highest annual average (78 $\mu g/m^3$) was measured at the urban station in Kwun Tong. The overall annual average of all stations was 65 $\mu g/m^3$, slightly higher than the 1998 value of 62 $\mu g/m^3$.

The highest 1-hour average (383 μg/m^3) and the highest 24-hour average (209 μg/m^3) were recorded at the Tsuen Wan and Causeway Bay stations respectively. Generally, exceedance of the short-term NO_2 AQO occurred more frequently at the roadside stations. There were altogether 46 counts of AQO exceedance for 24-hour NO_2 at the 3 roadside stations as compared with only 20 exceedances for the 11 general stations. As for the 1-hour NO_2, both the general and roadside stations recorded 13 counts of AQO exceedances during the year.

3.3 Ozone (O_3)

Ozone (O_3), a major constituent of photochemical smog, is formed by a series of complicated photochemical reactions of oxygen, nitrogen oxides and reactive organic compounds in the presence of sunlight and warm temperature. Being a strong oxidant, ozone can cause irritation to the eye, nose and throat even at low concentration levels. At elevated levels, it can increase a person's susceptibility to respiratory infections and aggravate pre-existing respiratory illnesses such as asthma.

Figure 4: Ozone Monitoring 1999



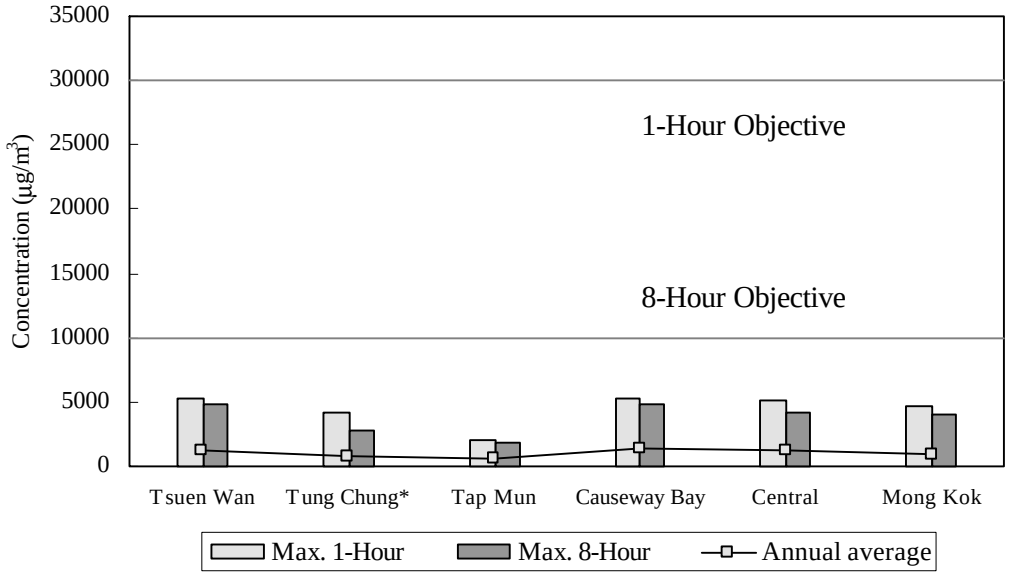
Ozone was measured at all 11 general monitoring stations during 1999. The lowest annual average (18 μg/m^3) was recorded at the Yuen Long station while the highest average (68 μg/m^3) was measured at the rural station in Tap Mun. The Tap Mun station also had the greatest number of AQO exceedance (8) in the year, followed sequentially by Tung Chung (6), Sha Tin (4) and Central/Western (2).

The highest two 1-hour ozone concentrations (335 μg/m^3 and 311 μg/m^3) in the year were both measured at the Tung Chung station in a very hot afternoon on 20 August. On that day, the atmospheric condition across the territory was extremely stagnant under the influence of Typhoon Sam located in the southeast. The very high outdoor temperature (maximum 35.4 ^{o}C) has facilitated the rapid formation of photochemical smog including ozone. Similar hot and calm wind conditions, which had eventually led to elevated ozone levels, also occurred on 12 September during the influence of Typhoon York about 1000 km southeast of Hong Kong. The highest 1-hour concentrations recorded at Tap Mun and Tung Chung on that day (maximum air temperature 34.3 ^{o}C) were 284 μg/m^3 and 278 μg/m^3 respectively, both higher than the permissible limit of 240 μg/m^3.

3.4 Carbon Monoxide (CO)

Carbon monoxide (CO) comes mainly from vehicular emissions although small amount of which may also come from incomplete combustion of fuels from factories and power stations. When it enters the bloodstream, CO can reduce oxygen delivery to the body's organs and tissues. Typical symptoms of CO poisoning include shortness of breath, chest pain, headaches, and loss of co-ordination. The health threat from CO is more severe for those who suffer from heart disease.

Figure 5: Carbon Monoxide Monitoring 1999



Carbon monoxide was monitored at 6 stations during 1999. Among them, 3 stations were located at the urban roadside with high traffic volume. In general, both the ambient and roadside CO concentrations continued to maintain at a very low level in 1999. During the year, none of the 6 stations recorded any exceedance of the 1-hour and 8-hour AQO. The highest 1-hour and 8-hour averages, both measured at the Causeway Bay roadside station, were about one sixth and one half of the respective AQO.

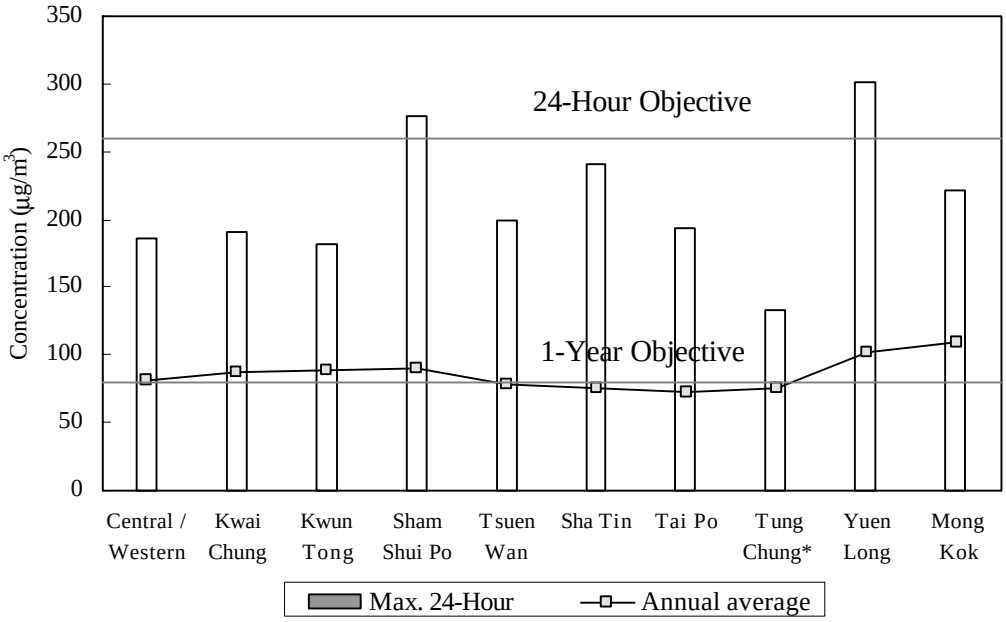
4. Suspended Particulates

4.1 Total Suspended Particulates (TSP)

Total suspended particulates (TSP) are small airborne particulates such as dust, fume and smoke with diameters less than 100 micrometres. Major sources of TSP include power stations, construction activities and vehicle exhausts. TSP can be broadly divided into two major types. Suspended particulates with a nominal aerodynamic diameter of 10 micrometres or less are called respirable suspended particulates (RSP), or PM10 for short, and is usually of much greater health concern (see Section 4.2 below). On the contrary, suspended particulates that are larger than 10 micrometres in diameter are mainly related to soiling and dust nuisance.

High-volume sampling of TSP was conducted at 9 general and 1 roadside stations during 1999. The TSP concentrations at various stations were in general higher than those measured in 1998. The highest 24-hour concentration (301 $\mu g/m^3$), which was almost 45% above the 1998 value, was measured at the Yuen Long station. Exceedance of the 24-hour AQO level (276 $\mu g/m^3$) was also observed once at the Sham Shui Po station in the year. Contrary to the situation in 1998, the highest annual average (110 $\mu g/m^3$), again measured at the Mong Kok roadside station, increased by about 7% in the year.

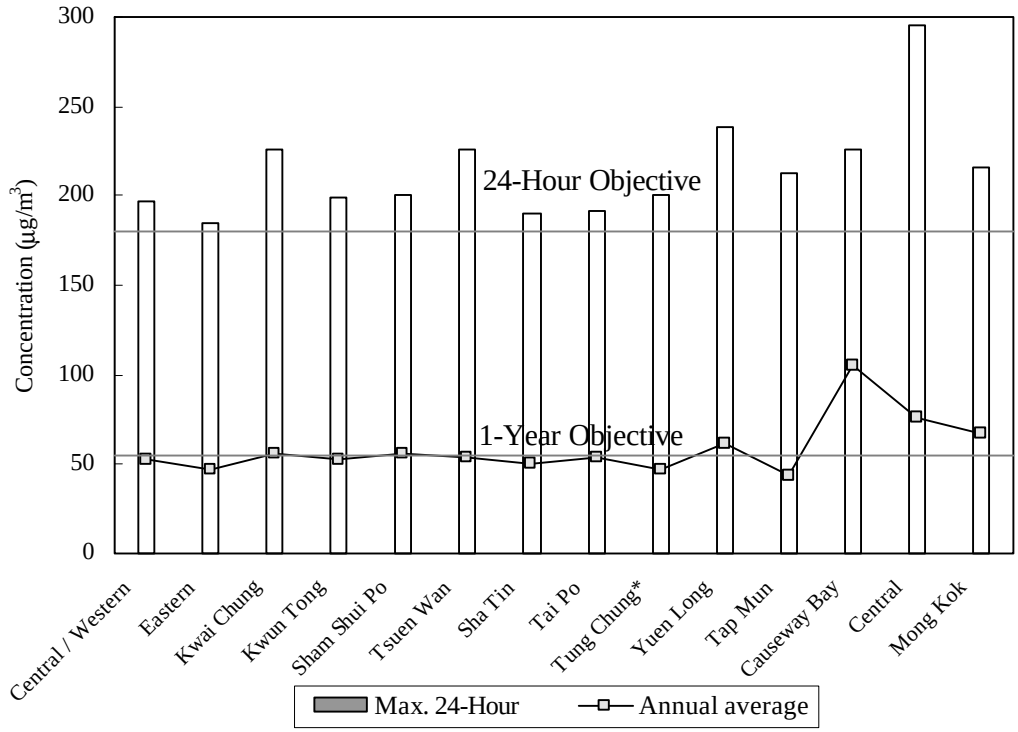
Figure 6: TSP Monitoring 1999



4.2 Respirable Suspended Particulates (RSP)

Respirable suspended particulates (RSP) refer to those suspended particulates with nominal aerodynamic diameters of 10 micrometres or less. Combustion sources, in particular diesel vehicle exhaust, are the major sources of RSP. Besides, RSP can be formed by atmospheric oxidation of sulphur dioxide and nitrogen oxides. Although to a lesser extent, crustal derived dust and marine aerosols are significant sources of RSP as well.

Figure 7: RSP Monitoring 1999



RSP at high level may cause chronic and acute effects on human health, particularly the pulmonary function, as they can penetrate deep into the lungs and cause respiratory problems. These effects are enhanced if high RSP levels are associated with higher levels of other pollutants, such as SO_2. The smaller particulates in RSP will also have a major impact on visibility.

Continuous monitoring of RSP was conducted at all 14 stations in the monitoring network in 1999. Most of these stations were also equipped with high-volume sampler to collect particulate samples for chemical analysis. The RSP concentrations continued to maintain at very high levels throughout the territory in 1999. During the year, all monitoring stations had experienced at least one exceedance of the 24-hour AQO level. The highest 24-hour average (296 $\mu g/m^3$), recorded at the Central roadside station during a two-day air pollution episode in January, was 64% above the AQO level of 180 $\mu g/m^3$. This was followed closely by the second highest 24-hour average of 238 $\mu g/m^3$ recorded at Yuen Long, which was also measured during the same episode.

The highest annual average (105 $\mu g/m^3$), which was almost double of the annual AQO, was again measured at the Causeway Bay roadside station while the lowest (44 $\mu g/m^3$) was measured at the rural station in Tap Mun. The relatively high background concentrations of RSP as compared with NO_2 indicated the possibility of regional sources in addition to the known local urban sources of diesel vehicle emission.

4.3 Lead (Pb)

Lead is the only one AQO pollutant which is also a toxic air pollutant. To lessen the threat of airborne lead, the sale and supply of leaded petrol, which is a known major source of lead, was banned in Hong Kong from 1 April 1999. The ambient lead concentration continued to linger at a very low level during 1999. The overall 3-month averages ranged from 34 ng/m^3 (third quarter) to 138 ng/m^3 (fourth quarter) and were well within the relevant limit of 1,500 ng/m^3.

5. Toxic Air Pollutants

Two groups of toxic air pollutants (TAPs), viz. heavy metals and organic substances, were regularly monitored at the Central/Western and Tsuen Wan stations since mid 1997. Among the various TAPs monitored in 1999, 10 of them are considered more important in terms of their health impacts and their annual averages are summarised in Table C10. Detailed description of the monitoring operation is given in Appendix B.4. The monitoring data collected so far indicate that the level of toxic air pollutants in Hong Kong is comparable to those observed in other major cities.

6. Variation of Air Pollution Levels over Time

The air pollutant concentration in the atmosphere can change over a day, over the months of a year and in the period of several years.

6.1 Over a Day

The concentrations of most air pollutants follow closely the diurnal pattern of human activities. For instance, higher levels of NO_2 and RSP are usually observed in the early morning and the evening rush-hours when there are more traffic and human activities. Likewise, the lowest concentrations often occur from midnight to dawn when the traffic is at its minimum. To no surprise, this type of traffic induced diurnal patterns is much more distinct for roadside air pollutant levels. The pollutant levels measured at the roadside station are generally higher than those measured at the urban station, which is followed in turn by the new town station and the rural station.

Figure 8: 1999 Diurnal variations of NO_2

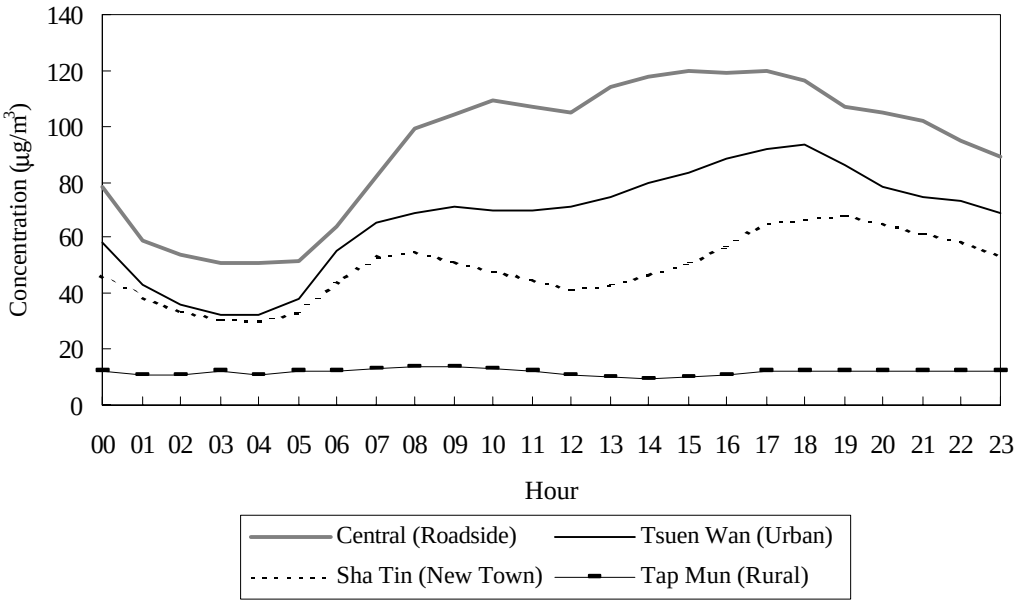
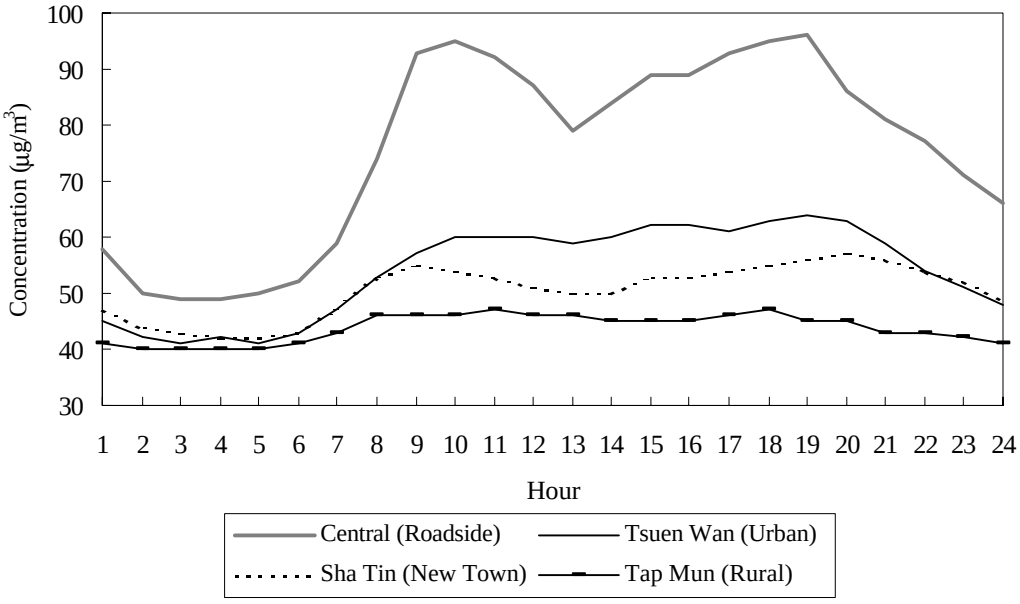
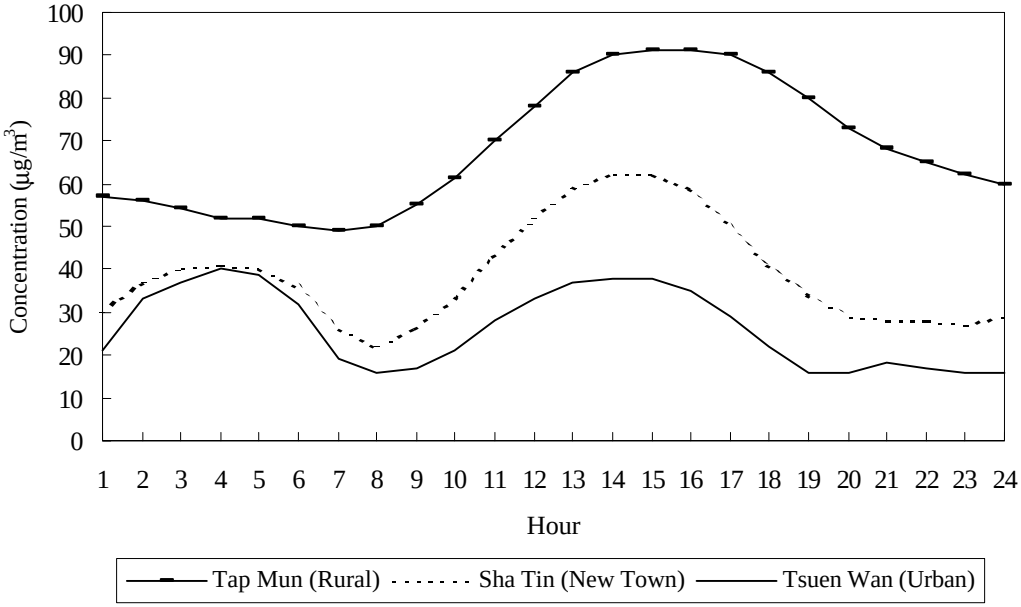


Figure 9: 1999 Diurnal variations of RSP



The diurnal pattern of ozone was different from that of NO_2 and RSP. Ozone is formed by photochemical reactions of its precursor pollutants such as NO_2 and volatile organic compounds (VOCs) under sunlight. Outside urban centres the ambient ozone levels start to build up before noon and peak in the afternoon, when precursor pollutants are accumulated and sunlight is strong. In urban areas, the lowest ozone concentrations are often observed during the rush-hours. This is because a large amount of nitric oxide from the rush-hour traffic acts as an efficient scavenger of ozone, and sunlight is also not strong enough for photochemical reactions to take place.

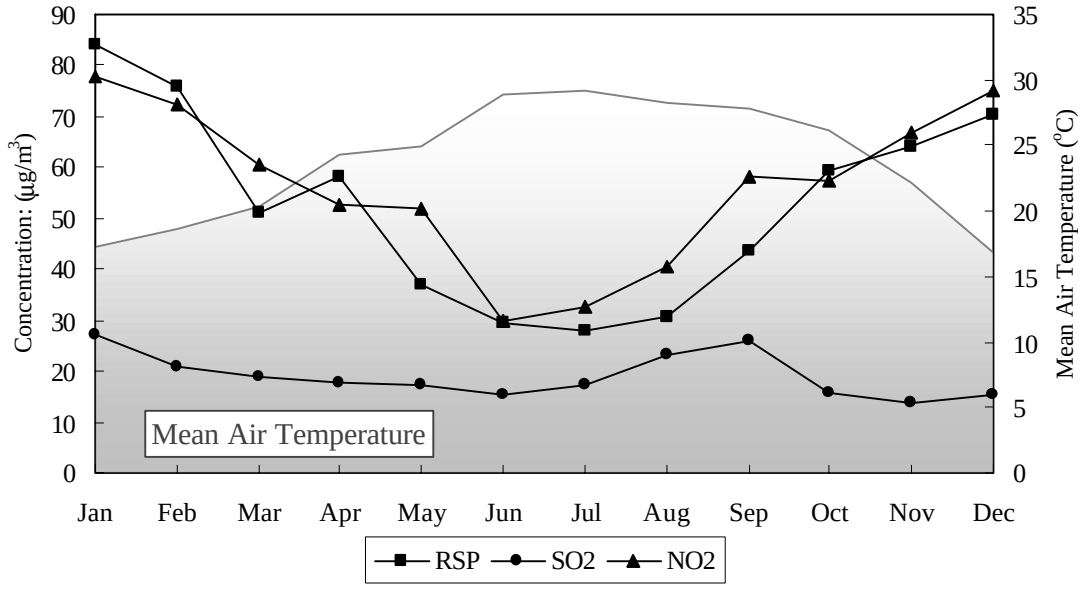
Figure 10: 1999 Diurnal variations of O_3



6.2 Over a Year

The emission strength of CO, NO_2 and RSP should not cause much variation in their concentrations as they are more or less constant throughout a year. Their variations are mainly determined by 3 meteorological factors that are interacting with each other to some extent and are showing seasonal patterns. Firstly, the higher temperature in the summer induces a larger mixing height, which helps to disperse the air pollutants. Secondly, the rains in the summer provide a washout effect to pollutants that are soluble in water, e.g. SO_2 and particulates. Finally, the change in prevailing wind direction to the southwest in July replenishes the region with cleaner ocean air. All these factors work together and help to lower the air pollutant levels in the

Figure 11: Monthly variations of SO_2, NO_2 and RSP at Central/Western in 1999

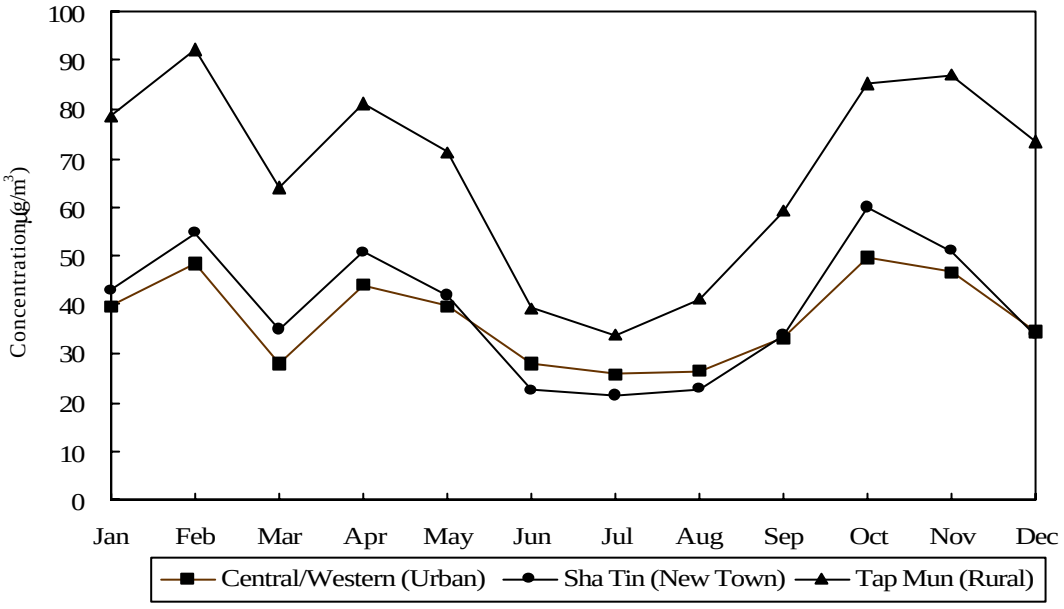


Note: Mean air temperature data were extracted from the "Summary of Meteorological Observations in Hong Kong, 1999" prepared by the Hong Kong Observatory.

summer months. On the other hand, the surge in SO_2 levels from July to September was mainly due to higher electricity demand for operating air conditioners in the hot summer season.

The formation of ozone is dependent on a number of actors including the availability of the precursor pollutants such as NO_2. The average ozone levels were low from June to August when the NO_2 level reached the trough of the year. The ozone levels in urban areas are generally lower than that in Tap Mun mainly due to the scavenging effect of nitric oxide emitted from motor vehicles in the urban areas.

Figure 12: Monthly variations of O_3 in 1999



6.3 Long Term Trends[1]

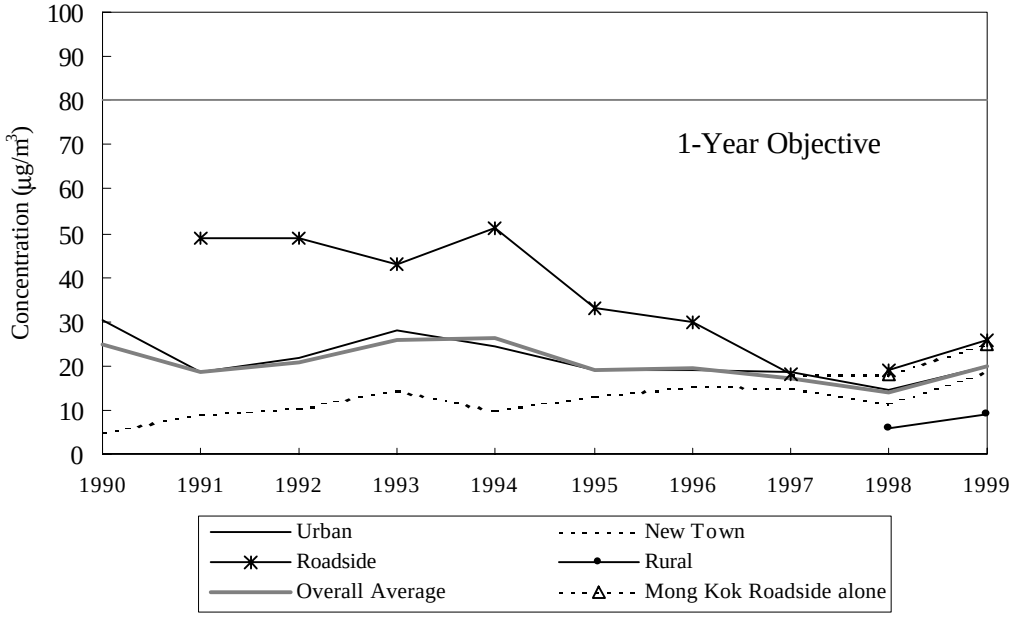
6.3.1 Sulphur Dioxide (SO_2)

The SO_2 concentration in ambient air has been maintaining at a reasonably low level since the implementation of the Air Pollution Control (Fuel Restriction) Regulations for stationary sources in 1990. Subsequent introduction of low sulphur diesel fuel under the Air Pollution Control (Motor Vehicle Fuel) Regulation and stringent diesel vehicle emission standards under the Air Pollution Control (Vehicle Design Standards) (Emission) Regulations in 1995 had further reduced the roadside SO_2 level by 65% in the following 3 years. Besides, improvement was also seen in 1998 after the tightening of the sulphur content of automobile diesel from 0.2% to 0.05% in that year.

In general, the overall SO_2 level in Hong Kong shown a steady downward trend in the last decade even though slight increases were observed in 1992 and 1999. The overall annual average in 1999 was about 19% lower than the 1990 value, with the biggest decrease recorded at the roadside station. On average, the roadside SO_2 level was higher than the urban and new town levels due to the street canyon effect. With more and more vehicles switching to the low sulphur content fuel, the SO_2 pollution problem should become less significant in the future.

[1] *The roadside trends from 1991 to 1997 in Fig. 13, 14, 15, 16 and 17 were plotted using data from the Mong Kok station only. After the addition of the Causeway Bay and Central stations to the monitoring network in 1998, the averages of all three roadside stations were then used. For the sake of comparison, the levels of Mong Kok station in 1998 and 1999 are also indicated with triangular markers in the figures.*

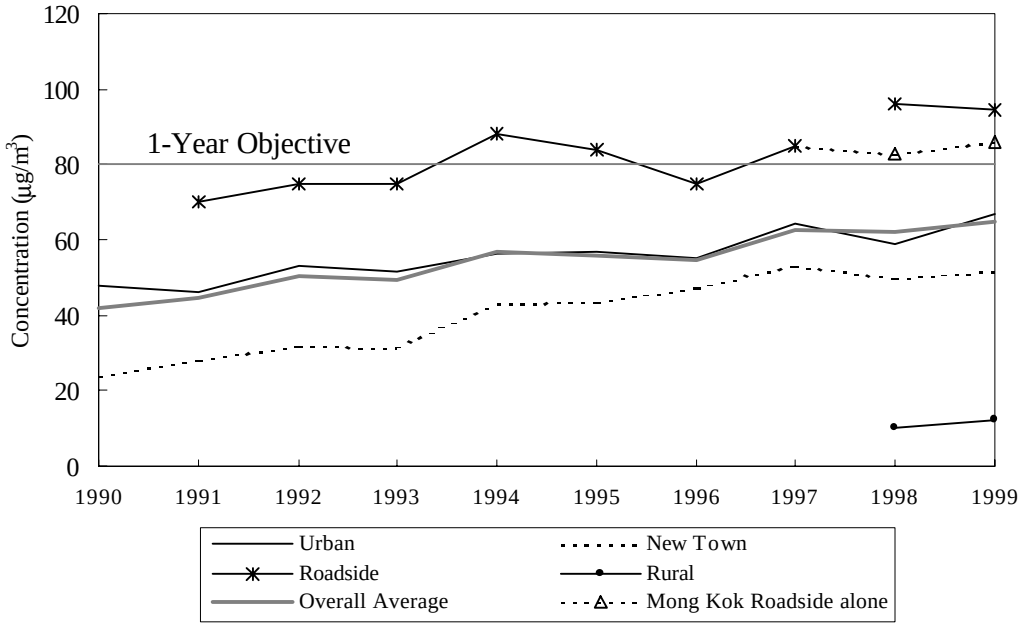
Figure 13: SO_2 long term trend



6.3.2 Nitrogen Dioxide (NO_2)

The NO_2 levels measured at the Causeway Bay and Central stations[2] were in general higher than that at the Mong Kok station. This caused an upward shift of about 16% and 10% in the 1998 and 1999 roadside averages respectively. Together with the addition of the Tap Mun rural station, which usually measured lower levels of NO_2 due to the lack of mobile sources there, the overall 1999 NO_2 level was found to be only 3% and 4% higher than the 1997 and 1998 levels respectively.

Figure 14: NO_2 long term trend



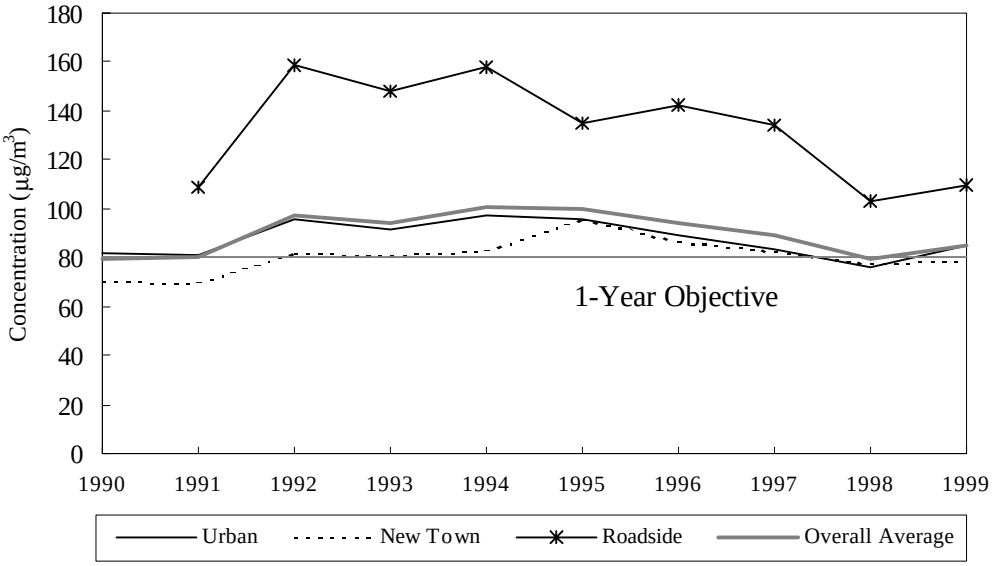
[2] *The Causeway Bay roadside stations was commissioned in January 1998 while the Central station in October 1998.*

Contrary to SO_2, the overall NO_2 level exhibited an unmistakable increasing trend in the past 10 years. The percentage increases between the 1991 and 1999 levels by land use types were urban 45%, new town 85% and roadside 35%. The overall NO_2 level in 1999 was 20 $\mu g/m^3$ higher than the corresponding value in 1991, an increase of about 44%. Due to closer proximity to the emission sources, the roadside NO_2 level exceeded the permissible limits of 80 $\mu g/m^3$ by about 18% in 1999.

6.3.3 Total Suspended Particulates (TSP)

The overall TSP levels in Hong Kong continued to stay at the rather high level of 85 $\mu g/m^3$ in 1999, with mild to moderate increase observed across the territory. In fact, the overall TSP average seemed to level off at a value slightly above the annual AQO level after experiencing a moderate drop of 22% in 1998 from the peak value of 101 $\mu g/m^3$. In spite of the drop, the roadside TSP levels in 1999 was still 38% above the annual AQO. The urban TSP level (85 $\mu g/m^3$) also exceeded the annual AQO by 6% while the new town level (78 $\mu g/m^3$) just barely satisfied the AQO. As with NO_2, the elevated roadside level of TSP was also due to the close proximity to the emission sources.

Figure 15: TSP long term trend

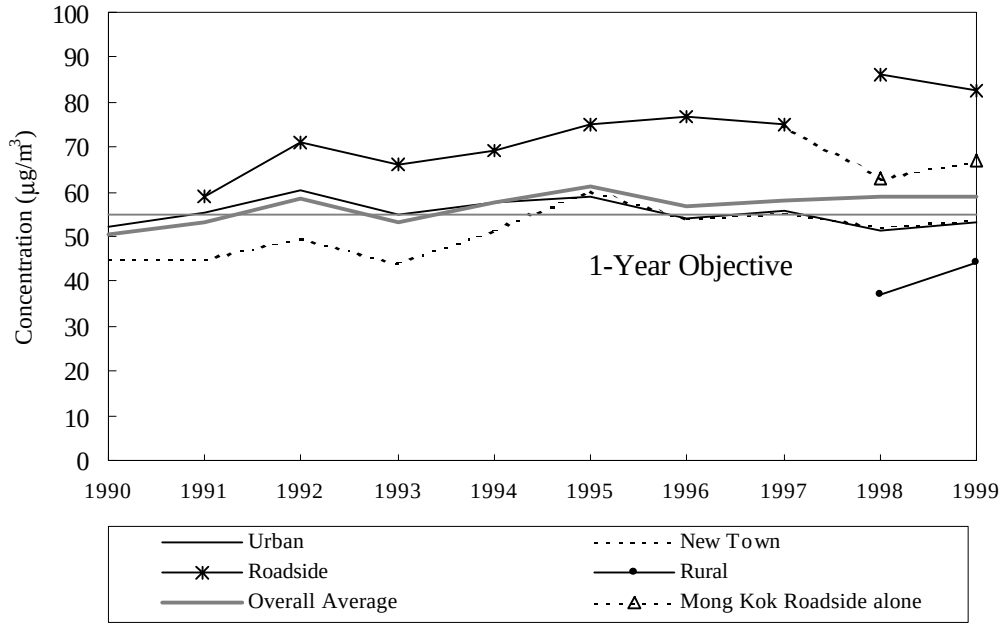


6.3.4 Respirable Suspended Particulates (RSP)

The overall average of RSP in 1999 remained the same as 1998 at 59 $\mu g/m^3$, which was about 11% (6 $\mu g/m^3$) above the 1991 level. During the year, the annual RSP levels in urban and new town areas were 53 $\mu g/m^3$ and 54 $\mu g/m^3$ respectively, just marginally below the AQO level of 55 $\mu g/m^3$. In fact, the RSP levels in these two areas have been exhibiting similar fluctuating trend since 1995.

The roadside RSP trend, on the other hand, shows a more definite rising trend even though there was a slight drop of 4% in annual average from the 1998 level. When data from the Causeway Bay and Central are excluded, the roadside level (as calculated from the Mong Kok monitoring data alone) in 1999 was still 14% (8 $\mu g/m^3$) higher than the corresponding value in 1991. As for the rural station in Tap Mun, the annual RSP concentration remained at the relatively high level of 44 $\mu g/m^3$ in 1999, an increase of about 19% from the 1998 value. However, this increase could be due to the absence of first quarter data in 1998, which were usually higher than the second and third quarter's data. Hence, a few more year's data will be required to establish the long term trend of background RSP level.

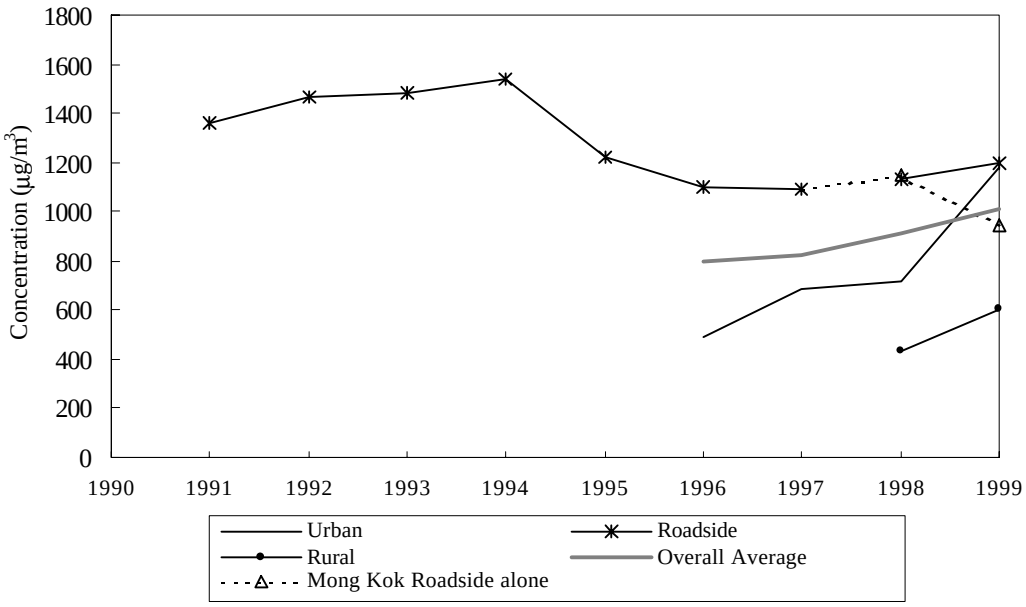
Figure 16: RSP long term trend



6.3.5 Carbon Monoxide (CO)

The overall CO level showed a moderate increase of 27% in 1999 from the 1996 value. Apparent rising trend was observed at all land use areas although with different magnitudes. Notwithstanding the rising trend, the CO level in general was still very low in Hong Kong. Even at the roadside close to the vehicular sources, the levels were always well within the relevant AQOs. The relatively low CO level could be due to the increase in the number of vehicles fitted with catalytic converters in the past few years.

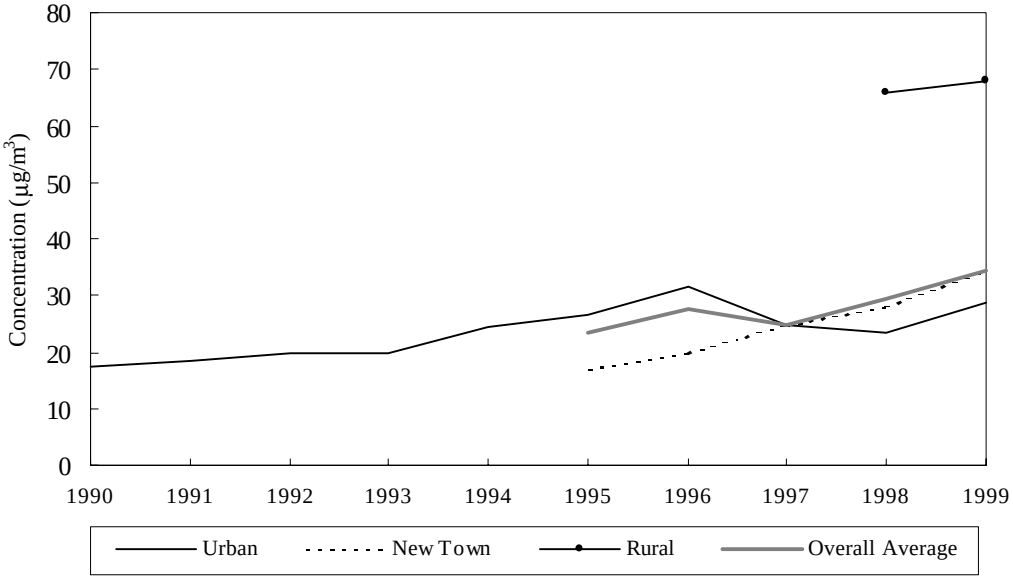
Figure 17: CO long term trend



6.3.6 Ozone (O_3)

With the exception of Yuen Long and Kwai Chung which both shown a moderate drop of 22%, all stations recorded higher annual averages of ozone in 1999. The increases ranged from 3% at the Tap Mun station to as high as 47% at the Kwun Tong station. The rather steep rise in the overall ozone average in the past few years (47% from 1995 to 1999) could be mostly attributed to the addition of 7 stations in ozone monitoring. The addition of the rural Tap Mun station in 1998 was particularly important since the ozone levels recorded there were in general much higher than those measured in the urban and new town areas. Nevertheless, data from stations such as Central/Western and Kwai Chung, which have been monitoring ozone since 1990, also revealed a slow but steady rising trend in the last decade.

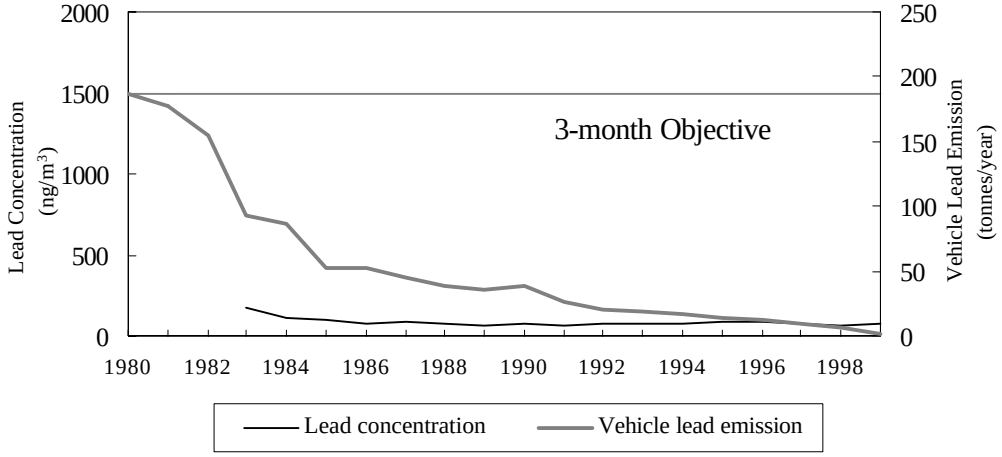
Figure 18: O_3 long term trend



6.3.7 Lead (Pb)

The lead content of petrol has reduced by almost 90% since the oil companies took voluntary action in reducing the use of lead in the eighties. Past monitoring results shown that the lead concentration was already at a rather low level when unleaded petrol was introduced to Hong Kong in April 1992. In fact, the ambient lead concentration has been maintaining at that level since the early eighties.

Figure 19 : Vehicle lead emission and lead concentration



Appendix A

Monitoring Results of Sulphur Dioxide and Nitrogen Dioxide by HEC and CLP

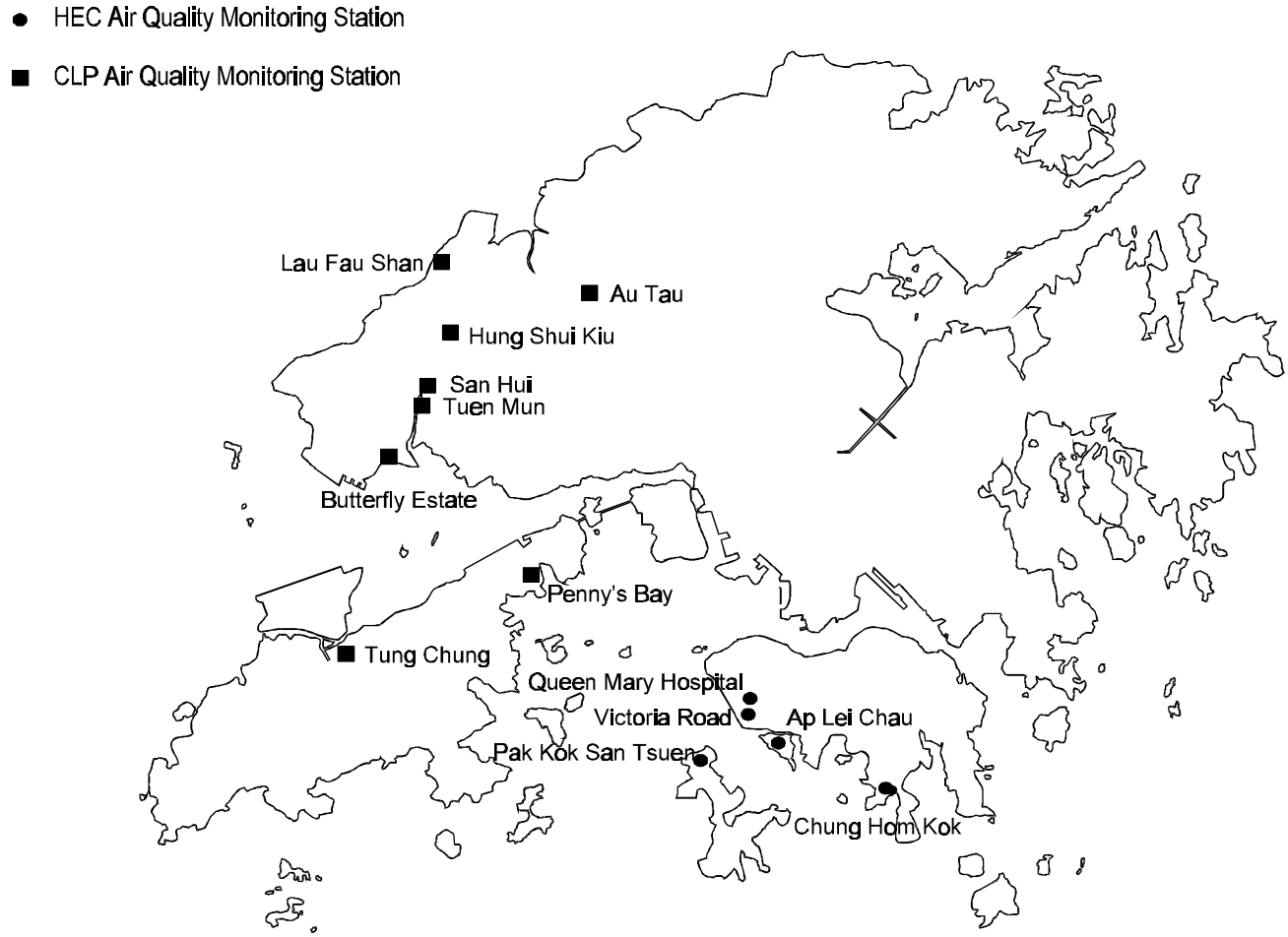


Figure A1 LOCATION OF HEC & CLP AIR QUALITY MONITORING STATIONS FOR SULPHUR DIOXIDE AND NITROGEN DIOXIDE

A.1 The Hongkong Electric Co. Ltd.

Air Quality Monitoring Stations	Annual Mean Concentration[1]	Range of Monthly Mean Concentration
Sulphur Dioxide (SO_2)		
Chung Hom Kok	6	2 - 9
Victoria Road	11	7 - 18
Queen Mary Hospital	16	8 - 24
Ap Lei Chau	10	7 - 16
Pak Kok San Tsuen	8	1 - 14
Nitrogen Dioxide (NO_2)		
Chung Hom Kok	18	11 - 24
Victoria Road	33	18 - 56
Queen Mary Hospital	30	13 - 52
Ap Lei Chau	28	9 - 53
Pak Kok San Tsuen	23	5 - 46

A.2 China Light & Power Co. Ltd.

Air Quality Monitoring Station	Annual Mean Concentration[1]	Range of Monthly Mean Concentration
Sulphur Dioxide (SO_2)		
San Hui	26	11 - 44
Tuen Mun	22	8 - 42
Hung Shui Kiu	15	6 - 22
Au Tau	88	84 - 91
Butterfly Estate[2]	16	3 - 45
Penny's Bay	8	2 - 17
Lau Fau Shan	32	6 - 87
Tung Chung	9	5 - 18
Nitrogen Dioxide (NO_2)		
Tuen Mun[3]	51	27 - 81
Butterfly Estate	51	27 - 75
Penny's Bay	35	11 - 63
Lau Fau Shan	36	9 - 66
Tung Chung[4]	35	26 - 51

Notes:

[1] All pollutant units are in micrograms per cubic metre on hourly average.

[2] The 24-hour AQO level for SO_2 was exceeded once in June at the Butterfly Estate station.

[3] The 24-hour AQO for NO_2 was violated because the 24-hour AQO level was exceeded three times in December at the Tuen Mun station.

[4] Station re-location is in progress. The Annual Mean Concentration is calculated using only the first 5 months data (i.e. January to May).

Appendix B

AIR QUALITY MONITORING OPERATION

B.1 Network Operation

The air quality monitoring network of 14 monitoring stations is operated by the Air Services Group of the Environmental Protection Department. The measurement of ambient concentrations of total suspended particulates (TSP), respirable suspended particulates (RSP), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3) and carbon monoxide (CO) have been accredited by the Hong Kong Laboratory Accreditation Scheme (HOKLAS) since August 1995.

In order to provide good representation of the air quality in areas of high population density, the locations of the 14 monitoring stations were carefully chosen by referencing to the United States Environmental Protection Agency's (USEPA) guidelines with practical consideration of the unique congested high-rise development of Hong Kong.

The details for the parameters monitored at each monitoring station and a list of equipment employed for measuring the air pollutants are summarised in Tables B2 and B3 respectively. In general, the concentration of gaseous pollutants and RSP are determined continuously by automatic analysers. Manually operated high volume samplers using the gravimetric methods are also used regularly to measure the TSP and RSP. In addition, meteorological parameters, including temperature and solar radiation, wind speed and direction, are also recorded continuously at each station as appropriate.

Wet and dry deposition samples are collected at 2 stations: Central/Western and Kwun Tong. The parameters measured for all wet and dry samples include: Si, Al, Ca, Fe, Mg, V, Mn, Cu and Ba in the residue; and pH, Na^+, K^+, NH_4^+, NO_3^-, SO_4^{2-}, Cl^-, Ca, Mg, formate and acetate in the filtrate.

B.2 Data Processing and Dissemination

At each monitoring station, signals from the continuous analysers and the meteorological instruments are first stored in a data logger and then sent back to the Data Processing Unit of the Air Services Group via dedicated telephone lines for further processing. After careful checking and validation, the monitoring data are disseminated to the public in the following manner:-

- Monthly release of the monitoring data recorded at the Mong Kok, Kwai Chung and Central/Western stations (up to June 1998)
- Monthly release of the Air Pollution Index (API) summary for all monitoring stations (since July 1998)
- Daily API reporting and forecast for three categories of land-use areas, viz., urban, industrial, and new development (from 6 June 1995 to 14 June 1998)
- Daily API reporting and forecast for individual station (from 15 June 1998 to 30 June 1999)
- Hourly API reporting for individual station (since 1 July 1999)
- Reporting of monitoring data in the annual reports *Air Quality in Hong Kong* and *Environment Hong Kong*

- *Ad hoc* provision of air quality data to the public, academics and environmental consultants upon request for the purposes of research and air quality assessment

The reporting and forecast of API will help the public (particularly susceptible groups such as the elderly, children and people with heart or respiratory illness) to decide on taking precautionary measures when necessary. The monitoring results are also regularly used to assist the formulation of air quality management plans and the evaluation on the effectiveness of the current air pollution control programmes.

B.3 Quality Control and Assurance

A quality policy is adopted to ensure that ambient air quality monitoring results from the monitoring stations attain a high degree of accuracy and precision. A quality system has been established in accordance with the HOKLAS criteria.

The accuracy of the monitoring network is assessed by performance audits. Similar to overseas standards, control limits of ±15% and ±10% are adopted for the gaseous pollutants and particulates respectively. In 1999, 388 audit checks were carried out on the stations' analysers and samplers. As shown in Figure B1 and based on the 95% probability limits, the accuracy of the network was within the specified control limits.

The precision, a measure of the repeatability, of the measurements is checked in accordance with EPD's quality manuals. In 1999, 1338 precision checks were carried out on the analysers and samplers. As shown in Figure B2 and based on the 95% probability limits, the precision of the network varied between -9.9% and 12.7%, which was again within target limits.

In addition to the above operations, a system audit to review the quality assurance activities is carried out on an annual basis on the monitoring network. A report outlining the deficiencies and corrective actions is compiled at the end of the audit.

B.4 Toxic Air Pollutants Monitoring Operation

The Air Services Group has installed in July 1997 additional monitoring facilities at the Tsuen Wan and Central/Western stations to measure regularly the levels of Toxic Air Pollutants (TAPs) in Hong Kong. The TAPs being monitored can be broadly classified as volatile organic compounds (e.g. benzene, perchloroethylene and 1,3-butadiene), dioxins and furans (e.g. 2,3,7,8-TCDF and 2,3,7,8-TCDD), carbonyl compounds (e.g. formaldehyde), polycyclic aromatic hydrocarbons (e.g. benzo(a)pyrene), and hexavalent chromium. Five distinct methods were used to analyse the collected samples for target TAPs (please refer to Table B4 for details). All these methods have stringent QA/QC criteria to ensure the data quality. Sampling media used include stainless steel canisters, Sep-Pak cartridges, polyurethane foams and bicarbonate impregnated filters. TAP samples were collected by EPD staff (Jan. to mid-Sept 99) and ENSA International, Inc., Hong Kong (mid-Sept 99 to Dec 99) on a 1-year contract and were sent to the Government Laboratory for analysis.

Table B1. Fixed Network Monitoring Stations: Site Information

Monitoring Station	Address	Area Type	Sampling Height (Above P.D.H.K.)	Above Ground	Date Start Operation
Central/Western (Upper Level Police Station)	1 High Street, Sai Ying Pun	Urban : Residential	78m	18m (4 floors)	Nov 83
Eastern (Sai Wan Ho Fire Station)	20 Wai Hang Street, Sai Wan Ho	Urban : Residential	28m	17.5m (4 floors)	Jan 99
Kwai Chung (Kwai Chung Police Station)	999 Kwai Chung Road, Kwai Chung	Urban : Mixed residential/ commercial/industrial	19m	13m (2 floors)	Jan 99
Kwun Tong (City District Office)	6 Tung Yan Street, Kwun Tong	Urban : Mixed residential/ commercial/industrial	34m	25m (6 floors)	Jul 83
Sham Shui Po (Police Station)	37A Yen Chow Street, Sham Shui Po	Urban : Mixed residential/commercial	21m	17m (4 floors)	Jul 84
Tsuen Wan (Princess Alexandra Community Centre)	60 Tai Ho Road, Tsuen Wan	Urban : Mixed residential/ Commercial/industrial	21m	17m (4 floors)	Aug 88
Sha Tin (Sha Tin Govt. Secondary School)	11-17 Man Lai Road, Tai Wai, Sha Tin	New Town : Residential	27m	21m (5 floors)	Jul 91
Tai Po (Tai Po Govt. Office Bldg.)	1 Ting Kok Road, Tai Po	New Town : Residential	31m	25m (6 floors)	Feb 90
Tung Chung (Tung Chung Health Centre)	6 Fu Tung Street, Tung Chung	New Town : Residential	28m	21m (4 floors)	Apr 99
Yuen Long (Yuen Long District Branch Offices Bldg.)	269 Castle Peak Road Yuen Long	New Town : Residential with fairly rapid development	31m	25m (6 floors)	July 95
Tap Mun (Tap Mun Police Station)	Tap Mun	Background : Rural	26m	11m (3 floors)	Apr 98
Causeway Bay	1 Yee Woo Street, Causeway Bay	Urban Roadside : Busy commercial area surrounded by many tall buildings	6.5m	2m	Jan 98
Central	Junction of Des Voeux Road Central and Chater Road, Central	Urban Roadside : Busy commercial/financial area surrounded by many tall buildings	8.5m	4.5m	Oct 98
Mong Kok (Mong Kok Rd. Pumping Station)	4E Mong Kok Road, Mong Kok	Urban Roadside : Mixed residential/commercial area surrounded by some moderately tall buildings	7m	2m (1 floor)	Apr 91

Note: P.D. = Principal datum

Table B2. Summary of the Parameters Monitored in the Network (1999)

	PARAMETERS									
STATIONS	SO_2	NO_x	NO	NO_2	CO	O_3	RSP		TSP	MET[3]
							Cont [1]	Hi-Vol [2]		
Central/Western	✓	✓	✓	✓		✓	✓	✓	✓	✓
Eastern	✓			✓		✓	✓			✓
Kwai Chung	✓	✓	✓	✓		✓	✓	✓	✓	✓
Kwun Tong	✓	✓	✓	✓		✓	✓	✓	✓	✓
Sham Shui Po	✓	✓	✓	✓		✓	✓	✓	✓	✓
Tsuen Wan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sha Tin	✓	✓	✓	✓		✓	✓	✓	✓	✓
Tai Po	✓			✓		✓	✓	✓	✓	✓
Tung Chung	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Yuen Long	✓			✓		✓	✓	✓	✓	✓
Tap Mun	✓	✓	✓	✓	✓	✓	✓			
Causeway Bay	✓	✓	✓	✓	✓		✓			
Central	✓	✓	✓	✓	✓		✓			
Mong Kok	✓	✓	✓	✓	✓		✓	✓	✓	✓

Note:

[1] "Cont" denotes continuous monitoring.

[2] "Hi-Vol" denotes high-volume sampling.

[3] "MET" denotes meteorological parameters such as temperature, wind speed, wind direction, etc.

Table B3 List of Equipment Used in Measuring Air Pollutant Concentration

Pollutants	**Measurement Principle**	**Commercial Instrument**
SO_2	UV fluorescence	TECO Model 43A Monitor Laboratories 8850
NO, NO_2, NO_x	Chemiluminescence	TECO Model 42, API 200A Monitor Laboratories 8840
O_3	UV absorption	TECO 49, API 400
CO	Non-dispersive infra-red absorption with gas filter correlation	TECO Model 48, 48C
TSP	Gravimetric	General Metals 2310
RSP	a) Gravimetric b) Oscillating microbalance	Graseby Andersen PM10 R&P TEOM Series 1400a-AB-PM10
NO_2, O_3, SO_2	Differential Optical Absorption Spectroscopy	Opsis AR 500 System

Table B4 Sampling and Analysis Methods Used in Measuring Toxic Air Pollutants

Toxic Air Pollutants	Sampling and Analysis Method	Sampling Instrument/Media	Sampling Schedule	Sampling Period
Benzene	USEPA Method TO-14	Xontech 910A / Canister	Every 6 days	24 hours
Perchloroethylene	USEPA Method TO-14	Xontech 910A / Canister	Every 6 days	24 hours
1,3-Butadiene	USEPA Method TO-14	Xontech 910A / Canister	Every 6 days	24 hours
Formaldehyde	USEPA Method TO-11	Xontech 920 / DNPH coated Sep-Pak Cartridge	Every 12 days	24 hours
Benzo(a)pyrene	USEPA Method TO-13	Graseby GPSI / PUF/XAD-2 Sorbents	Twice per month	24 hours
Dioxin	USEPA Method TO-9 / 23	Graseby GPSI / Polyurethane Foam	Twice per month	24 hours
Hexavalent Chromium	CARB SOP MLD 039	Xontech 925 / Bicarbonate Impregnated Filter	Every 12 days	24 hours

Figure B1: Accuracy of Air Quality Monitoring Network, 1999

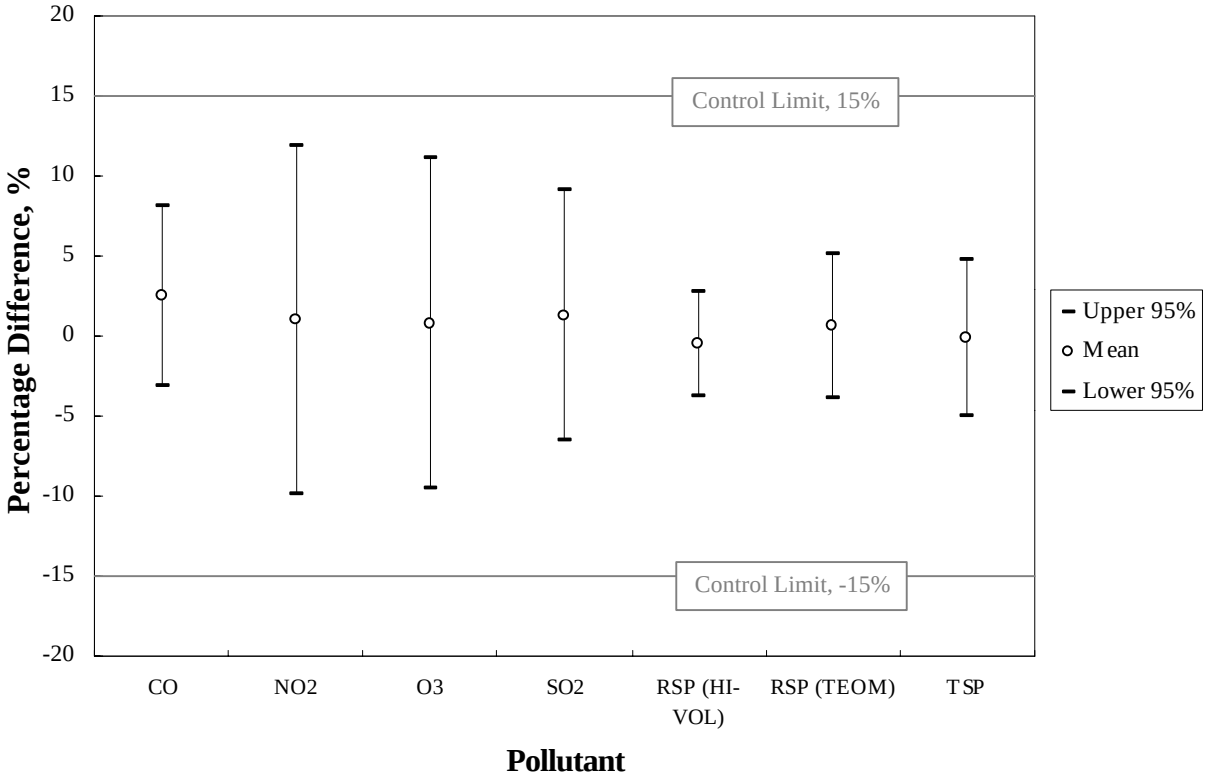
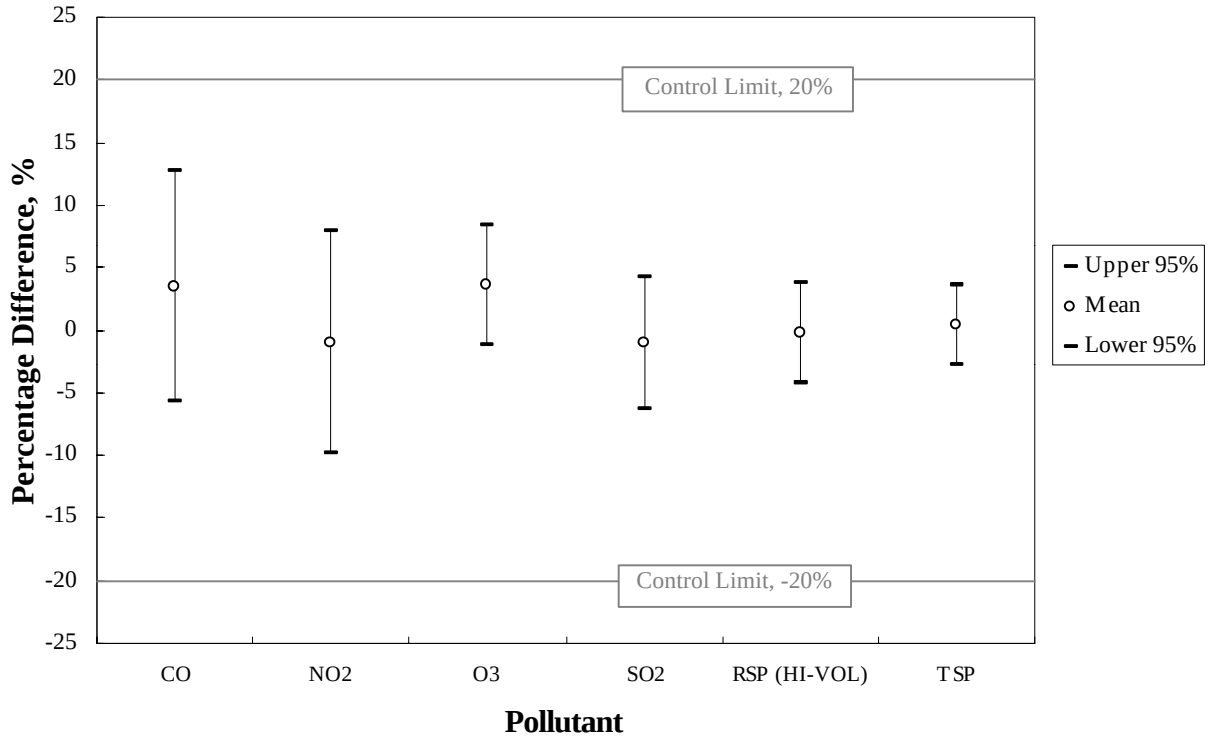


Figure B2: Precision of Air Quality Monitoring Network, 1999



Note: The Control Limits for RSP and TSP are ±10% for both Accuracy and Precision.

Appendix C

Tables of Air Quality Data

TABLE C1: THE HIGHEST 4 HOURLY POLLUTANT CONCENTRATIONS MEASURED IN 1999

Pollutant: Sulphur Dioxide *
(1-hour AQO = 800)

Station	1st High	2nd High	3rd High	4th High
Central / Western	464	351	273	249
Eastern	284	245	170	112
Kwai Chung	249	248	233	232
Kwun Tong	225	197	193	177
Sham Shui Po	249	198	195	193
Tsuen Wan	311	179	170	166
Sha Tin	151	149	140	129
Tai Po	210	177	163	159
Tung Chung	192	192	184	182
Yuen Long	204	170	157	156
Tap Mun	97	83	81	71
Causeway Bay	202	154	148	147
Central	286	255	246	239
Mong Kok	235	213	212	201

Pollutant: Nitrogen Oxides

Station	1st High	2nd High	3rd High	4th High
Central / Western	1139	1074	804	795
Kwai Chung	1448	1247	1243	1222
Kwun Tong	1227	1163	1158	1138
Sham Shui Po	1231	1176	1131	1124
Tsuen Wan	887	882	826	812
Sha Tin	816	750	743	730
Tai Po	639	594	584	532
Tung Chung	596	588	561	524
Yuen Long	802	681	659	613
Tap Mun	131	129	127	126
Causeway Bay	2472	2147	2111	2042
Central	2453	2196	2154	2139
Mong Kok	1377	1365	1288	1202

Pollutant: Nitric Oxide

Station	1st High	2nd High	3rd High	4th High
Central / Western	601	554	409	405
Kwai Chung	828	686	685	685
Kwun Tong	662	641	624	608
Sham Shui Po	668	648	634	632
Tsuen Wan	450	436	435	409
Sha Tin	449	403	394	382
Tai Po	358	317	299	290
Tung Chung	217	215	187	186
Yuen Long	437	371	357	327
Tap Mun	44	42	39	39
Causeway Bay	1448	1279	1255	1211
Central	1428	1261	1250	1248
Mong Kok	763	734	700	662

Note: 1. All concentration units are in micrograms per cubic metre.
2. Shaded 1-hour averages are above their respective AQO.
3. Only the asterisked pollutants have hourly AQO.

Pollutant: Nitrogen Dioxide *
(1-hour AQO = 300)

Station	1st High	2nd High	3rd High	4th High
Central / Western	252	250	242	239
Eastern	195	190	179	173
Kwai Chung	304	302	300	292
Kwun Tong	306	288	279	274
Sham Shui Po	272	266	260	259
Tsuen Wan	383	359	344	322
Sha Tin	266	260	255	254
Tai Po	278	265	236	231
Tung Chung	335	330	310	300
Yuen Long	314	314	291	288
Tap Mun	98	86	85	84
Causeway Bay	335	332	331	321
Central	334	314	311	298
Mong Kok	319	307	304	295

Pollutant: Carbon Monoxide *
(1-hour AQO = 30000)

Station	1st High	2nd High	3rd High	4th High
Tsuen Wan	5290	5180	5060	4950
Tung Chung	4240	4010	3320	3320
Tap Mun	2070	1960	1960	1840
Causeway Bay	5290	5180	5060	4950
Central	5180	4600	4600	4490
Mong Kok	4600	4490	4490	4370

Pollutant: Ozone *
(1-hour AQO = 240)

Station	1st High	2nd High	3rd High	4th High
Central / Western	264	245	213	208
Eastern	130	129	120	107
Kwai Chung	180	152	144	137
Kwun Tong	125	122	120	116
Sham Shui Po	203	195	123	119
Tsuen Wan	201	183	162	161
Sha Tin	295	290	273	246
Tai Po	209	208	184	180
Tung Chung	335	311	281	278
Yuen Long	193	173	145	144
Tap Mun	294	284	284	269

Pollutant: Respirable Suspended Particulates

Station	1st High	2nd High	3rd High	4th High
Central / Western	292	270	267	257
Eastern	241	239	239	233
Kwai Chung	319	305	304	302
Kwun Tong	264	260	249	247
Sham Shui Po	323	321	309	288
Tsuen Wan	362	356	317	315
Sha Tin	279	275	265	265
Tai Po	261	258	256	256
Tung Chung	446	431	331	322
Yuen Long	295	294	292	288
Tap Mun	291	285	283	271
Causeway Bay	302	297	288	285
Central	555	519	500	492
Mong Kok	328	327	319	310

TABLE C2: THE HIGHEST 2 DAILY POLLUTANT CONCENTRATIONS MEASURED IN 1999

Pollutant: Sulphur Dioxide *
(24-hour AQO = 350)

Station	1st High	2nd High
Central / Western	108	73
Eastern	78	49
Kwai Chung	91	87
Kwun Tong	103	81
Sham Shui Po	96	94
Tsuen Wan	76	64
Sha Tin	55	49
Tai Po	75	74
Tung Chung	58	58
Yuen Long	89	82
Tap Mun	36	36
Causeway Bay	90	69
Central	119	88
Mong Kok	91	85

Pollutant: Nitrogen Dioxide *
(24-hour AQO = 150)

Station	1st High	2nd High
Central / Western	160	145
Eastern	125	120
Kwai Chung	191	168
Kwun Tong	192	159
Sham Shui Po	165	152
Tsuen Wan	193	169
Sha Tin	140	124
Tai Po	147	129
Tung Chung	199	190
Yuen Long	179	168
Tap Mun	46	39
Causeway Bay	209	207
Central	207	205
Mong Kok	180	176

Pollutant: Respirable Suspended Particulates *
(24-hour AQO = 180)

Station	1st High	2nd High
Central / Western	197	195
Eastern	185	152
Kwai Chung	226	170
Kwun Tong	199	147
Sham Shui Po	200	198
Tsuen Wan	226	170
Sha Tin	190	169
Tai Po	191	164
Tung Chung	200	197
Yuen Long	238	188
Tap Mun	213	159
Causeway Bay	226	209
Central	296	207
Mong Kok	216	168

Pollutant: Nitrogen Oxides

Station	1st High	2nd High
Central / Western	422	412
Kwai Chung	580	574
Kwun Tong	553	478
Sham Shui Po	599	484
Tsuen Wan	436	415
Sha Tin	365	348
Tai Po	298	276
Tung Chung	319	298
Yuen Long	411	267
Tap Mun	57	54
Causeway Bay	1261	1231
Central	1193	910
Mong Kok	645	561

Pollutant: Nitric Oxide

Station	1st High	2nd High
Central / Western	177	174
Kwai Chung	285	251
Kwun Tong	265	225
Sham Shui Po	284	224
Tsuen Wan	161	159
Sha Tin	167	139
Tai Po	120	99
Tung Chung	84	66
Yuen Long	163	109
Tap Mun	13	10
Causeway Bay	693	678
Central	648	481
Mong Kok	309	288

Pollutant: Total Suspended Particulates *
(24-hour AQO = 260)

Station	1st High	2nd High
Central / Western	186	174
Kwai Chung	190	167
Kwun Tong	182	158
Sham Shui Po	276	157
Tsuen Wan	200	195
Sha Tin	240	196
Tai Po	194	176
Tung Chung	255	152
Yuen Long	301	241
Mong Kok	221	179

Pollutant: Ozone

Station	1st High	2nd High
Central / Western	102	89
Eastern	75	71
Kwai Chung	72	70
Kwun Tong	64	61
Sham Shui Po	54	53
Tsuen Wan	85	72
Sha Tin	107	103
Tai Po	102	102
Tung Chung	118	108
Yuen Long	70	68
Tap Mun	151	134

Pollutant: Carbon Monoxide *
(8-hour AQO = 10000)

Station	1st High	2nd High
Tsuen Wan	4759	4715
Tung Chung	2807	2734
Tap Mun	1799	1799
Causeway Bay	4789	4731
Central	4214	4199
Mong Kok	4070	4013

Note: 1. *All concentration units are in micrograms per cubic metre.*
2. *Values for Carbon Monoxide are 8-hour averages.*
3. *Shaded 24-hour averages are above their respective AQO.*
4. *Only the asterisked pollutants have either 8-hour or 24-hour AQO.*

TABLE C3: 1999 MONTHLY AND ANNUAL AVERAGES OF GASEOUS POLLUTANTS

Pollutant: Sulphur Dioxide (Annual AQO = 80)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	27	21	19	18	17	15	17	23	26	16	14	16	19
Eastern	20	17	18	17	18					16	12	15	17 *
Kwai Chung	27	19	28	26	30	37	42	44	32	18	18	23	29
Kwun Tong	23 *	22	17	13	18	13	15	25	30	17	13	15	18
Sham Shui Po	24	19	19	15	16	17	19	26	28	12	11	15	18
Tsuen Wan	19	13	18	15	18	26	21	26	21	13	14	18	19
Sha Tin	15	13	12	10	12	14	16	20	15	10	15	19	14
Tai Po	17	32	35	35	36	20	17	22	18	14	13	18 *	23
Tung Chung				12	15	8	13	10	20	16	18	25	15 *
Yuen Long	29	24	27	28	25	15	15	23	22	17	14	27	22
Tap Mun	16	9	7	8	6	4	6	11	12	11	12	10	9
Causeway Bay	33	29	25	24	24	21	27	16	18	24	25	35	25
Central	43	25	19	20	20	24	26	36	37	26	27	35	28
Mong Kok	28	24	24	29	32	24	25	28	33	18	15	21	25

Pollutant: Nitrogen Oxides

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	125	113	111	84	79	53	60	76	98	76	96	125	91
Kwai Chung	220	174	192	163	175	194	211	229	191	129	160	221	189
Kwun Tong	231 *	215	201	169	194	145	174	190	184	175	182	213	188
Sham Shui Po	194	168	160	139	135	104	109	132	145	122	147	177	144
Tsuen Wan	181	138	150	123	119	107	111	126	124	110	132	164	132
Sha Tin	126	119	93	70	78	63	65	109	98	59	86	132	91
Tai Po	133	99 *											128 *
Tung Chung				53	58	28	37	42	71	69	84	126	64 *
Yuen Long	162	124 *											155 *
Tap Mun	19	13	14	13	12	9	11	17	18	14	13	16	14
Causeway Bay	685	676	615	505	552	420	378	430	461	443	471	601	517
Central	500	421	419	326	359	370	369	397	363	297	379	438	387
Mong Kok	303	282	252	239	246	197	220	246	279	270	284	313	262

Pollutant: Nitric Oxide

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	33	29	36	22	19	17	21	26	29	14	20	33	25
Kwai Chung	82	63	82	63	70	92	101	107	80	43	56	88	78
Kwun Tong	92 *	81	87	62	75	63	79	85	73	62	65	78	75
Sham Shui Po	69	56	61	46	44	42	46	56	54	34	44	63	51
Tsuen Wan	60	40	57	39	37	43	44	49	39	28	37	53	44
Sha Tin	39	39	29	19	21	22	23	44	34	14	25	44	29
Tai Po	40	25 *											37 *
Tung Chung				10	11	7	10	11	14	11	15	27	13 *
Yuen Long	50	33 *											47 *
Tap Mun	2	2	3	3	2	2	2	2	3	3	2	1	2
Causeway Bay	360	348	326	257	292	233	206	236	249	217	234	313	271
Central	250	201	211	152	170	203	203	214	178	137	174	208	192
Mong Kok	125	118	114	96	100	91	109	124	133	117	121	132	115

Pollutant: Nitrogen Dioxide (Annual AQO = 80)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	78	72	60	53	52	30	33	41	58	58	67	75	56
Eastern	71	72	64	62	62					62	66	70	66 *
Kwai Chung	95	78	68	68	69	56	59	68	72	66	77	89	72
Kwun Tong	96 *	97	75	78	81	51	56	64	79	87	83	95	78
Sham Shui Po	87	80	64	67	66	38	37	44	60	68	78	81	64
Tsuen Wan	91	79	65	65	64	43	46	53	66	68	77	83	67
Sha Tin	72	64	53	45	49	31	32	45	50	40	50	66	50
Tai Po	73	67	64	55	58	34	31	47	53	43	49	74 *	54
Tung Chung				38	42	15	22	25	48	52	63	85	43 *
Yuen Long	85	72	62	58	62	34	38	45	58	56	63	81	60
Tap Mun	16	11	12	12	10	6	8	13	14	12	11	15	12
Causeway Bay	137	146	119	115	109	67	65	73	82	112	114	123	105
Central	122	112	94	92	96	58	57	68	89	87	113	122	92
Mong Kok	111	102	77	92	92	58	54	57	76	92	100	115	86

Pollutant: Carbon Monoxide

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tsuen Wan	1889	1308	1014	1069	1230	959	909	936	1020	1109	1251	1425	1177
Tung Chung				762	598	587	769	606	623	578	884	984	709 *
Tap Mun	1237	628	603	309	386	697	328	295	428	685	770	770	603
Causeway Bay	1918	1117	1326	1244	1328	1283	1558	1423	1665	1465	1855	1426	1468
Central	1694	875	1210	1054	989	1048	1041	1350	996	1049	1493	1286	1179
Mong Kok	1919	1026	585	308	757	590	908	698	530	1168	731	1856	941

Pollutant: Ozone

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	40	49	28	44	40	28	26	27	33	50	47	35	37
Eastern	29	47	37	49	41					46	45	33	41 *
Kwai Chung	26	36	17	31	24	9	11	11	21	38	38	27	24
Kwun Tong	29 *	36	25	33	24	15	11	12	24	35	30	28	25
Sham Shui Po	20	26	13	24	20	12	10	13	21	32	27	22	20
Tsuen Wan	26	36	25	35	27	15	13	15	25	38	34	29	26
Sha Tin	43	55	35	51	42	23	21	23	34	60	51	34	39
Tai Po	39	59	42	62	53	22	21	20	27	40	38	14 *	37
Tung Chung				51	48	39	36	34	42	57	52	31	43 *
Yuen Long	25	28	17	30	21	13	10	12	16	18	16	6	18
Tap Mun	79	92	64	81	71	39	34	41	59	85	87	74	68

Notes:

1. All units are in micrograms per cubic metre.

2. Asterisked values are below their respective minimum data requirement of 66% for number of data within the period.

3. Shaded monthly averages are below the minimum data requirements for number of data within a quarter.

4. Shaded annual averages are above their respective AQO.

5. Air monitoring at the Tung Chung station commenced in April 1999.

6. Monitoring of nitrogen oxides and nitric oxide at the Tai Po and Yuen Long stations ceased in March 1999.

TABLE C4: 1999 MONTHLY AND ANNUAL AVERAGES OF PARTICULATE POLLUTANTS

Pollutant: Total Suspended Particulates (Annual AQO = 80)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	133	134	84	95	65	37	34	43	69	86	99	97	81
Kwai Chung	134	130	78	80	67	61	63	74	78	84	99	103	87
Kwun Tong	133	117	84	85	69	53	61	59	77	85	113	121	87
Sham Shui Po	137	122	93	86	65	77	59	50	66	94	114	119	90
Tsuen Wan	118	111	67	73	59	46	46	74	66	73	99	121	79
Sha Tin	135	114	61	100	44	45	42	37	55	78	89	104	76
Tai Po	110	103	73	83	36	35	33	54	56	78	97	107	73
Tung Chung				76	62	37	34	45	85	99	109	134	75 *
Yuen Long	175	158	94	80	79	53	45	59	83	106	128	167	102
Mong Kok	155	153	105	107	92	76	78	87	96	109	126	117	110

Pollutant: Respirable Suspended Particulates (Annual AQO = 55)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	84	76	51	58	37	29	28	31	44	59	64	71	53
Eastern	73	69	45	52	32	26	23	28	38	53	59	63	47
Kwai Chung	87	71	46	54	38	40	43	47	51	58	63	72	56
Kwun Tong	77	78	50	59	37	32	33	35	47	61	63	66	52
Sham Shui Po	85	76	49	60	40	36	37	41	51	60	68	70	56
Tsuen Wan	93	74	46	53	36	33	31	38	46	58	67	77	54
Sha Tin	84	76	42	52	32	29	28	36	41	54	62	73	51
Tai Po	79	70	50	58	39	36	34	38	46	57	61	75	54
Tung Chung				51	35	25	24	28	47	59	66	89	48 *
Yuen Long	108	87	55	59	44	35	35	38	50	64	73	95	62
Tap Mun	69	67	37	50	29	23	21	26	31	47	55	62	44
Causeway Bay	114	106	105	116	96	96	89	91	99	119	121	109	105
Central	114	102	82	81	61	61	57	55	63	72	77	80	76
Mong Kok	96	87	61	68	52	48	48	53	60	72	79	84	67

Notes:

1. All concentration units are in micrograms per cubic metre.

2. Asterisked values are below their respective minimum data requirement of 66% for number of data within the period.

3. Shaded annual averages are above their respective AQO.

4. Air monitoring at the Tung Chung station commenced in April 1999.

TABLE C5: 1999 HOURLY STATISTICS OF MAJOR AIR POLLUTANTS

Pollutant: Sulphur Dioxide

Station	No. of hours	Data capture rate %	<----------Percentiles----------> 10	25	50	75	90	95	98	99	Geometric mean	Arithmetic mean	Highest 1 hour	Highest 24 hour
Central / Western	8599	98.2	5	8	13	22	39	57	81	98	14	19	464	108
Eastern	5352	61.1	7	10	14	20	26	35	51	63	14	17	284	78
Kwai Chung	8554	97.6	6	10	18	38	68	88	111	129	19	29	249	91
Kwun Tong	8227	93.9	3	7	14	21	35	58	87	108	13	18	225	103
Sham Shui Po	8527	97.3	4	7	12	20	39	61	92	110	13	18	249	96
Tsuen Wan	8589	98.0	4	7	13	23	41	56	78	95	13	19	311	76
Sha Tin	8572	97.9	4	6	10	17	28	39	58	73	10	14	151	55
Tai Po	7991	91.2	7	11	19	32	39	52	70	86	19	23	210	75
Tung Chung	6217	94.2	2	5	10	19	34	49	69	85	11	15	192	58
Yuen Long	8191	93.5	7	12	18	27	40	54	80	99	17	22	204	89
Tap Mun	8059	92.0	3	4	7	11	19	25	35	43	7	9	97	36
Causeway Bay	8533	97.4	9	14	21	31	44	57	77	91	21	25	202	90
Central	8453	96.5	8	13	21	35	58	74	96	115	21	28	286	119
Mong Kok	8249	94.2	9	13	20	29	46	66	93	110	20	25	235	91

Pollutant: Nitrogen Oxides

Station	No. of hours	Data capture rate %	<----------Percentiles----------> 10	25	50	75	90	95	98	99	Geometric mean	Arithmetic mean	Highest 1 hour	Highest 24 hour
Central / Western	8583	98.0	21	38	71	117	178	231	343	459	65	91	1139	422
Kwai Chung	8539	97.5	37	94	158	250	363	451	579	685	139	189	1448	580
Kwun Tong	8102	92.5	44	111	180	246	321	377	466	550	150	188	1227	553
Sham Shui Po	8443	96.4	37	83	133	181	240	302	424	547	115	144	1231	599
Tsuen Wan	8511	97.2	36	75	119	166	232	290	386	461	106	132	887	436
Sha Tin	8567	97.8	21	34	62	112	196	277	393	488	62	91	816	365
Tai Po	867	95.1	38	61	96	158	267	357	464	496	97	128	639	298
Tung Chung	6148	93.2	10	21	50	92	135	161	199	233	43	64	596	319
Yuen Long	908	99.6	54	81	124	198	309	370	458	500	125	155	802	411
Tap Mun	8036	91.7	4	6	10	16	28	38	56	70	10	14	131	57
Causeway Bay	8481	96.8	185	305	466	685	908	1050	1240	1383	435	517	2472	1261
Central	8508	97.1	99	200	357	517	700	831	996	1152	306	387	2453	1193
Mong Kok	8223	93.9	104	162	243	338	429	500	597	673	228	262	1377	645

Pollutant: Nitric Oxide

Station	No. of hours	Data capture rate %	<----------Percentiles----------> 10	25	50	75	90	95	98	99	Geometric mean	Arithmetic mean	Highest 1 hour	Highest 24 hour
Central / Western	8583	98.0	2	4	12	29	60	92	151	209	12	25	601	177
Kwai Chung	8539	97.5	5	25	55	109	174	225	300	353	46	78	828	285
Kwun Tong	8102	92.5	8	35	66	100	144	177	232	275	50	75	662	265
Sham Shui Po	8443	96.4	5	21	42	65	96	134	207	270	33	51	668	284
Tsuen Wan	8511	97.2	4	15	35	58	90	123	171	212	27	44	450	161
Sha Tin	8567	97.8	2	4	11	32	80	125	191	244	12	29	449	167
Tai Po	867	95.1	2	8	17	42	101	149	220	243	18	37	358	120
Tung Chung	6148	93.2	2	3	6	17	34	46	62	75	7	13	217	84
Yuen Long	908	99.6	5	11	26	62	118	153	206	245	26	47	437	163
Tap Mun	8036	91.8	1	1	2	2	3	5	10	16	2	2	44	13
Causeway Bay	8482	96.8	77	142	238	371	506	588	707	781	215	271	1448	693
Central	8509	97.1	29	82	170	270	376	453	541	634	133	192	1428	648
Mong Kok	8223	93.9	33	61	105	154	206	243	301	346	92	115	763	309

Pollutant: Nitrogen Dioxide

Station	No. of hours	Data capture rate %	<----------Percentiles----------> 10	25	50	75	90	95	98	99	Geometric mean	Arithmetic mean	Highest 1 hour	Highest 24 hour
Central / Western	8583	98.0	19	28	51	77	102	119	141	160	46	56	252	160
Eastern	5374	61.3	28	44	66	86	103	115	129	140	59	66	195	125
Kwai Chung	8539	97.5	28	46	67	90	118	144	174	195	62	72	304	191
Kwun Tong	8102	92.5	33	50	76	101	124	139	159	182	69	78	306	192
Sham Shui Po	8443	96.4	25	35	60	87	108	126	146	164	55	64	272	165
Tsuen Wan	8484	96.8	29	41	59	85	112	132	160	180	58	67	383	193
Sha Tin	8567	97.8	19	28	42	64	92	109	130	145	42	50	266	140
Tai Po	7997	91.3	22	32	47	70	95	112	131	142	46	54	278	147
Tung Chung	6148	93.2	5	15	36	64	89	105	128	151	29	43	335	199
Yuen Long	8187	93.5	25	35	52	78	104	125	147	166	51	60	314	179
Tap Mun	8037	91.7	3	5	8	14	24	32	44	54	9	12	98	46
Causeway Bay	8482	96.8	53	71	102	133	158	174	198	222	96	105	335	209
Central	8509	97.1	41	56	86	122	151	175	199	220	81	92	334	207
Mong Kok	8223	93.9	40	56	81	111	137	155	177	195	77	86	319	180

Pollutant: Carbon Monoxide

Station	No. of hours	Data capture rate %	<----------Percentiles----------> 10	25	50	75	90	95	98	99	Geometric mean	Arithmetic mean	Highest 1 hour	Highest 8 hour
Tsuen Wan	8586	98.0	690	800	1030	1380	1730	1960	2300	2530	1098	1177	5290	4759
Tung Chung	6204	94.0	460	460	690	800	1150	1260	1490	1830	650	709	4240	2807
Tap Mun	7827	89.3	230	340	570	800	1030	1270	1490	1610	511	603	2070	1799
Causeway Bay	8487	96.9	800	1030	1380	1730	2180	2530	2880	3110	1364	1468	5290	4789
Central	8423	96.2	580	800	1150	1490	1840	2070	2300	2530	1086	1179	5180	4214
Mong Kok	8084	92.3	120	350	800	1380	1960	2180	2530	2880	814	941	4600	4070

Pollutant: Ozone

Station	No. of hours	Data capture rate %	<----------Percentiles----------> 10	25	50	75	90	95	98	99	Geometric mean	Arithmetic mean	Highest 1 hour	Highest 24 hour
Central / Western	8371	95.6	10	16	30	53	75	87	99	107	28	37	264	102
Eastern	5376	61.4	16	27	39	53	66	72	82	86	35	41	130	75
Kwai Chung	8271	94.4	2	5	16	37	58	69	82	92	14	24	180	72
Kwun Tong	8151	93.0	6	10	19	34	52	65	80	88	19	25	125	64
Sham Shui Po	8341	95.2	2	5	13	29	47	61	74	84	12	20	203	54
Tsuen Wan	8407	96.0	5	9	20	38	58	70	84	93	18	26	201	85
Sha Tin	8252	94.2	7	11	29	61	87	100	112	122	26	39	295	107
Tai Po	7950	90.8	5	13	29	57	82	96	108	114	25	37	209	102
Tung Chung	6166	93.4	8	20	36	58	87	105	133	159	31	43	335	118
Yuen Long	8208	93.7	0	3	10	27	49	64	78	87	11	18	193	70
Tap Mun	7973	91.0	20	36	64	97	119	132	144	156	54	68	294	151

Pollutant: Respirable Suspended Particulates

Station	No. of hours	Data capture rate %	<----------Percentiles----------> 10	25	50	75	90	95	98	99	Geometric mean	Arithmetic mean	Highest 1 hour	Highest 24 hour
Central / Western	8544	97.5	18	27	46	70	95	115	139	156	43	53	292	197
Eastern	8252	94.2	15	25	43	63	84	100	120	135	39	47	241	185
Kwai Chung	8493	97.0	24	35	50	69	95	115	139	162	48	56	319	226
Kwun Tong	8342	95.2	19	30	47	68	90	108	134	153	44	52	264	199
Sham Shui Po	8497	97.0	21	33	50	71	95	114	141	160	47	56	323	200
Tsuen Wan	8547	97.6	21	30	46	69	97	117	145	173	45	54	362	226
Sha Tin	8593	98.1	17	27	43	66	93	111	137	157	42	51	279	190
Tai Po	8177	93.3	23	32	48	68	94	112	135	152	47	54	261	191
Tung Chung	6201	94.0	13	20	37	65	96	119	144	175	36	48	446	200
Yuen Long	8443	96.4	23	32	53	80	112	138	174	210	51	62	295	238
Tap Mun	8083	92.3	13	22	39	59	78	94	118	140	35	44	291	213
Causeway Bay	8483	96.8	53	74	103	133	159	178	199	219	96	105	302	226
Central	8410	96.0	33	49	69	93	124	148	182	209	66	76	555	296
Mong Kok	8372	95.6	31	44	62	84	108	127	154	172	60	67	328	216

Note: All concentration units are in micrograms per cubic metre.

TABLE C6(a): 1999 AIRBORNE SPECIES CONCENTRATIONS AS DERIVED FROM TOTAL SUSPENDED PARTICULATES

Station	TSP	As	Be	Cd	Ni	Pb	Cr	Al	Mn	Fe	Ca	Mg	V	Zn	Ba	Cu	Hg	Se	Na+	K+	Cl-	Br-	SO4=	BAP	NH4+	NO3-
Central / Western	81	4.2	0.06	1.66	3.9	67	2.9	527	29	903	2206	634	6.7	160	21	93	0.21	2.0	4018	707	4478	13	10670	0.12	1886	4807
Kwai Chung	87	4.2	0.06	1.86	10.1	74	4.6	516	31	1158	2182	435	15.1	206	40	153	0.22	1.9	2150	673	1869	9	10482	0.22	2055	3948
Kwun Tong	87	3.8	0.07	1.65	4.0	65	3.8	568	34	1092	2134	424	6.9	191	35	110	0.22	1.6	2285	669	2022	9	9042	0.14	1656	4454
Sham Shui Po	90	4.8	0.07	1.85	5.4	73	3.9	558	34	1134	2705	486	9.2	202	36	114	0.22	1.7	2620	804	2696	11	10005	0.25	1825	4615
Tsuen Wan	79	4.3	0.07	1.83	5.2	80	2.8	473	28	960	1844	375	10.1	193	29	86	0.21	2.2	1847	765	1438	8	9861	0.21	2268	4596
Sha Tin	76	5.4	0.07	2.02	4.0	84	2.9	517	32	1125	2103	432	8.3	226	39	105	0.22	1.8	1950	842	1563	9	10378	0.20	1939	3635
Tai Po	73	5.1	0.06	2.03	3.2	83	2.6	470	27	945	1550	390	5.4	184	28	80	0.22	2.0	1912	784	1677	8	10151	0.24	2311	3843
Tung Chung	75	4.5	0.07	1.99	4.0	81	2.5	519	32	993	2207	382	6.8	218	19	812	0.22	1.0	1980	733	1703	8	8789	0.19	1554	3788
Yuen Long	102	5.8	0.08	2.26	5.3	99	4.4	725	41	1386	2913	413	7.4	281	31	208	0.22	2.2	1632	927	1561	8	10432	0.42	2232	5150
Mong Kok	110	4.3	0.07	1.77	6.2	73	5.5	676	38	1393	3189	588	7.5	217	38	164	0.21	1.5	3083	753	3383	11	10662	0.23	1786	4993
Average	86	4.6	0.07	1.89	5.2	78	3.5	554	32	1108	2293	456	8.4	207	32	177	0.22	1.8	2350	767	2241	10	10076	0.22	1965	4389

Note: *1. All concentration units are in nanograms per cubic metre except TSP which is in micrograms per cubic metre.*

2. All values presented are annual arithmetic means.

3. All particulate samples were collected using high-volume samplers.

TABLE C6(b): 1999 AIRBORNE SPECIES CONCENTRATIONS AS DERIVED FROM TOTAL SUSPENDED PARTICULATES (EXPRESSED AS PERCENTAGE BY WEIGHT)

Station		As	Be	Cd	Ni	Pb	Cr	Al	Mn	Fe	Ca	Mg	V	Zn	Ba	Cu	Hg	Se	Na+	K+	Cl-	Br-	SO4=	BAP	NH4+	NO3-
Central / Western		0.01	0.00	0.00	0.00	0.08	0.00	0.65	0.04	1.12	2.73	0.79	0.01	0.20	0.03	0.11	0.00	0.00	4.97	0.88	5.54	0.02	13.21	0.00	2.33	5.95
Kwai Chung		0.00	0.00	0.00	0.01	0.08	0.01	0.59	0.04	1.33	2.50	0.50	0.02	0.24	0.05	0.17	0.00	0.00	2.46	0.77	2.14	0.01	11.99	0.00	2.35	4.52
Kwun Tong		0.00	0.00	0.00	0.00	0.08	0.00	0.65	0.04	1.25	2.45	0.49	0.01	0.22	0.04	0.13	0.00	0.00	2.62	0.77	2.32	0.01	10.36	0.00	1.90	5.10
Sham Shui Po		0.01	0.00	0.00	0.01	0.08	0.00	0.62	0.04	1.26	3.01	0.54	0.01	0.22	0.04	0.13	0.00	0.00	2.92	0.90	3.00	0.01	11.15	0.00	2.03	5.14
Tsuen Wan		0.01	0.00	0.00	0.01	0.10	0.00	0.60	0.04	1.21	2.33	0.47	0.01	0.24	0.04	0.11	0.00	0.00	2.33	0.97	1.81	0.01	12.44	0.00	2.86	5.80
Sha Tin		0.01	0.00	0.00	0.01	0.11	0.00	0.68	0.04	1.49	2.79	0.57	0.01	0.30	0.05	0.14	0.00	0.00	2.58	1.12	2.07	0.01	13.75	0.00	2.57	4.81
Tai Po		0.01	0.00	0.00	0.00	0.11	0.00	0.65	0.04	1.30	2.13	0.54	0.01	0.25	0.04	0.11	0.00	0.00	2.63	1.08	2.31	0.01	13.97	0.00	3.18	5.29
Tung Chung		0.01	0.00	0.00	0.01	0.11	0.00	0.69	0.04	1.32	2.95	0.51	0.01	0.29	0.03	1.08	0.00	0.00	2.64	0.98	2.27	0.01	11.73	0.00	2.07	5.05
Yuen Long		0.01	0.00	0.00	0.01	0.10	0.00	0.71	0.04	1.36	2.87	0.41	0.01	0.28	0.03	0.21	0.00	0.00	1.61	0.91	1.54	0.01	10.27	0.00	2.20	5.07
Mong Kok		0.00	0.00	0.00	0.01	0.07	0.01	0.62	0.03	1.27	2.91	0.54	0.01	0.20	0.03	0.15	0.00	0.00	2.81	0.69	3.09	0.01	9.73	0.00	1.63	4.55
Average		0.01	0.00	0.00	0.01	0.09	0.00	0.65	0.04	1.29	2.67	0.53	0.01	0.24	0.04	0.23	0.00	0.00	2.76	0.90	2.61	0.01	11.86	0.00	2.31	5.13

TABLE C7(a): 1999 AIRBORNE SPECIES CONCENTRATIONS AS DERIVED FROM RESPIRABLE SUSPENDED PARTICULATES

Station	RSP	As	Be	Cd	Ni	Pb	Cr	Al	Mn	Fe	Ca	Mg	V	Zn	Ba	Cu	Hg	Se	Na+	K+	Cl-	Br-	SO4=	C	THC	BAP	NH4+	NO3-
Central / Western	53	3.7	0.06	1.40	2.8	59	1.4	245	17	446	820	334	6.1	129	12	29	0.22	1.8	2078	620	1671	9	9514	22074	1741	0.14	2273	3226
Kwai Chung	63	3.6	0.06	1.62	5.4	68	1.8	250	17	559	839	278	13.2	149	24	56	0.23	1.6	1485	631	998	9	10055	29664	2377	0.27	2548	3014
Kwun Tong	56	3.1	0.06	1.37	2.7	57	1.7	248	16	526	760	253	6.3	139	19	58	0.22	1.3	1422	619	873	8	8490	25897	1991	0.17	2073	2936
Sham Shui Po	58	4.0	0.06	1.56	3.5	72	1.7	242	17	499	928	272	7.8	152	20	32	0.22	1.3	1574	734	1209	9	8965	25003	2115	0.30	2162	3254
Tsuen Wan	58	3.8	0.06	1.57	3.4	75	1.4	238	17	484	744	234	8.8	163	16	34	0.22	1.7	1256	738	719	8	9725	27348	1982	0.28	2631	3366
Sha Tin	52	4.6	0.06	1.70	2.9	75	1.4	254	19	626	844	256	7.6	185	23	33	0.22	1.5	1218	750	749	8	9405	22098	1641	0.27	2241	2473
Tai Po	54	4.5	0.06	1.75	2.4	71	1.4	243	16	548	674	258	5.3	152	20	43	0.23	1.6	1353	747	887	8	10092	25820	1665	0.29	2604	2815
Tung Chung	48	4.3	0.06	1.85	3.0	72	1.5	228	19	457	781	228	6.6	183	12	81	0.23	1.0	1280	685	864	8	8343	18735	1526	0.22	1978	2778
Yuen Long	60	4.8	0.06	1.77	3.2	81	1.8	282	22	582	1010	243	5.8	204	15	39	0.23	1.6	1197	792	870	9	9534	26369	2140	0.46	2595	3502
Mong Kok	66	3.5	0.07	1.38	3.6	58	2.0	253	17	552	928	309	7.3	143	18	61	0.23	1.4	1774	629	1470	9	9622	31780	2805	0.25	2417	3550
Average	57	4.0	0.06	1.59	3.3	69	1.6	249	18	529	834	268	7.5	159	18	46	0.23	1.5	1468	695	1035	8	9405	25663	2011	0.26	2363	3100

Note: *1. All concentration units are in nanograms per cubic metre except RSP which is in micrograms per cubic metre.*

2. All values presented are annual arithmetic means.

3. All particulate samples were collected using high-volume samplers.

TABLE C7(b): 1999 AIRBORNE SPECIES CONCENTRATIONS AS DERIVED FROM RESPIRABLE SUSPENDED PARTICULATES (EXPRESSED AS PERCENTAGE BY WEIGHT)

Station		As	Be	Cd	Ni	Pb	Cr	Al	Mn	Fe	Ca	Mg	V	Zn	Ba	Cu	Hg	Se	Na+	K+	Cl-	Br-	SO4=	C	THC	BAP	NH4+	NO3-
Central / Western		0.01	0.00	0.00	0.01	0.11	0.00	0.46	0.03	0.84	1.54	0.63	0.01	0.24	0.02	0.05	0.00	0.00	3.91	1.17	3.14	0.02	17.90	41.54	3.28	0.00	4.28	6.07
Kwai Chung		0.01	0.00	0.00	0.01	0.11	0.00	0.40	0.03	0.89	1.33	0.44	0.02	0.24	0.04	0.09	0.00	0.00	2.36	1.00	1.58	0.01	15.96	47.09	3.77	0.00	4.04	4.78
Kwun Tong		0.01	0.00	0.00	0.00	0.10	0.00	0.45	0.03	0.94	1.36	0.45	0.01	0.25	0.03	0.10	0.00	0.00	2.55	1.11	1.57	0.01	15.24	46.50	3.57	0.00	3.72	5.27
Sham Shui Po		0.01	0.00	0.00	0.01	0.12	0.00	0.42	0.03	0.87	1.61	0.47	0.01	0.26	0.03	0.05	0.00	0.00	2.73	1.27	2.10	0.02	15.56	43.40	3.67	0.00	3.75	5.65
Tsuen Wan		0.01	0.00	0.00	0.01	0.13	0.00	0.41	0.03	0.83	1.28	0.40	0.02	0.28	0.03	0.06	0.00	0.00	2.15	1.27	1.23	0.01	16.68	46.91	3.40	0.00	4.51	5.77
Sha Tin		0.01	0.00	0.00	0.01	0.14	0.00	0.48	0.04	1.19	1.61	0.49	0.01	0.35	0.04	0.06	0.00	0.00	2.33	1.43	1.43	0.02	17.96	42.21	3.13	0.00	4.28	4.72
Tai Po		0.01	0.00	0.00	0.00	0.13	0.00	0.45	0.03	1.01	1.24	0.48	0.01	0.28	0.04	0.08	0.00	0.00	2.50	1.38	1.64	0.01	18.63	47.65	3.07	0.00	4.81	5.20
Tung Chung		0.01	0.00	0.00	0.01	0.15	0.00	0.48	0.04	0.96	1.64	0.48	0.01	0.38	0.03	0.17	0.00	0.00	2.69	1.44	1.82	0.02	17.56	39.43	3.21	0.00	4.16	5.85
Yuen Long		0.01	0.00	0.00	0.01	0.14	0.00	0.47	0.04	0.97	1.69	0.41	0.01	0.34	0.03	0.06	0.00	0.00	2.00	1.32	1.45	0.01	15.93	44.06	3.58	0.00	4.34	5.85
Mong Kok		0.01	0.00	0.00	0.01	0.09	0.00	0.38	0.03	0.84	1.41	0.47	0.01	0.22	0.03	0.09	0.00	0.00	2.69	0.95	2.23	0.01	14.60	48.23	4.26	0.00	3.67	5.39
Average		0.01	0.00	0.00	0.01	0.12	0.00	0.44	0.03	0.93	1.47	0.47	0.01	0.29	0.03	0.08	0.00	0.00	2.59	1.24	1.82	0.01	16.60	44.70	3.49	0.00	4.16	5.46

TABLE C8: 1999 TOTAL WET AND DRY DEPOSITION

(a) WET DEPOSITION

	Monitoring Station	Kwun Tong	Central / Western
	WET DEPOSITION (Ton/Ha)	14352	11036
	WEIGHTED MEAN pH (based on volume-weighted mean hydrogen ion concentrations ($[H^+]$)	4.63	4.33
	WEIGHTED MEAN pH (based on volume-weighted mean pH)	4.87	4.75
	NO. OF SAMPLES	32	28
Filtrate (Kg/Ha)	**NH_4^+**	4.32	3.13
	NO_3^-	9.90	10.34
	$SO_4^=$	26.05	22.66
	Cl^-	27.04	22.46
	Na^+	13.42	11.13
	K^+	3.36	2.64
	Formate	2.65	2.05
	Acetate	2.65	2.05
	Ca^{++}	5.52	2.56
	Mg^{++}	1.07	0.99
Residue (Kg/Ha)	**WEIGHT**	76.64	26.86
	Si	6.60	2.15
	Al	2.47	0.78
	Ca	0.34	0.18
	Fe	1.64	0.47
	Mg	0.26	0.19
	V	0.10	0.08
	Mn	0.10	0.08
	Cu	0.23	0.10
	Ba	0.25	0.19

(b) DRY DEPOSITION

	Monitoring Station	Kwun Tong	Central / Western
	NO. OF SAMPLES	57	54
Filtrate (Kg/Ha)	**NH_4^+**	0.48	0.43
	NO_3^-	7.30	7.01
	$SO_4^=$	10.82	10.46
	Cl^-	11.34	13.22
	Na^+	6.52	8.03
	K^+	0.99	0.72
	Formate	0.43	0.41
	Acetate	0.43	0.41
	Ca^{++}	7.87	6.17
	Mg^{++}	0.84	1.05
Residue (Kg/Ha)	**WEIGHT**	231.03	68.26
	Si	38.50	14.26
	Al	12.28	4.08
	Ca	4.43	1.44
	Fe	5.53	1.95
	Mg	0.57	0.28
	V	0.02	0.01
	Mn	0.17	0.05
	Cu	0.03	0.02
	Ba	0.11	0.04

Note: The weighted mean pH is calculated from the pH values measured by the Government Laboratory.

TABLE C9: 1999 DIURNAL VARIATIONS OF AIR POLLUTANT

Pollutant: Sulphur Dioxide

Station	Hr00	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23
Central / Western	14	12	12	13	13	13	14	18	23	25	24	23	22	25	25	26	25	23	22	20	19	17	16	15
Eastern	12	12	11	11	11	12	13	17	22	22	22	20	17	20	20	20	21	20	19	18	18	18	14	13
Kwai Chung	22	20	19	18	17	16	18	25	32	36	36	35	34	36	37	37	38	38	36	33	30	28	25	24
Kwun Tong	13	12	11	11	10	11	14	19	23	25	24	22	21	22	24	23	24	22	22	20	17	16	16	15
Sham Shui Po	12	11	11	12	12	13	15	18	22	22	23	23	21	22	24	25	24	22	22	22	20	18	16	14
Tsuen Wan	13	11	10	10	9	10	12	16	21	23	24	24	24	26	25	25	26	26	25	21	18	17	16	15
Sha Tin	11	10	9	10	9	9	10	12	15	16	17	16	16	16	18	18	18	18	18	17	15	14	13	12
Tai Po	20	19	19	18	18	19	21	25	26	25	24	23	23	23	24	25	26	27	28	27	25	24	24	22
Tung Chung	12	12	11	12	11	11	11	13	17	20	20	21	21	22	21	19	18	17	15	14	14	13	12	12
Yuen Long	18	17	16	17	16	16	19	24	26	27	27	25	25	25	24	26	27	27	26	24	23	22	20	19
Tap Mun	8	8	7	9	8	9	9	10	11	12	12	11	10	10	9	9	9	9	9	9	8	8	8	8
Causeway Bay	22	20	19	18	17	16	19	27	33	33	31	30	29	30	30	29	28	26	26	25	25	24	23	22
Central	20	18	16	15	16	16	17	25	40	40	38	36	33	35	38	37	37	36	34	30	27	26	24	22
Mong Kok	18	16	16	18	16	17	19	24	30	36	37	35	31	32	33	33	30	28	27	25	23	22	20	19

Pollutant: Nitrogen Oxides

Station	Hr00	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23
Central / Western	67	50	46	43	42	42	58	102	137	138	122	110	95	99	100	105	110	118	124	116	104	94	89	82
Kwai Chung	126	79	67	56	56	69	156	247	282	277	240	216	200	201	220	228	242	263	279	247	202	196	189	175
Kwun Tong	147	84	62	54	53	76	175	268	283	268	231	204	190	192	202	215	241	265	273	242	200	194	196	188
Sham Shui Po	119	76	61	57	59	70	122	183	210	198	173	157	144	148	158	163	174	189	198	189	165	157	152	143
Tsuen Wan	105	61	50	42	42	57	113	169	190	181	156	144	136	139	145	148	160	176	194	177	151	149	148	144
Sha Tin	100	72	57	49	46	52	89	134	134	105	82	71	63	61	66	72	81	97	114	128	130	133	133	118
Tai Po	142	94	81	56	59	72	119	210	209	133	107	95	90	89	89	94	111	141	175	182	182	166	180	174
Tung Chung	57	46	40	35	36	40	53	65	83	90	88	85	71	73	66	64	67	71	71	69	66	63	63	62
Yuen Long	151	121	104	82	82	90	132	210	215	171	136	125	112	109	117	137	164	184	214	233	231	219	205	182
Tap Mun	13	13	13	14	13	14	15	17	18	18	17	15	13	12	11	12	13	13	13	13	13	13	13	13
Causeway Bay	432	325	287	249	221	203	367	634	700	678	617	599	579	590	573	588	625	617	624	621	623	587	569	519
Central	255	152	133	120	125	129	226	404	592	576	535	478	429	467	478	492	511	543	538	465	441	433	397	355
Mong Kok	210	144	138	124	120	132	203	305	360	367	334	300	274	282	310	306	316	336	358	313	266	274	272	262

Pollutant: Nitric Oxide

Station	Hr00	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23
Central / Western	16	12	12	11	11	10	16	34	51	50	40	32	25	25	24	25	26	29	32	29	26	23	22	20
Kwai Chung	47	25	20	16	16	22	68	117	135	129	105	89	79	76	85	88	95	108	120	104	81	80	78	72
Kwun Tong	54	25	17	14	14	23	72	124	132	121	98	80	72	71	75	81	93	107	112	98	76	74	77	74
Sham Shui Po	40	23	17	16	17	22	45	77	92	84	68	57	48	48	52	53	57	65	71	68	57	55	53	50
Tsuen Wan	32	13	10	8	7	13	39	69	80	73	58	49	43	43	43	43	48	56	67	61	49	49	50	50
Sha Tin	36	24	17	14	13	14	31	55	54	36	25	19	15	14	15	16	18	24	33	42	45	49	51	44
Tai Po	49	28	20	9	12	17	39	88	87	43	29	22	17	16	15	15	18	28	47	55	60	52	64	63
Tung Chung	11	7	6	5	6	7	13	18	25	27	24	21	15	14	11	10	11	11	11	12	12	11	12	13
Yuen Long	51	37	31	21	22	27	47	88	88	59	38	30	23	19	20	26	33	42	58	73	77	76	72	63
Tap Mun	2	2	2	2	2	2	2	3	4	4	3	3	2	2	2	2	2	2	2	2	2	2	2	2
Causeway Bay	215	152	132	113	100	91	191	354	391	375	333	318	304	309	296	304	328	325	331	331	333	313	304	273
Central	115	60	51	45	48	49	105	211	322	308	278	242	211	230	235	242	256	276	275	234	220	216	197	173
Mong Kok	88	54	52	46	45	51	89	146	177	178	156	134	117	120	133	129	135	147	163	140	115	121	120	117

Pollutant: Nitrogen Dioxide

Station	Hr00	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23
Central / Western	45	34	31	29	29	30	37	53	63	65	64	63	60	64	67	70	74	78	79	74	67	62	58	54
Eastern	56	45	35	33	32	37	53	69	76	76	74	73	67	72	77	82	89	92	92	85	77	73	67	63
Kwai Chung	56	43	37	34	33	37	54	71	78	82	82	82	82	86	93	96	99	100	98	90	80	75	72	67
Kwun Tong	68	49	40	36	36	44	68	82	85	87	85	84	84	86	92	96	102	106	104	96	87	84	83	79
Sham Shui Po	56	40	34	31	31	35	52	63	68	68	68	68	68	72	77	81	85	88	88	84	77	72	69	65
Tsuen Wan	58	43	36	32	32	38	55	65	69	71	70	70	71	75	80	83	88	92	93	86	78	75	73	69
Sha Tin	47	39	34	31	30	33	44	53	55	52	48	45	42	43	47	51	57	65	67	68	65	62	59	54
Tai Po	53	44	39	36	36	39	50	61	60	54	48	46	45	45	48	51	59	69	76	73	68	65	63	60
Tung Chung	39	34	31	28	27	30	33	37	44	48	51	52	49	52	49	49	51	54	53	50	48	46	44	42
Yuen Long	54	47	40	36	36	38	46	57	61	60	59	59	58	58	61	66	75	83	89	84	77	71	65	60
Tap Mun	12	11	11	12	11	12	12	13	14	14	13	12	11	10	9	10	11	12	12	12	12	12	12	12
Causeway Bay	105	94	87	78	71	65	77	95	104	107	110	114	117	120	122	125	126	123	120	118	116	110	107	104
Central	78	59	54	51	51	52	64	82	99	104	109	107	105	114	118	120	119	120	116	107	105	102	95	89
Mong Kok	76	62	59	53	52	54	67	81	90	94	96	95	95	98	107	109	111	112	109	99	90	90	88	84

Pollutant: Carbon Monoxide

Station	Hr00	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23
Tsuen Wan	1120	1060	1030	1010	1000	1020	1070	1170	1230	1220	1210	1180	1170	1190	1210	1220	1230	1260	1340	1330	1270	1270	1250	1200
Tung Chung	670	650	660	660	660	670	690	710	750	750	750	760	740	740	740	720	710	720	730	730	720	700	700	690
Tap Mun	590	580	580	590	590	600	610	640	640	640	640	630	620	610	590	590	600	600	590	590	590	590	590	590
Causeway Bay	1280	1160	1090	1030	990	980	1100	1280	1440	1480	1570	1640	1650	1630	1630	1660	1700	1790	1850	1840	1790	1720	1580	1400
Central	1000	900	870	860	870	900	970	1110	1320	1360	1310	1280	1270	1260	1310	1330	1380	1400	1480	1390	1250	1220	1160	1080
Mong Kok	780	690	650	610	600	600	690	870	1040	1060	1010	980	960	980	1090	1100	1110	1200	1360	1210	1050	1060	1010	920

Pollutant: Ozone

Station	Hr00	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23
Central / Western	39	47	48	49	48	46	38	27	23	26	32	38	46	47	46	44	39	31	27	27	29	30	31	32
Eastern	40	48	53	53	52	49	38	29	29	32	37	42	47	47	47	45	40	36	32	33	35	36	37	37
Kwai Chung	24	32	35	37	37	33	21	15	14	18	22	27	30	30	29	27	22	19	15	16	17	17	17	18
Kwun Tong	23	35	40	42	42	35	20	15	15	18	23	28	31	32	31	28	22	18	15	16	19	18	18	18
Sham Shui Po	17	29	34	35	34	30	16	10	11	14	19	24	27	29	26	23	19	13	10	9	11	11	11	12
Tsuen Wan	21	33	37	40	39	32	19	16	17	21	28	33	37	38	38	35	29	22	16	16	18	17	16	16
Sha Tin	30	37	40	41	40	36	26	22	26	33	43	52	59	62	62	59	50	41	34	29	28	28	27	29
Tai Po	29	33	34	34	33	30	24	22	26	35	44	52	58	61	60	58	51	40	32	29	29	29	27	27
Tung Chung	34	38	40	42	39	35	32	30	30	34	39	48	59	65	71	70	62	52	43	39	36	35	35	34
Yuen Long	12	15	17	18	17	16	12	9	11	16	23	30	36	38	38	34	26	17	10	8	9	9	10	11
Tap Mun	57	56	54	52	52	50	49	50	55	61	70	78	86	90	91	91	90	86	80	73	68	65	62	60

Pollutant: Respirable Suspended Particulates

Station	Hr00	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23
Central / Western	45	43	42	42	42	43	45	51	58	61	61	59	57	57	59	59	59	59	60	59	56	52	49	47
Eastern	40	39	39	39	40	40	42	47	52	55	56	55	54	52	55	52	54	53	51	48	47	45	43	42
Kwai Chung	47	44	43	42	43	44	49	57	61	63	62	62	60	61	62	64	66	66	67	65	60	55	51	49
Kwun Tong	44	41	40	40	40	41	47	55	62	63	61	58	55	56	59	58	61	61	61	59	54	50	48	47
Sham Shui Po	46	43	42	42	43	45	49	55	61	63	63	63	61	62	64	62	63	65	66	66	60	54	50	47
Tsuen Wan	45	42	41	42	41	43	47	53	57	60	60	60	59	60	62	62	61	63	64	63	59	54	51	48
Sha Tin	47	44	43	42	42	43	47	53	55	54	53	51	50	50	53	53	54	55	56	57	56	54	52	49
Tai Po	50	48	47	47	48	49	54	61	61	57	56	55	54	54	53	54	54	56	59	60	59	56	54	52
Tung Chung	39	39	38	38	38	39	40	42	48	52	57	59	55	60	61	57	56	55	51	48	46	44	43	41
Yuen Long	54	52	50	49	49	51	56	64	68	68	68	66	65	64	66	65	67	69	70	72	69	65	61	57
Tap Mun	41	40	40	40	40	41	43	46	46	46	47	46	46	45	45	45	46	47	45	45	43	43	42	41
Causeway Bay	96	79	71	67	65	63	76	95	110	115	111	114	111	123	122	122	129	132	134	135	130	117	107	101
Central	58	50	49	49	50	52	59	74	93	95	92	87	79	84	89	89	93	95	96	86	81	77	71	66
Mong Kok	57	53	50	49	48	50	55	66	75	77	77	75	73	76	77	76	76	78	79	79	74	68	64	61

Note: All concentration units are in micrograms per cubic metre.

TABLE C10: 1999 AMBIENT LEVELS OF TOXIC AIR POLLUTANTS

Toxic Air Pollutants	Concentration Unit	Annual Averages [1]	
		Tsuen Wan	Central/Western
Heavy Metals [2]			
Cadmium	ng/m^3	1.83	1.66
Hexavalent chromium	ng/m^3	0.27	0.26
Lead	ng/m^3	80	67
Nickel	ng/m^3	5.2	3.9
Organic Substances			
Benzene	µg/m^3	2.79	2.11
Benzo[a]pyrene	ng/m^3	0.21	0.15
1,3-Butadiene	µg/m^3	0.30	0.23
Formaldehyde	µg/m^3	4.98	4.66
Perchloroethylene	µg/m^3	1.22	3.40
Dioxin [3]	pg TEQ/m^3	0.143	0.096

Note:

[1] For TAP concentrations that are lower than the method detection limit (MDL), one half of the MDL is used in calculating the annual averages.

[2] For cadmium, lead and nickel the reported figures are the respective 1999 annual average concentrations in the elemental analysis of total suspended particulates.

[3] The ambient level of dioxins is expressed here as toxic equivalent (TEQ) concentration of 2,3,7,8-Tetrachlorodibenzodioxin (TCDD) based on the International Toxic Equivalent Factors (I-TEF) of the North Atlantic Treaty Organisation (NATO/CCMS), 1988.

Further Information

- **This report is also available on the Internet at**

  http://www.epd-asg.gov.hk/reportf.html

- **The latest Air Pollution Index (API) and forecast can be obtained**

  from EPD's API Hotline at (852) 2827 8541 and website at

  http://www.epd-asg.gov.hk/

- **For all enquiry on API and air quality data, please call the API**

  Enquiry Hotline at (852) 2594 6413.