AIR QUALITY
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Air Science Group

Environmental Protection Department

The Government of the Hong Kong
Special Administrative Region

A report on the results from the Air Quality Monitoring Network (AQMN) (2011)

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Summary

This report summarises the 2011 air quality monitoring data collected by the Environmental Protection Department's monitoring network comprising 11 general stations and 3 roadside stations.

As a result of the enhanced vehicle emission control programme implemented by the Government since 2000, concentrations of respirable suspended particulates (RSP) and sulphur dioxide (SO_2) at roadside have reduced substantially over the past decade. However, the level of roadside nitrogen dioxide (NO_2) has shown an upward trend during the period. Additional control measures are being introduced to reduce its concentration.

Thanks to the joint control efforts of the Hong Kong Special Administrative Region Government and the Guangdong Provincial Government in cutting emissions in the Pearl River Delta (PRD) Region, the ambient levels of SO_2 and RSP have also reduced in recent years. However, concentrations of ozone, a major constituent of photochemical smog, were on a slow rising trend over the past years. The two governments will continue to implement measures to alleviate photochemical smog and ozone problem in the PRD Region.

As in previous years, concentrations of carbon monoxide and lead in 2011 remained at levels well below their respective Air Quality Objectives limits.

Fine suspended particulates (FSP or PM2.5) was previously measured at 5 of the stations in the monitoring network while ozone was monitored at the 11 general stations only. Extending the measurement of PM2.5 and ozone to all the general and roadside stations in the monitoring network started in 2011.

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1. Introduction

The Environmental Protection Department (EPD) operates a network of 14 air quality monitoring stations for measuring concentrations of major air pollutants. It consists of 11 general stations for monitoring ambient air quality and three roadside stations for measuring street level air quality. Details of these monitoring stations are shown in Table B1 of Appendix B.

Additional monitoring facilities specifically designed for collecting Toxic Air Pollutants (TAPs) samples have been installed at the Tsuen Wan and Central/Western monitoring stations since 1997.

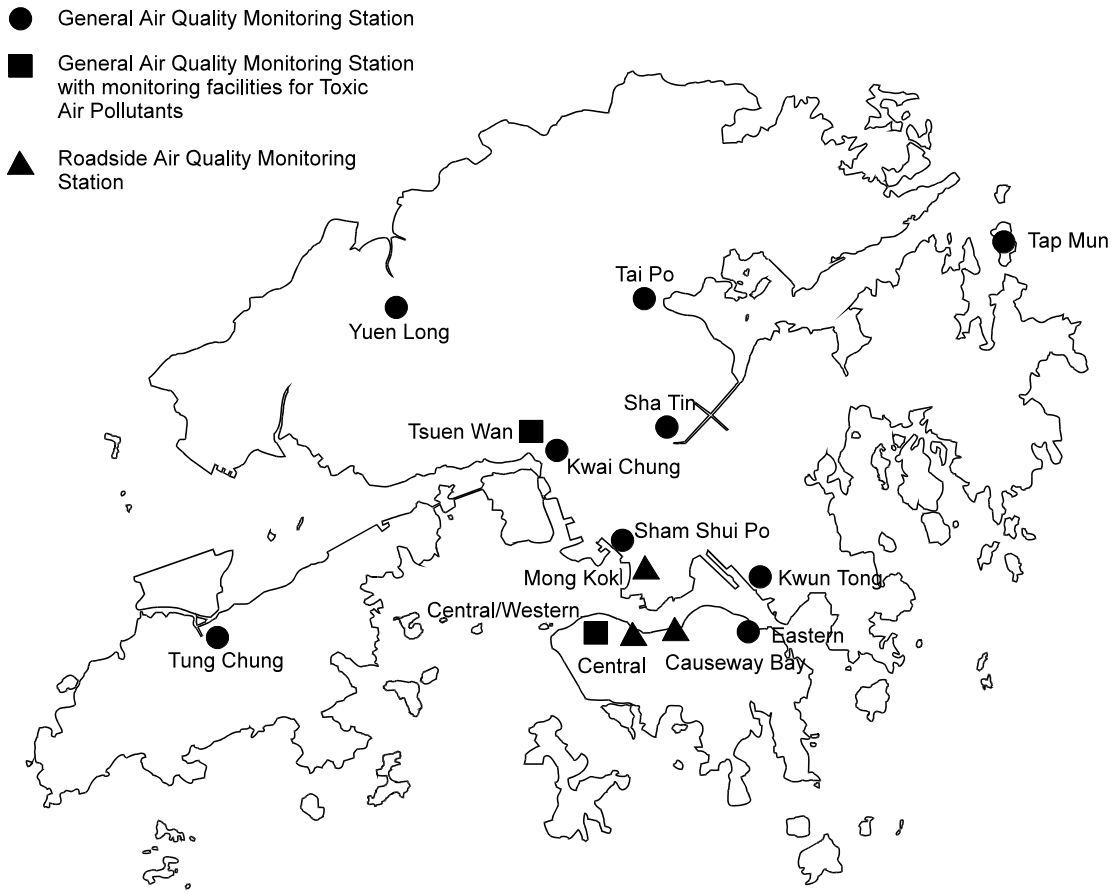


Figure 1: Location of EPD's Air Quality Monitoring Stations (2011)

Apart from EPD's network, the Hongkong Electric Co. Ltd. (HEC) and the CLP Power Hong Kong Limited (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 2011 are at Appendix D.

2. Gaseous Pollutants

2.1 Sulphur Dioxide (SO_2)

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

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.

Figure 2a: Sulphur Dioxide Monitoring 2011
(1-Hour Average Statistics)

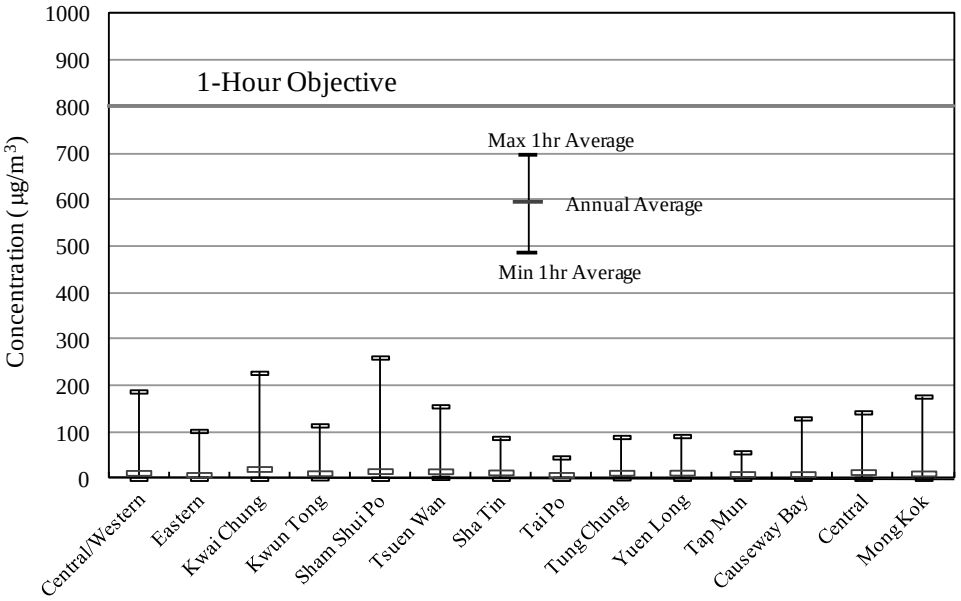


Figure 2b: Sulphur Dioxide Monitoring 2011
(24-Hour Average Statistics)

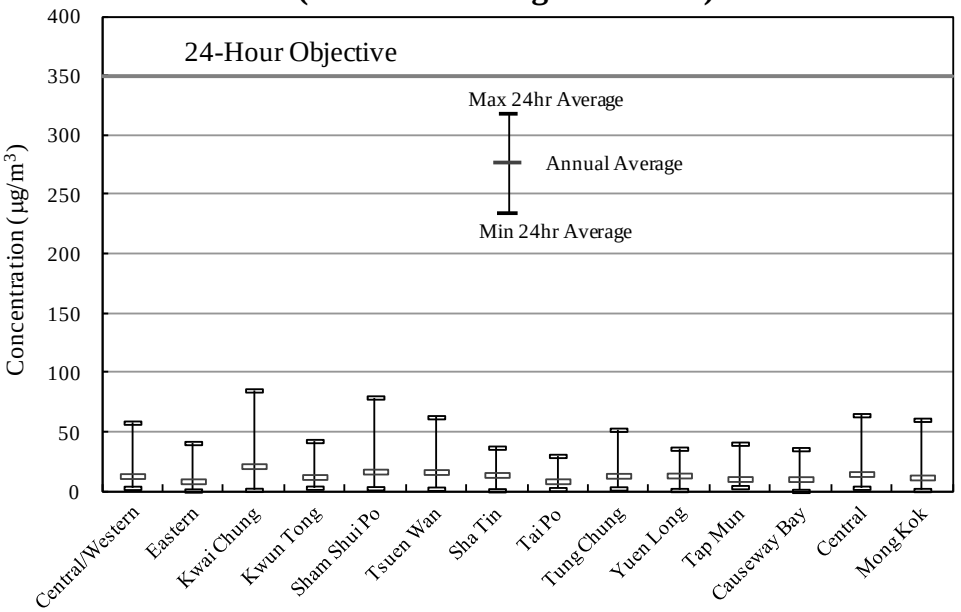
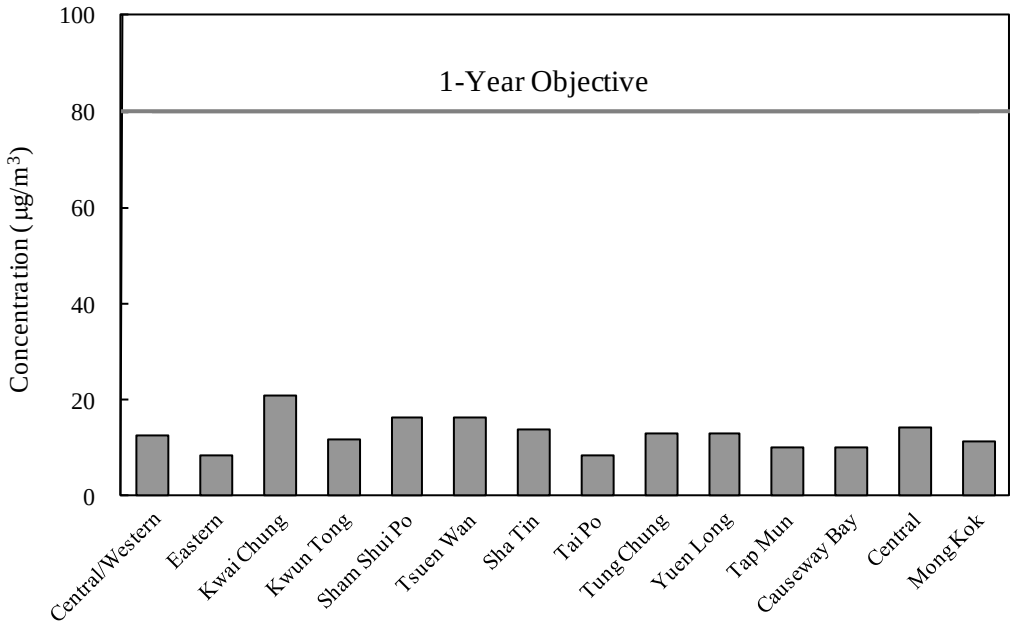


Figure 2c: Sulphur Dioxide Monitoring 2011 (Annual Average)



Sulphur dioxide was continuously measured at all the 14 monitoring stations during 2011. As in previous years, SO_2 concentrations remained low throughout the territory. All of the 14 monitoring stations complied with the relevant short and long term Hong Kong Air Quality Objectives[1] (AQOs) for SO_2. Both the highest 1-hour average (261 μg/m^3) and the highest 24-hour average (79 μg/m^3) in the year were recorded at the Sham Shui Po general station. As for the annual average, the Kwai Chung station recorded the highest value (21 μg/m^3) in the year. The highest 1-hour average, 24-hour average and annual average were all well below their respective AQO limits.

2.2 Nitrogen Oxides (NOx) and Nitrogen Dioxide (NO_2)

The various chemical species of the oxides of nitrogen are collectively termed as nitrogen oxides. From an air pollution standpoint, the most important nitrogen oxides in the atmosphere are nitric oxide (NO) and nitrogen dioxide (NO_2). In the context of air pollution, these two gases are often mentioned as NOx. They are usually produced in combustion processes. Emissions from power stations and motor vehicles are the two major sources of NOx in Hong Kong. NOx emissions from motor vehicles have greater impact on roadside air quality.

Nitrogen dioxide (NO_2) is mainly formed from the oxidation of nitric oxide (NO) emitted from fuel combustion. Long-term exposure to NO_2 can lower a person's resistance to respiratory infections and aggravate existing chronic respiratory diseases.

Nitrogen dioxide was continuously measured at all the 14 monitoring stations during 2010. In 2011, the highest 1-hour average (511 μg/m^3) and the highest 24-hour average (252 μg/m^3) were recorded at the roadside stations of Causeway Bay and Central respectively. All the general stations complied with the 1-hour AQO (i.e., no general station recorded more than 3 counts of exceedance with the 1-hour AQO limit in the year).

[1] Details of the Hong Kong Air Quality Objectives can be found in Appendix A.

For the 24-hour AQO, all general stations were in compliance except Sham Shui Po general station which recorded more than one count of exceedance with the 24-hour AQO limit in the year. Non-compliance with the 1-hour and 24-hour AQO for NO_2 was recorded at all the three roadside stations.

As in previous years, all general stations complied with the annual AQO for NO_2 in 2011 while non-compliance was observed at all the three roadside stations. The highest annual average (124 $\mu g/m^3$) was recorded at the Causeway Bay roadside station in the year.

Figure 3a: Nitrogen Dioxide Monitoring 2011
(1-Hour Average Statistics)

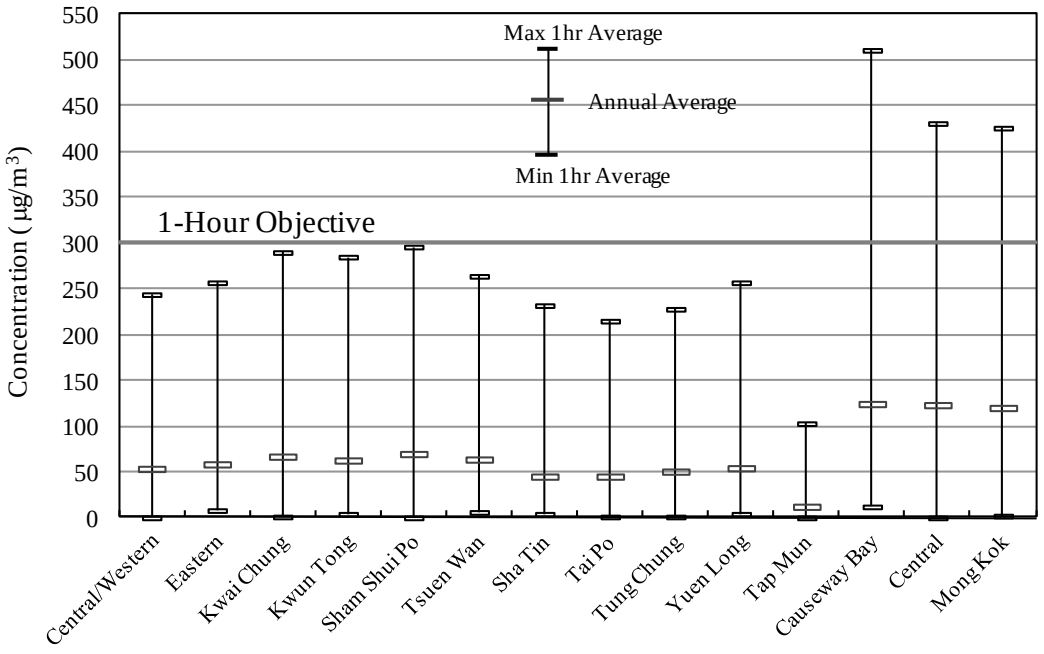


Figure 3b: Nitrogen Dioxide Monitoring 2011
(24-Hour Average Statistics)

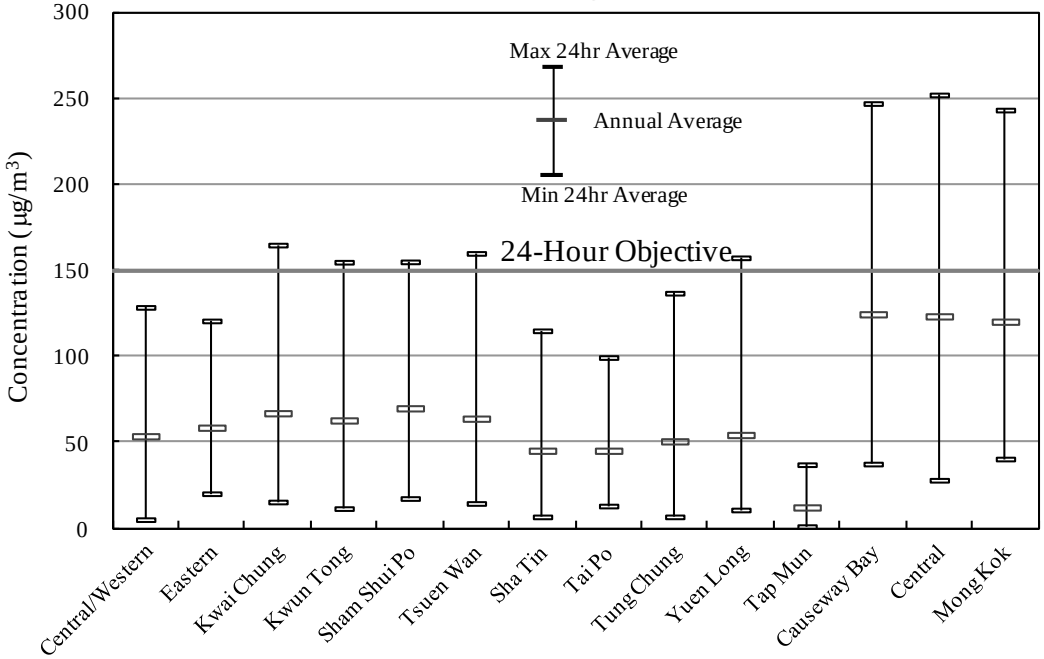
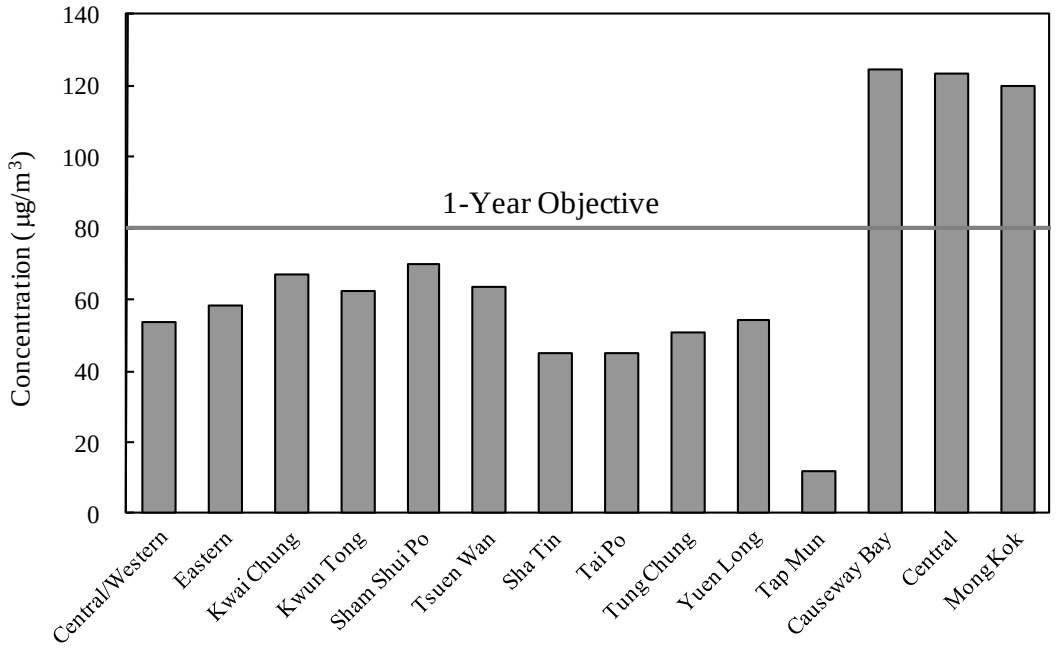


Figure 3c: Nitrogen Dioxide Monitoring 2011 (Annual Average)



2.3 Ozone (O_3)

Ozone (O_3) is a major constituent of photochemical smog. It is not a pollutant directly emitted from man-made sources but formed by photochemical reactions of primary pollutants such as nitrogen oxides (NOx) and volatile organic compounds (VOCs) under sunlight. As it takes several hours for these photochemical reactions to take place, ozone recorded in one place could be attributed to VOC and NOx emissions from places afar. Hence, ozone is a regional air pollution problem.

Being a strong oxidant, ozone can cause irritation to the eyes, nose and throat even at low concentrations. At elevated levels, it can increase a person's susceptibility to respiratory infections and aggravate pre-existing respiratory illnesses such as asthma.

In the past, ozone was monitored at the 11 general stations. Starting from January 2011, the measurement of ozone was extended to the three roadside stations.

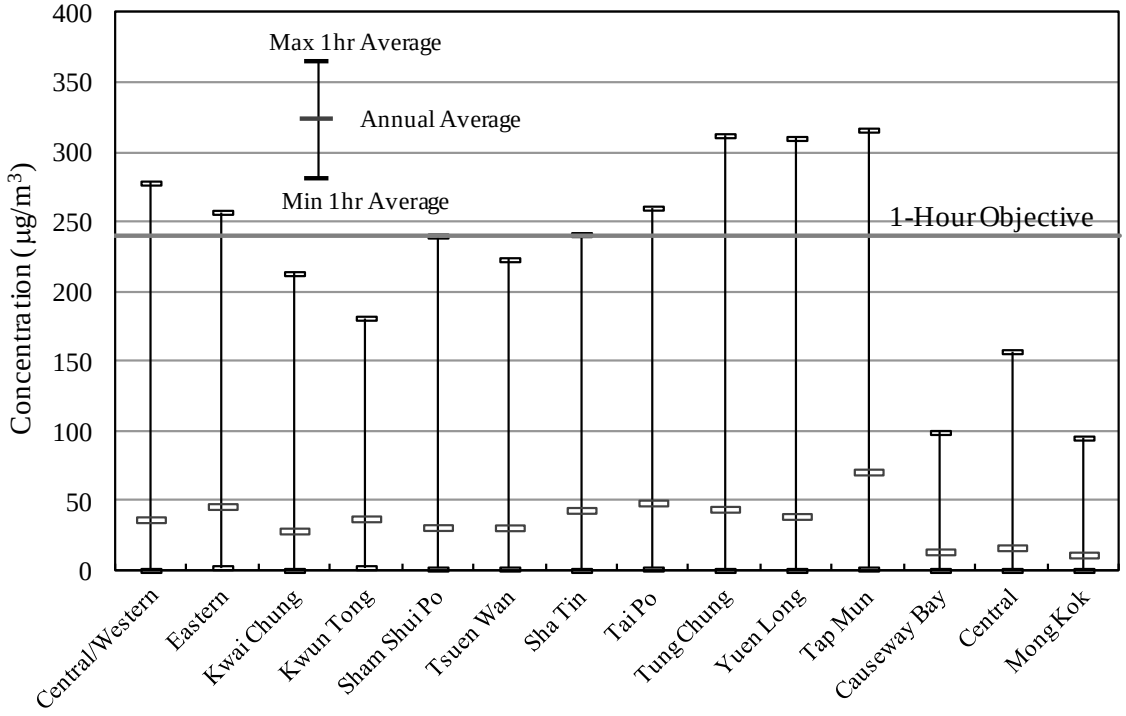
Among the 11 general stations, four of them recorded non-compliance with the 1-hour AQO in 2011 (i.e., the 1-hour AQO limit was exceeded more than three times in the year). The highest 1-hour average (316 $\mu g/m^3$) was recorded at the Tap Mun station.

All the three roadside stations complied with the 1-hour AQO in the year. At the roadside, the nitric oxide emitted from motor vehicles readily reacts with ozone to form NO_2, thereby removing ozone. Because of such ozone scavenging effect, the ozone concentrations at the roadside are significantly lower than those at the general stations.

In Hong Kong, elevated ozone incidents are mostly associated with very hot, fine and calm weather conditions in the region, which favour the formation via photochemical reactions and accumulation of ozone. Such weather conditions mostly occur in summer

and autumn, especially when Hong Kong and the Pearl River Delta Region is under the influence of subsiding air induced by a tropical cyclone located in the Western Pacific Ocean near Taiwan.

Figure 4a: Ozone Monitoring 2011
(1-Hour Average Statistics)



2.4 Carbon Monoxide (CO)

Carbon monoxide (CO) comes mainly from vehicular emissions although a small amount of which may also come from flue gases of 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 diseases.

Carbon monoxide was continuously monitored at seven stations including four general stations and three roadside stations during 2011. Similar to previous years, both the ambient and roadside CO concentrations remained very low throughout the year. All the seven monitoring stations complied with the 1-hour and 8-hour AQOs for CO. In 2011, the highest 1-hour average (4030 $\mu g/m^3$) and the highest 8-hour average (3309 $\mu g/m^3$) were both recorded at the Causeway Bay roadside station; these values were around one seventh and one third of the respective AQO limits.

Figure 5a: Carbon Monoxide Monitoring 2011 (1-Hour Average Statistics)

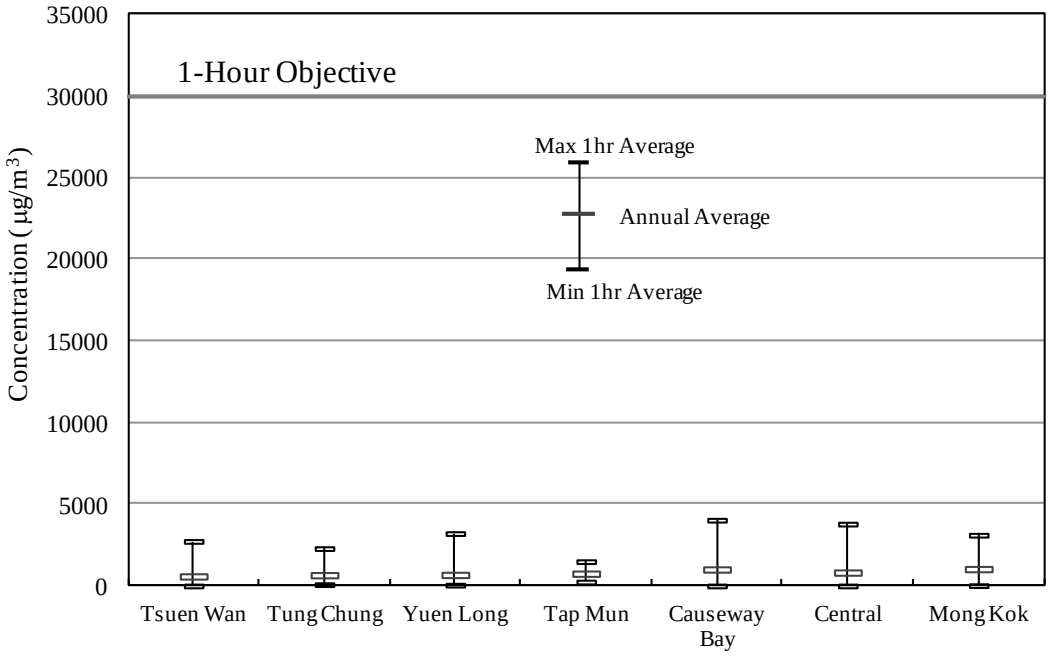
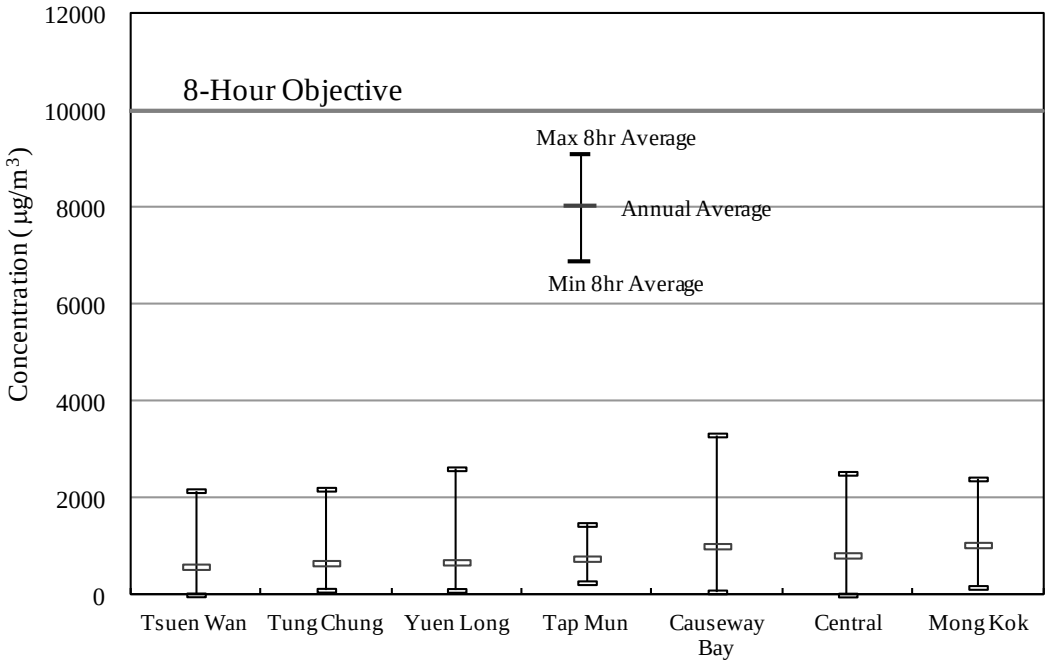


Figure 5b: Carbon Monoxide Monitoring 2011 (8-Hour Average Statistics)



3. Suspended Particulates

3.1 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 further divided into different categories according to the sizes. Particulates with a nominal aerodynamic diameter of 10 micrometres or less are called respirable suspended particulates (RSP or PM10 for short) while the sizes of 2.5 micrometres or less are named fine suspended particulates (FSP or PM2.5 for short). The smaller the size of particulate, the greater is the concern on its health impact (see Sections 3.2 and 3.3 below). On the other hand, suspended particulates that are larger than 10 micrometres in diameter mainly cause soiling and dust nuisance.

TSP measurement was conducted by sampling using high-volume samplers at nine general stations and one roadside station during 2011. Samples are taken for 24 hours at a frequency of about one sample per six days.

All stations complied with the 24-hour AQO (260 μg/m^3) for TSP in 2011. Both the highest 24-hour average (199 μg/m^3) and annual average (102 μg/m^3) were recorded at the Mong Kok roadside station in the year. Yuen Long general station and Mong Kok roadside station exceeded the annual AQO for TSP (80 μg/m^3) in 2011. All other stations complied with the corresponding AQO.

Figure 6a: TSP Monitoring 2011
(24-Hour Average Statistics)

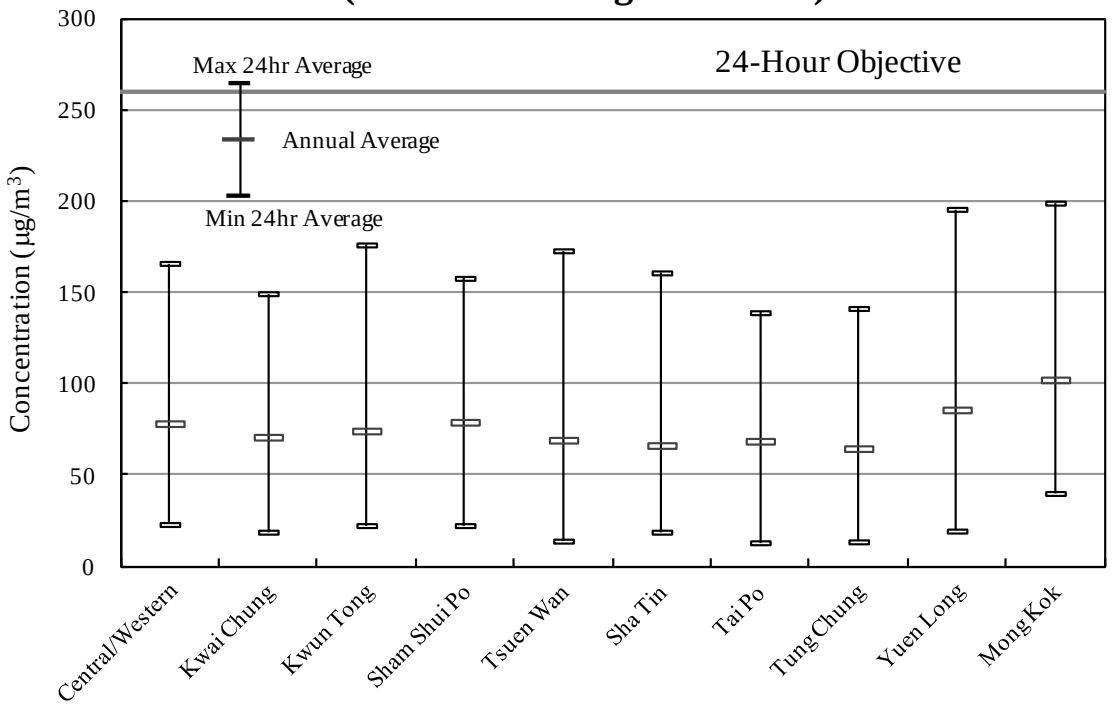
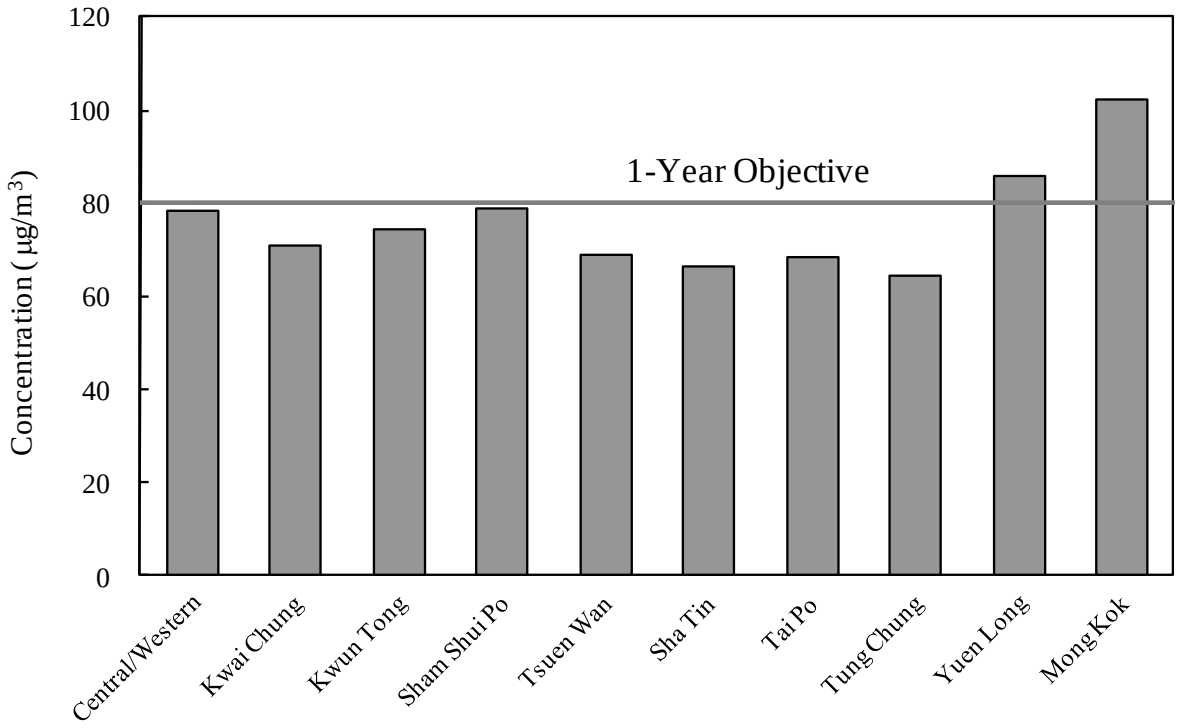


Figure 6b: TSP Monitoring 2011 (Annual Average)



3.2 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 and emissions from power plants, are the major sources of RSP in Hong Kong. Besides, RSP can be formed by photochemical reactions of nitrogen oxides and volatile organic compounds and atmospheric oxidation of gaseous pollutants such as sulphur dioxide and nitrogen oxides. Although to a lesser extent, crustal derived dust and marine aerosols are also sources of RSP.

RSP at high levels 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.

RSP was continuously measured at all 14 monitoring stations during 2011. Most of these stations were also equipped with high-volume sampler to collect particulate samples for chemical analysis.

In 2011, all stations complied with the 24-hour AQO of RSP. The annual AQO limit of RSP (55 $\mu g/m^3$) was exceeded at two roadside stations namely Causeway Bay and Central in the year. The highest 24-hour average (173 $\mu g/m^3$) was recorded at Yuen Long general station while the highest annual average (66 $\mu g/m^3$) was recorded at the Causeway Bay roadside station.

Figure 7a: RSP Monitoring 2011 (24-Hour Average Statistics)

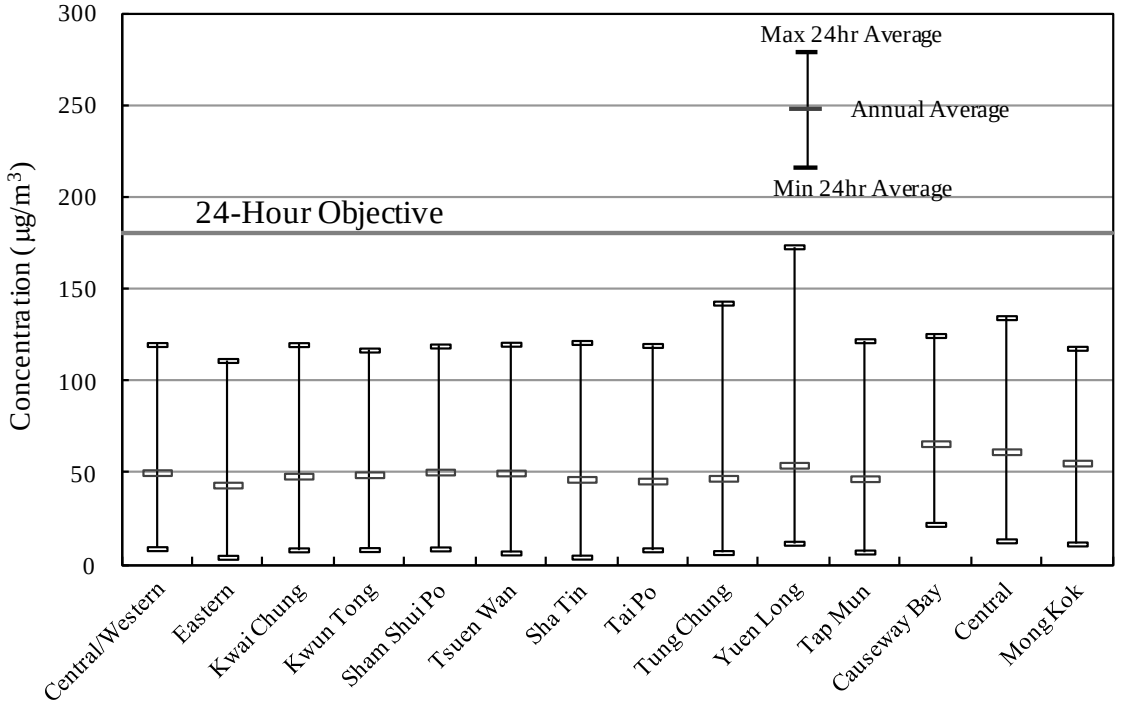
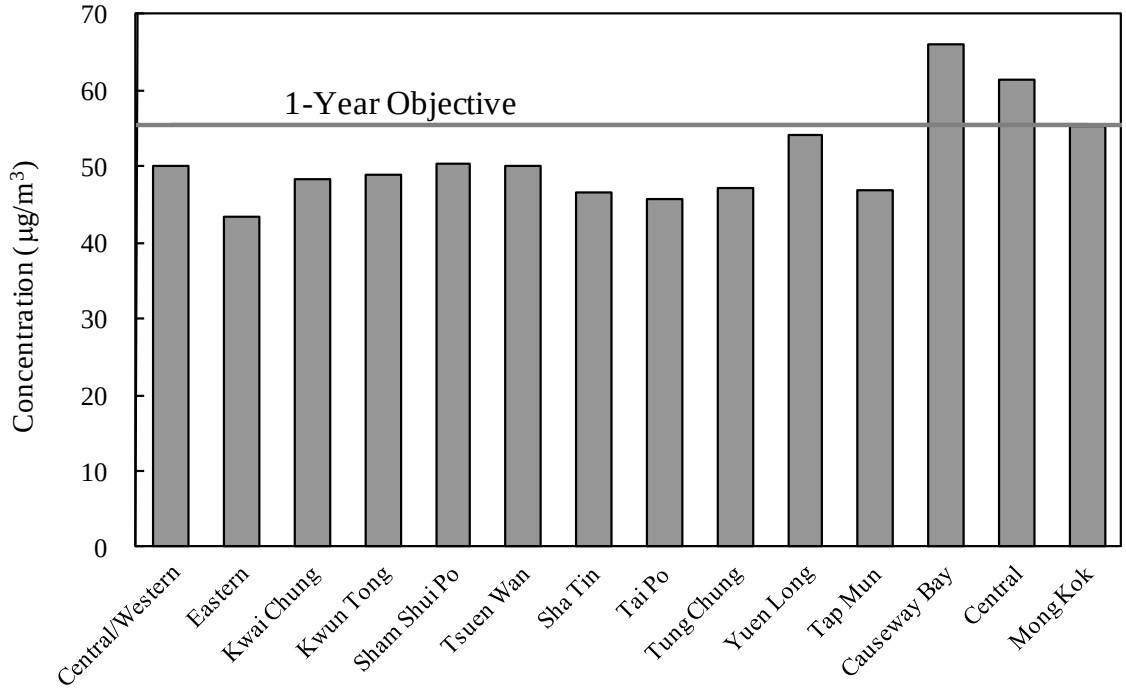


Figure 7b: RSP Monitoring 2011 (Annual Average)



3.3 Fine Suspended Particulates (FSP)

Fine suspended particulates (FSP or PM2.5) refer to those suspended particulates with nominal aerodynamic diameters of 2.5 micrometres or less, which is the finer component of RSP. PM2.5 is able to penetrate to the deepest parts of the lung because of its small size, hence poses a higher risk to health. Besides, PM2.5 also causes visibility impairment in air.

PM2.5 was measured at five stations in the network over the past years. The measurement has been extended to the whole network since the fourth quarter of 2011. In 2011, five general stations and two roadside stations had full year monitoring data while the remaining seven monitoring stations had not collected sufficient data for the calculation of annual averages. In the year, the highest 24-hour average (109 $\mu g/m^3$) was recorded at Yuen Long general station while the highest annual average (39 $\mu g/m^3$) was recorded at the Central roadside station.

Figure 8a: PM2.5 Monitoring 2011
(24-Hour Average Statistics)

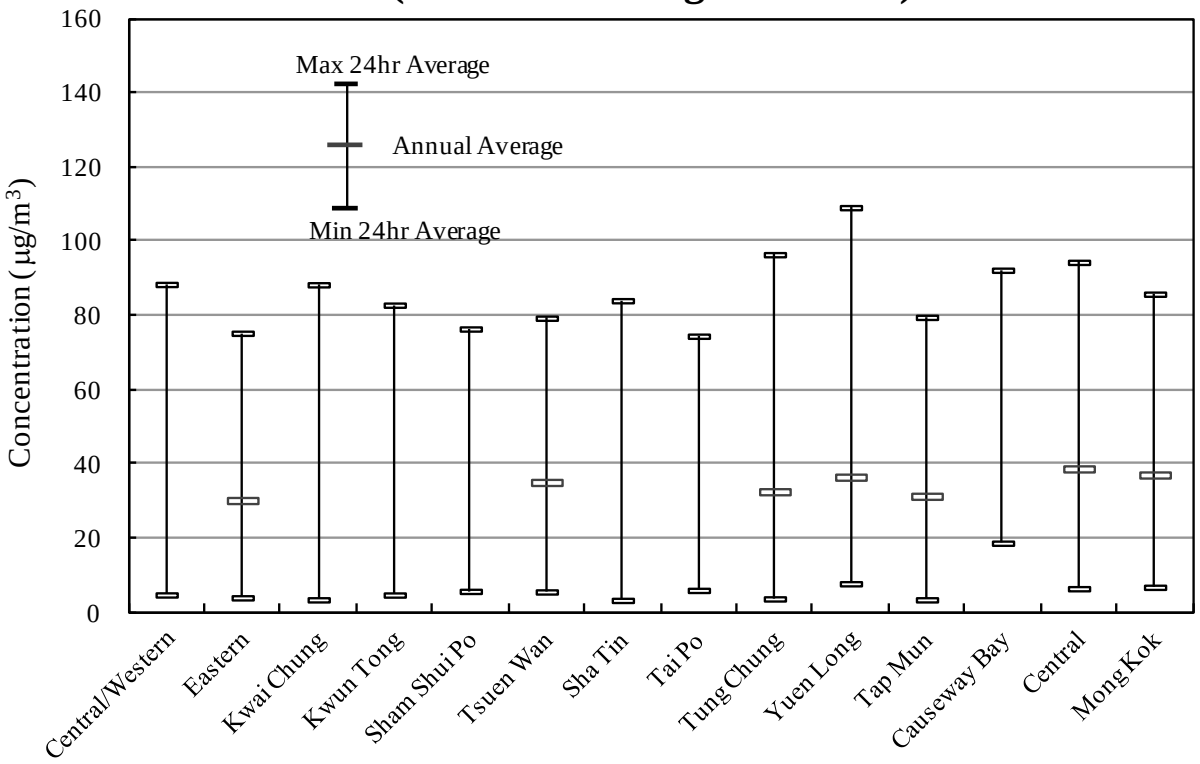
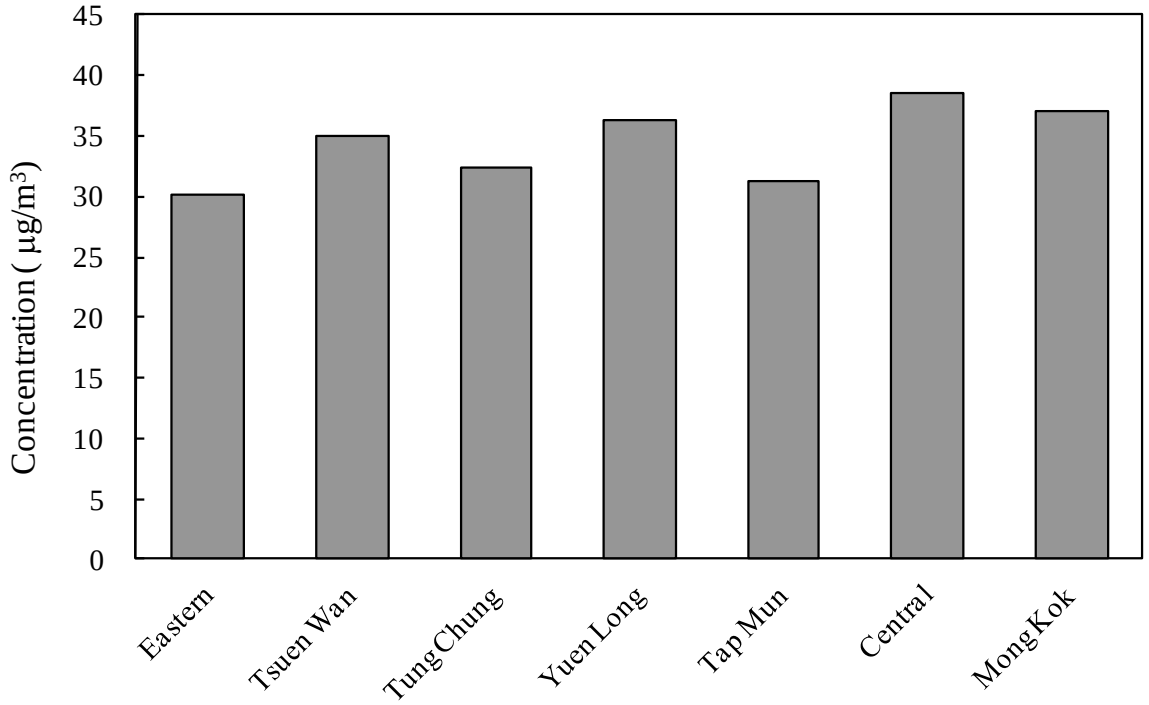


Figure 8b: PM2.5 Monitoring 2011
(Annual Average)



3.4 Lead (Pb)

Lead is the only one criteria pollutant included in the AQO that is also a toxic air pollutant. In Hong Kong, the sale and supply of leaded petrol, which is a known major source of lead, was banned from 1 April 1999. As in previous years, the ambient lead concentrations continued to linger at very low levels during 2011. The overall 3-month averages, ranging from 20 ng/m^3 (Kwun Tong and Tung Chung) to 104 ng/m^3 (Yuen Long), were well below the AQO limit of 1,500 ng/m^3.

4. Toxic Air Pollutants (TAPs)

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 2011, eight 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 TAPs monitoring operation is given in Appendix B4. The monitoring data collected so far indicate that the levels of toxic air pollutants in Hong Kong are comparable to those observed in other major cities.

5. Variation of Air Pollution Levels over Time

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

5.1 Over a Day

The concentrations of most air pollutants generally follow the diurnal pattern of human activities and traffic. For instance, higher levels of NO_2 and RSP are usually observed in the 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. This type of traffic induced diurnal pattern is much more distinct for pollutant levels at roadside.

Figure 9: 2011 Diurnal variations of NO_2

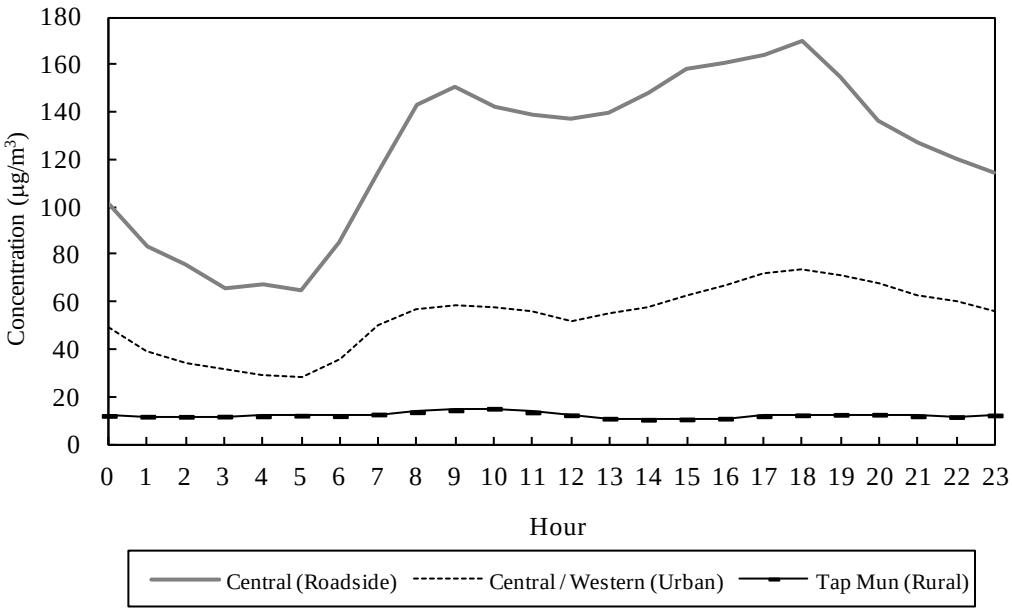
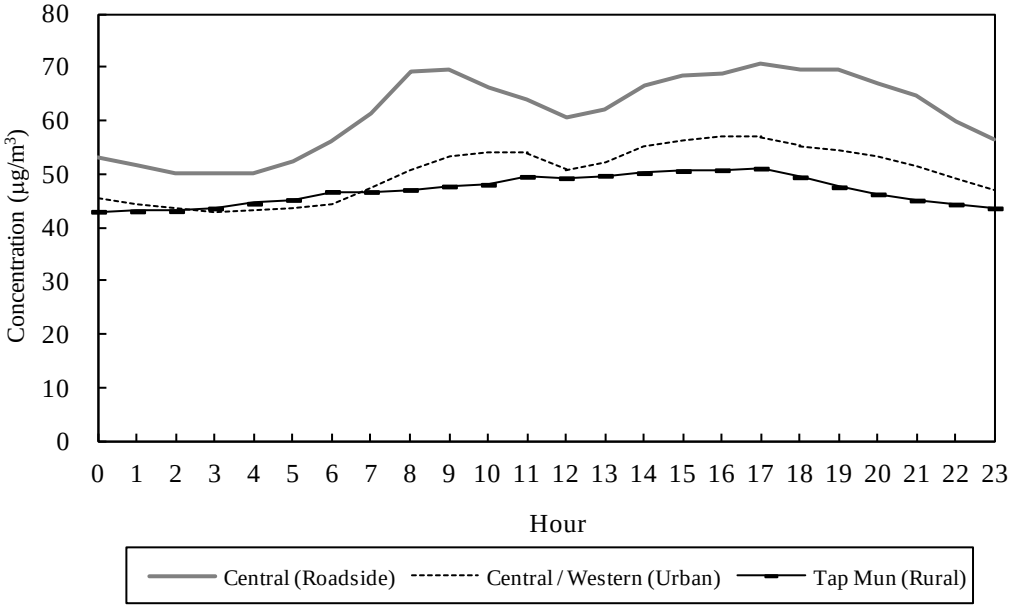
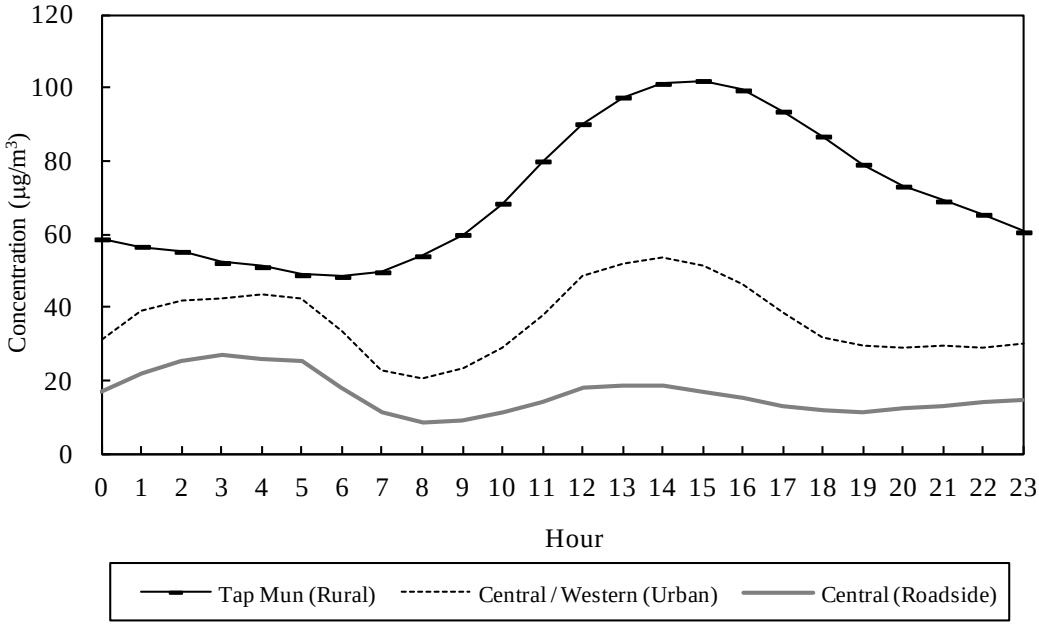


Figure 10: 2011 Diurnal variations of RSP



The diurnal pattern of ozone is different from that of NO_2 and RSP. Ozone is formed by photochemical reactions of its precursor pollutants such as NOx 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 and roadside, the lowest ozone concentrations are often observed during rush hours. This is because a large amount of nitric oxide from rush-hour traffic acts as an efficient scavenger of ozone. At the roadside, ozone levels are significantly lower than those at the general stations because of the scavenging effect due to higher concentrations of nitric oxide from vehicular emissions.

Figure 11: 2011 Diurnal variations of O_3



5.2 Over a Year

Concentrations of NO_2, RSP and O_3 are in general lower in summer (June to August) than autumn and winter due to a number of reasons. The higher temperatures in summer months induce larger mixing heights, which favour the dispersion of pollutants. The rain in summer helps to wash out pollutants more frequently. The south-westerly monsoon in summer also helps to replenish the region with cleaner oceanic air.

Figure 12: Monthly variations of NO_2 and RSP at Central / Western in 2011

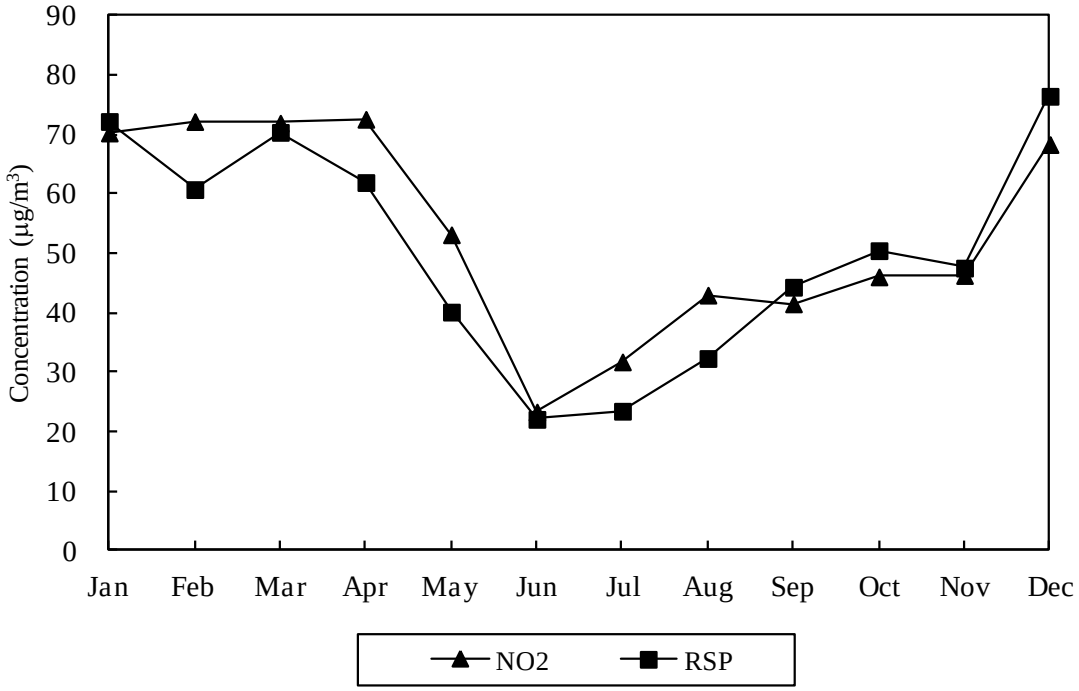
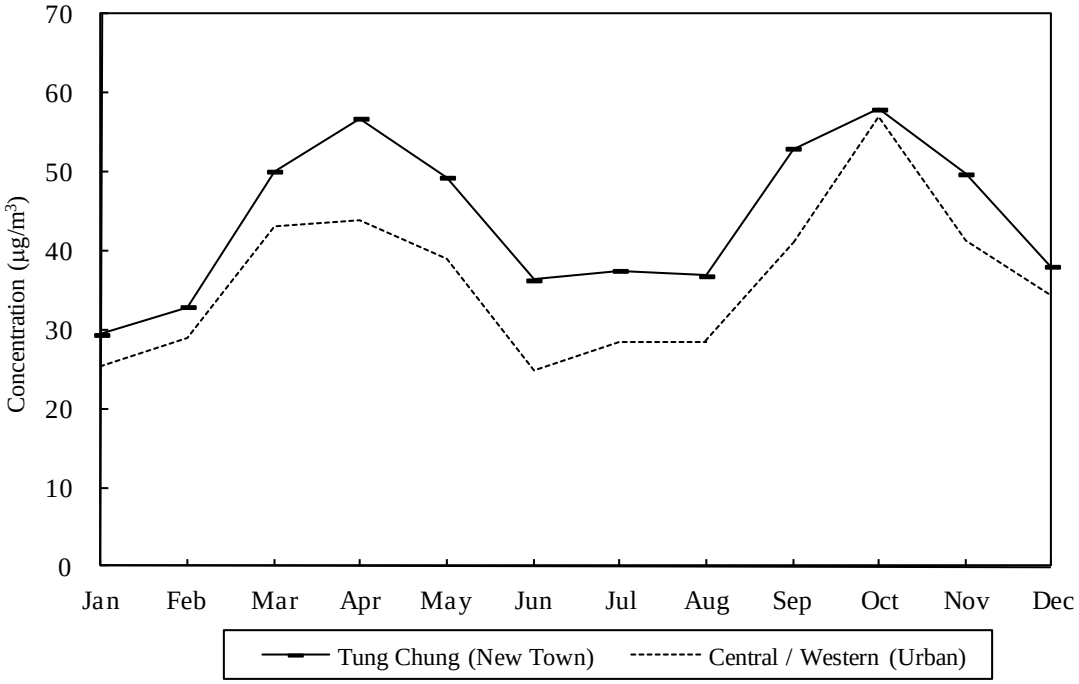


Figure 13: Monthly variations of O_3 in 2011



5.3 Long Term Trends

The long-term trends for the air pollutants presented in this section are based on their annual average concentrations recorded from the relevant air quality monitoring stations categorised into four groups of land use types, namely Urban, New Town, Rural and Roadside as defined in Table 1 below.

Table 1: Classification of Air Monitoring Stations by Land Use Types

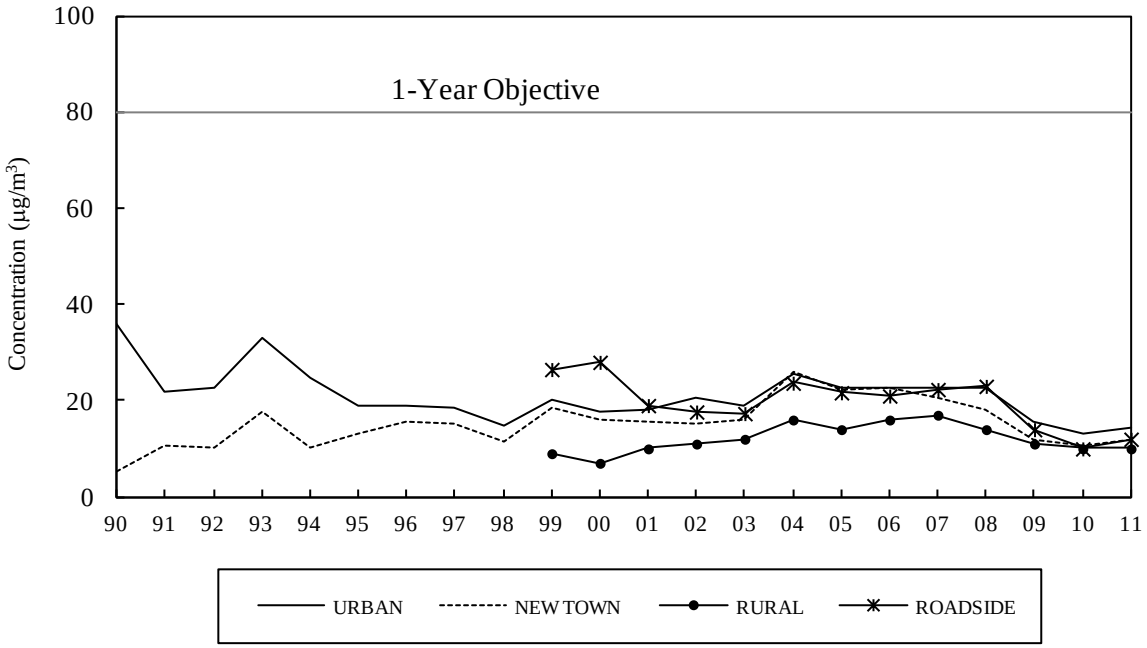
Land Use Type	Land Use Characteristics	Air Monitoring Stations
Urban	Densely populated residential areas mixed with some commercial and/or industrial areas	Central/Western, Eastern, Kwai Chung, Kwun Tong, Sham Shui Po and Tsuen Wan
New Town	Mainly residential areas	Sha Tin, Tai Po, Tung Chung and Yuen Long
Rural	Rural areas	Tap Mun (background station)
Roadside	Urban roadside in mixed residential/ commercial area with heavy traffic and surrounded by many tall buildings	Causeway Bay, Central and Mong Kok

5.3.1 Sulphur Dioxide (SO_2)

Since the implementation of the Air Pollution Control (Fuel Restriction) Regulations in 1990 for restricting sulphur content of industrial fuels and the Air Pollution Control (Motor Vehicle Fuel) Regulations in 1995 for controlling motor vehicle fuel quality, SO_2 concentrations in Hong Kong have remained at levels well below the annual AQO limit of 80 $\mu g/m^3$. Significant improvement was noted in the past few years due to measures taken by Governments in Guangdong Province and Hong Kong, such as retrofitting power plants with flue gas desulphurization devices, phasing out highly polluting industrial plants in the Pearl River Delta, introducing fuels with lower sulphur content, etc.

As a result of the introduction of ultra low sulphur diesel for vehicle fleet in late 2000, the average SO_2 concentration at roadside in 2011 (12 $\mu g/m^3$) dropped by 56% as compared with the 1999 value (27 $\mu g/m^3$).

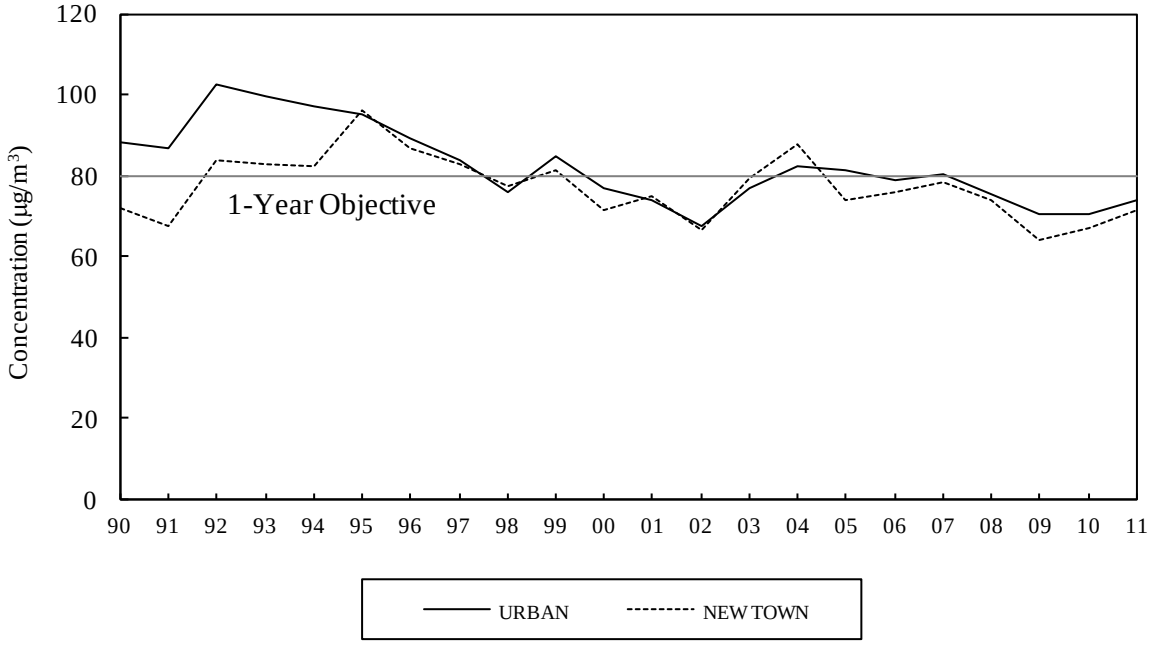
Figure 14: SO_2 long term trend



5.3.2 Total Suspended Particulates (TSP)

The TSP concentrations in the territory exhibited a general declining trend from mid-1990s.

Figure 15: TSP long term trend

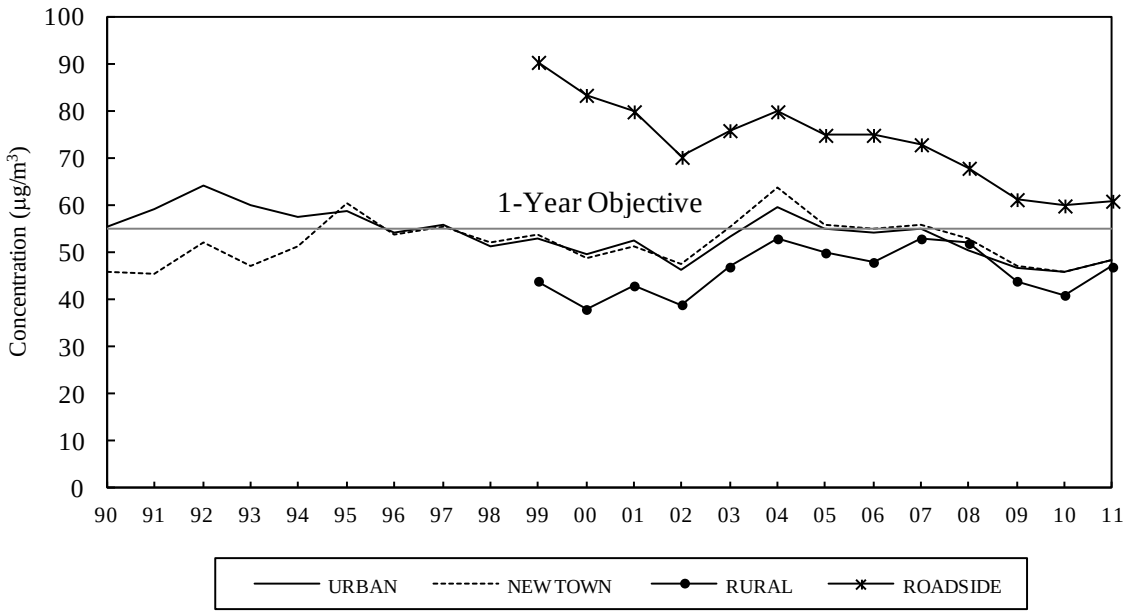


5.3.3 Respirable Suspended Particulates (RSP)

The ambient concentrations of RSP in the territory showed a primarily downward trend between 1995 and 2002, followed by a rebound that peaked in 2004 which was caused by the increase in regional background RSP levels. The RSP concentrations then dropped to a level below the annual AQO limit, reflecting a reduction in regional background RSP levels in the past few years.

In Hong Kong, high level of roadside RSP, caused mainly by the exhaust emissions of diesel vehicles, has long been a major air pollution concern. As a result of the implementation of various vehicle emission control measures in recent years, the annual average of RSP concentration at roadside in 2011 had reduced by 33% when compared with the 1999 value.

Figure 16: RSP long term trend



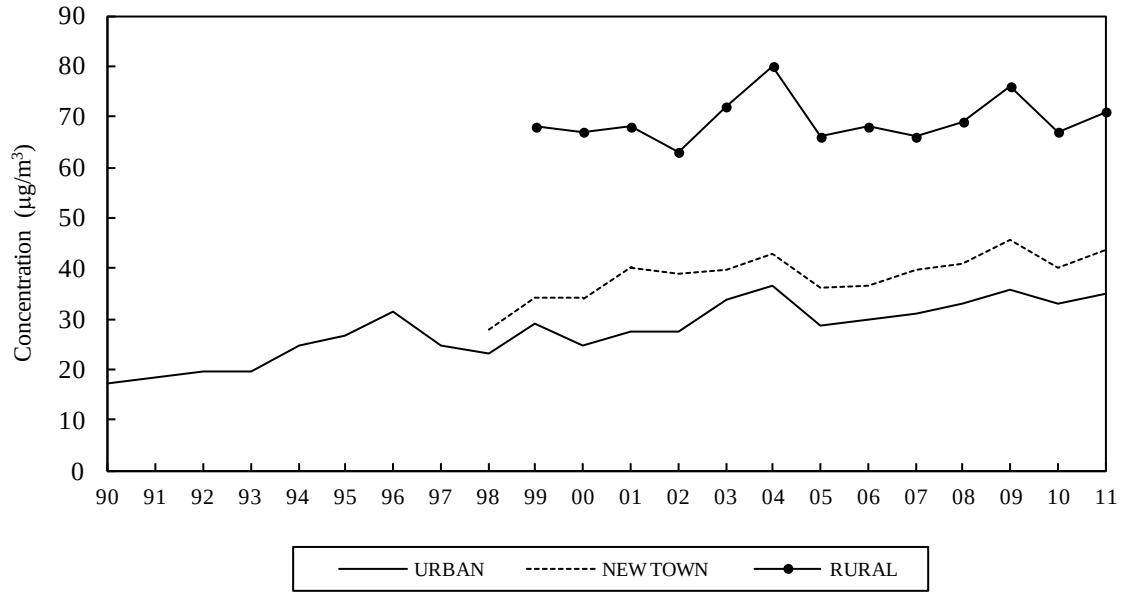
5.3.4 Ozone (O_3)

The ozone concentrations in the territory have shown a moderate upward trend since 1990.

As nitric oxide emissions from motor vehicles can react with and remove ozone in the air, regions with heavy traffic normally have lower ozone levels than areas with light traffic. Hence, Tap Mun rural station has steadily recorded more than twice the ozone levels measured in urban areas since 1999.

Ozone, a major constituent of photochemical smog, is a regional air pollution issue. The Hong Kong Special Administrative Region Government and Guangdong Provincial Government are implementing a regional air quality management plan to alleviate photochemical smog problem and reduce ozone levels in the Pearl River Delta region.

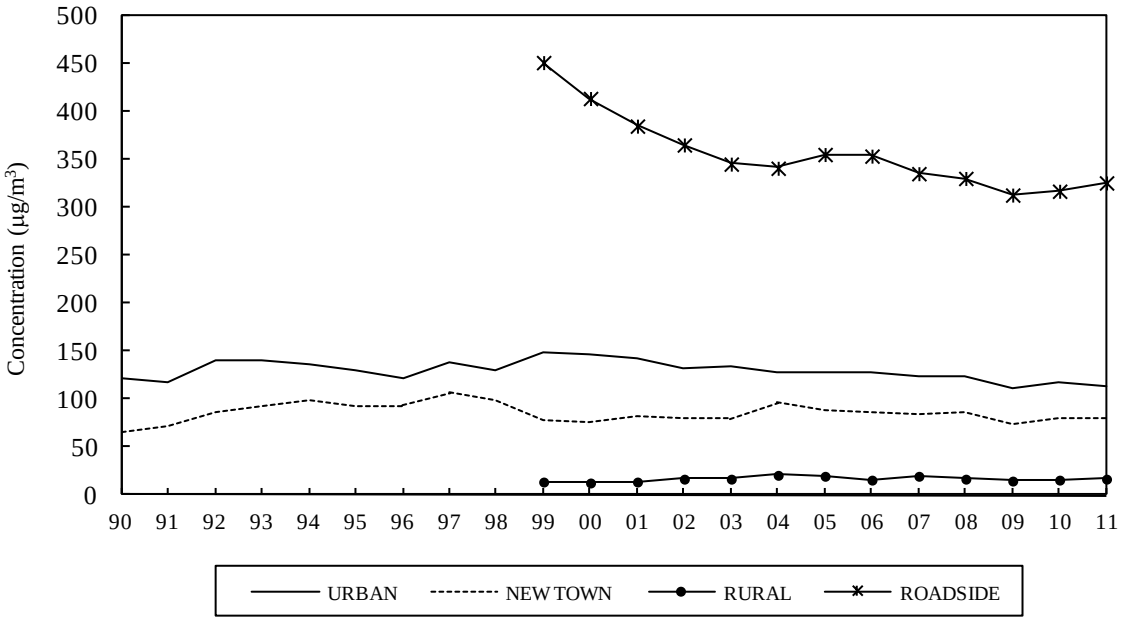
Figure 17: O_3 long term trend



5.3.5 Nitrogen Oxides (NOx) and Nitrogen Dioxide (NO_2)

The annual average of NOx in urban areas exhibited a gradual declining trend over the past decade. During the same period, the roadside NOx concentration showed a more distinct decreasing trend, reflecting a reduction in vehicular NOx emission as a result of vehicle emission control measures implemented in the past decade. The roadside NOx concentration in 2011 was 28% lower than its 1999 value.

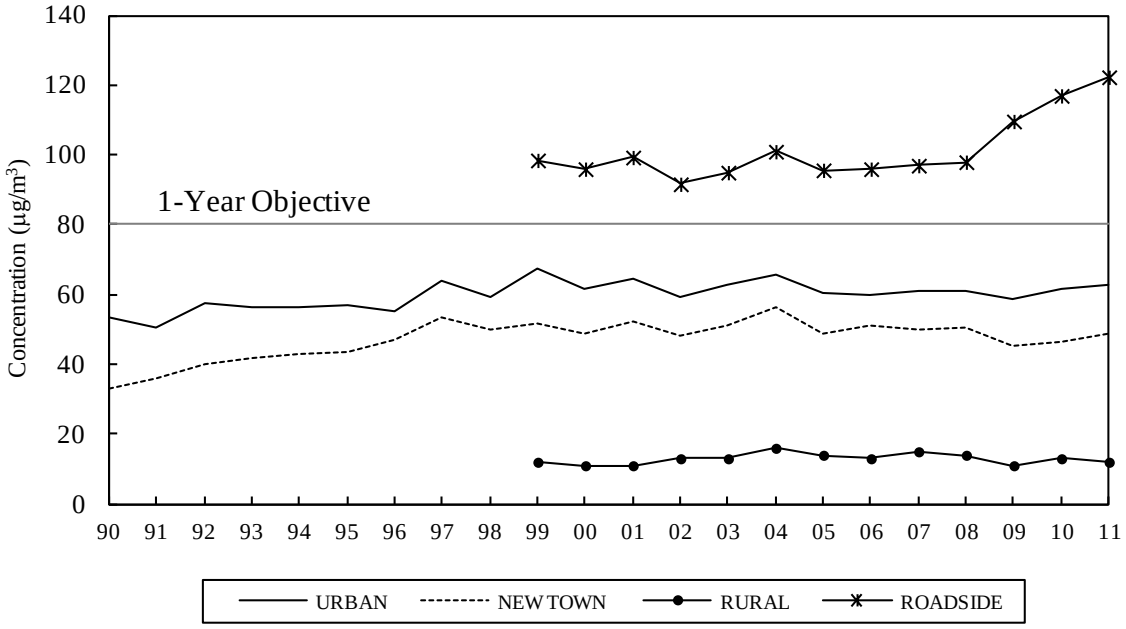
Figure 18: NOx long term trend



NO_2 is mainly formed from the oxidation of nitric oxide, a major component of NOx. The oxidation can be promoted by the presence of more ozone and VOCs in the ambient air. The ambient NO_2 levels have exhibited slow rising trends since 1990 but the trends have levelled off in recent years. The roadside NO_2 concentrations have shown an overall increasing trend over the past years, which could be caused by a combination of the ageing of motor vehicles, increase in direct NO_2 emissions from motor vehicles and rise in regional background ozone concentration promoting the conversion of nitric oxide

emitted from motor vehicles to NO_2. To address the problem of the rising roadside NO_2 concentration in recent years, the government has put forward additional measures including supporting the transport trades to test green vehicles, testing the feasibility of installing after-treatment devices to franchised buses to reduce their NOx emissions and stepping up the control on emissions from petrol and liquefied petroleum gas vehicles.

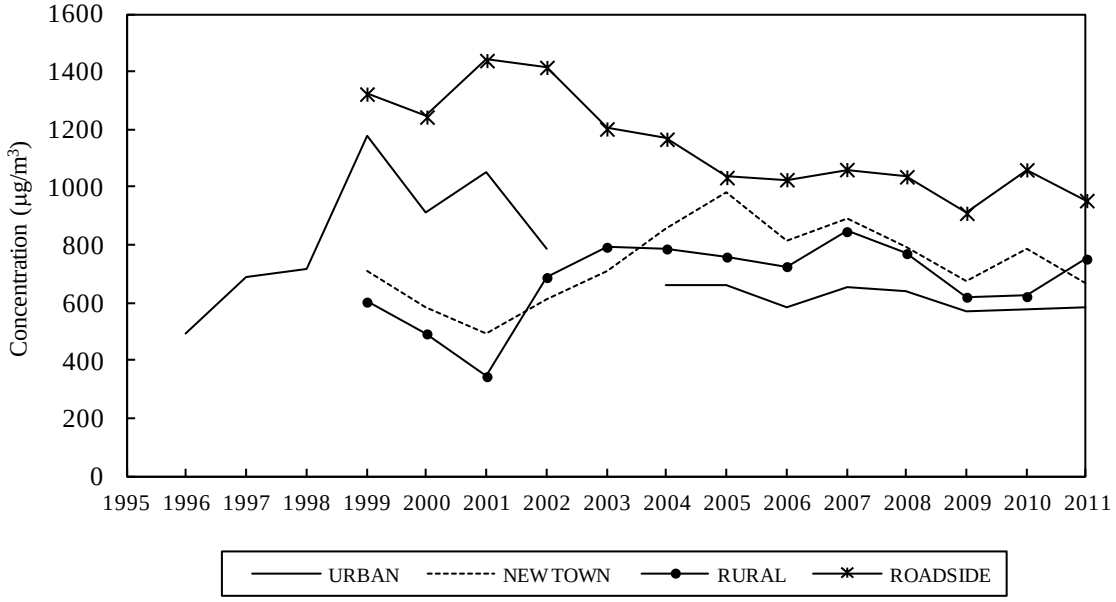
Figure 19: NO_2 long term trend



5.3.6 Carbon Monoxide (CO)

The concentrations of CO in Hong Kong remained at very low levels in the past several years. Even at the roadside close to the vehicular emission sources, the CO levels were well within the 1-hour AQO (30,000 μg/m^3) and 8-hour AQO (10,000 μg/m^3) levels.

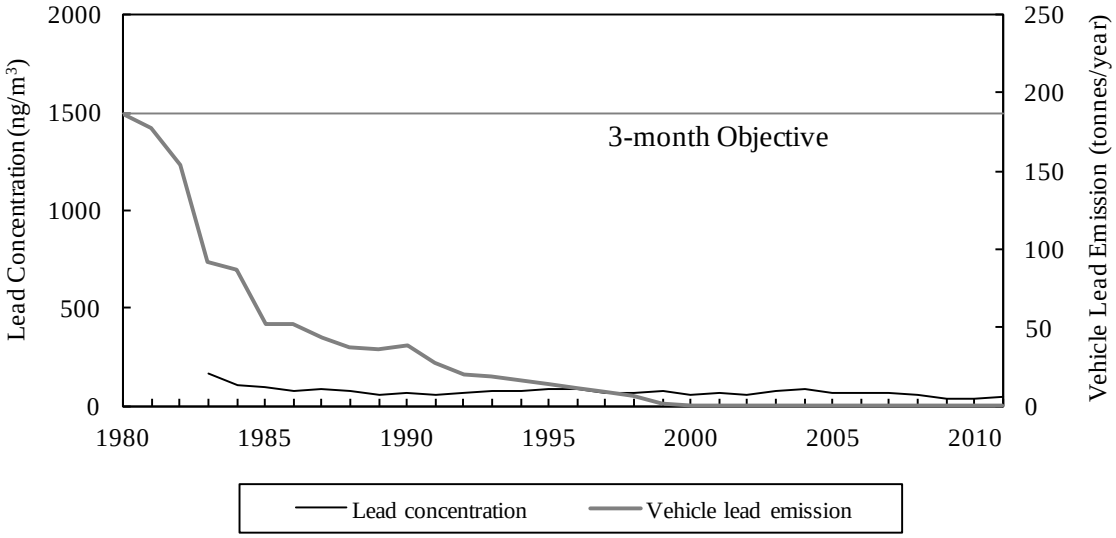
Figure 20: CO long term trend



5.3.7 Lead (Pb)

The ambient lead concentrations have been lingering at very low levels since the oil companies took voluntary action in reducing the lead content of petrol in the early eighties. Lead emissions from motor vehicles were further reduced as a result of the introduction of unleaded petrol in April 1992 and completely eliminated when the sale and supply of leaded petrol was banned in April 1999.

Figure 21 : Vehicle lead emission and lead concentration



Appendix A

Air Quality Objectives and their Compliance Status

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

Table A1: Hong Kong Air Quality Objectives (AQO)

Concentration in micrograms per cubic metre [1]

Pollutant	Averaging Time				
	1 hour [2]	**8 hours** [3]	**24 hours** [3]	**3 months** [4]	**1 year** [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 mean suspended particulates in air with a nominal aerodynamic diameter of 10 micrometres or smaller.
[6] Photochemical oxidants are determined by measurement of ozone only.

Compliance with the short-term AQO

Table A2 shows the percentage time of compliance with the short-term AQO (i.e. 1-hour to 24-hour AQO) recorded at each of the monitoring stations in 2011. For NO_2, the compliance percentages of the 24-hour AQO were above 99% for general stations and between 78% to 82% for roadside stations; its 1-hour AQO compliance rates were above 99% at all stations. As regards TSP and RSP, the compliance percentage of their 24-hr AQOs achieved 100% at all stations. The compliance levels of 1-hour AQO for O_3 were over 99% at all monitoring stations. The compliance percentage of SO_2 reached 100% for all stations. For CO, all monitoring stations achieved full compliance with AQO in 2011.

Table A2: Percentage Time in compliance with Short-Term Air Quality Objectives in 2011

Station		O_3	NO_2		TSP	RSP	SO_2		CO	
		1-hr	1-hr	24-hr	24-hr	24-hr	1-hr	24-hr	1-hr	8-hr
General Station	Central/Western	99.94	100	100	100	100	100	100	--	--
	Eastern	99.99	100	100	--	100	100	100	--	--
	Kwai Chung	100	100	99.73	100	100	100	100	--	--
	Kwun Tong	100	100	99.72	100	100	100	100	--	--
	Sham Shui Po	100	100	99.45	100	100	100	100	--	--
	Tsuen Wan	100	100	99.72	100	100	100	100	100	100
	Sha Tin	99.99	100	100	100	100	100	100	--	--
	Tai Po	99.99	100	100	100	100	100	100	--	--
	Tung Chung	99.55	100	100	100	100	100	100	100	100
	Yuen Long	99.81	100	99.73	100	100	100	100	100	100
	Tap Mun	99.85	100	100	--	100	100	100	100	100
Roadside Station	Causeway Bay	--	99.08	81.04	--	100	100	100	100	100
	Central	--	99.37	77.84	--	100	100	100	100	100
	Mong Kok	--	99.60	82.13	100	100	100	100	100	100

Notes: "--" *Not measured*

Compliance with the long-term AQO

Table A3 shows the compliance status of the long-term (annual) AQO for all 14 monitoring stations in 2011. Similar to previous years, all monitoring stations achieved full compliance with the long-term AQO for SO_2 and lead in 2011. Compliance with the annual AQO for NO_2 was recorded at 11 out of 14 stations. For TSP, eight out of the 10 stations complied with the annual AQO. The annual AQO for RSP was complied at 12 out of 14 stations in 2011.

Table A3: Compliance Status of Long-Term (Annual) Air Quality Objectives in 2011

Station		NO_2	TSP	RSP	SO_2	Lead
		1-year	1-year	1-year	1-year	3-months
General Station	Central/Western	✓	✓	✓	✓	✓
	Eastern	✓	--	✓	✓	--
	Kwai Chung	✓	✓	✓	✓	✓
	Kwun Tong	✓	✓	✓	✓	✓
	Sham Shui Po	✓	✓	✓	✓	--
	Tsuen Wan	✓	✓	✓	✓	✓
	Sha Tin	✓	✓	✓	✓	--
	Tai Po	✓	✓	✓	✓	--
	Tung Chung	✓	✓	✓	✓	✓
	Yuen Long	✓	×	✓	✓	✓
	Tap Mun	✓	--	✓	✓	--
Roadside Station	Causeway Bay	×	--	×	✓	--
	Central	×	--	×	✓	--
	Mong Kok	×	×	✓	✓	✓

Notes: "✓" *Complied with the AQO* "×" *Violated the AQO* "--" *Not measured*

Appendix B

Air Quality Monitoring Operation

B.1 Network Operation

The air quality monitoring network of 14 monitoring stations is operated by the Air Science Group of the Environmental Protection Department. Table B1 shows the station site information. 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, RSP and FSP 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 three stations: Central/Western, Kwun Tong and Yuen Long. The parameters measured for all wet and dry samples include: pH, Na^+, K^+, NH_4^+, NO_3^-, SO_4^{2-}, Cl^-, F^-, Ca^{2+}, Mg^{2+}, 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 Science 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:-

- Hourly API reporting for individual station
- Monthly release of the Air Pollution Index (API) summary for all monitoring stations
- Monthly updating the data in the Environmental Protection Interactive Centre (EPIC) for the public to download air quality monitoring data (http://www.epd.gov.hk/epd/epic/english/epichome.html)
- 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 (TSP and RSP) respectively. In 2011, 536 audit checks were carried out on the stations' analysers and samplers. Based on the 95% probability limits, the accuracy of the network was within the specified control limits as shown in Figure B1.

The precision, a measure of the repeatability, of the measurements is checked in accordance with EPD's quality manuals. In 2011, 2304 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 -6.4% and 4.8%, which was again within the control limits of ±20% and ±10% for the gaseous pollutants and particulates (TSP and RSP) respectively.

In addition to the above operation, 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 Science Group installed in July 1997 additional monitoring facilities at 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 are analysed by the Government Laboratory.

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 (Sai Ying Pun Community Complex)	2 High Street, Sai Ying Pun	Urban : Mixed residential/ commercial	82m	16m (5 floors)	Oct 09
Eastern (Sai Wan Ho Fire Station)	20 Wai Hang Street, Sai Wan Ho	Urban : Residential	28m	15m (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	31m	25m (6 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	34.5m	27.5m (4 floors)	Apr 99
Yuen Long (Yuen Long District Branch Offices Bldg.)	269 Castle Peak Road Yuen Long	New Town : Residential	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 : Mixed commercial/ residential area surrounded by many tall buildings	6.5m	3m	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	Junction of Nathan Road and Lai Chi Kok Road	Urban Roadside : Mixed commercial/ residential area surrounded by many tall buildings	8.5m	3m	Jan 01

Note: P.D. = Principal Datum

Table B2: Summary of the Parameters Monitored in the Network (2011)

STATIONS	PARAMETERS										
	SO_2	NO_x	NO	NO_2	CO	O_3	FSP	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 43A, API 100E, TECO 43I
NO, NO_2, NO_x	Chemiluminescence	API 200A
O_3	UV absorption	API 400, API 400A
SO_2, NO_2, O_3	Differential Optical Absorption Spectroscopy	Opsis AR 500 System
CO	Non-dispersive infra-red absorption with gas filter correlation	TECO 48C, API 300
TSP	Gravimetric	General Metal Works GS2310
RSP (PM10)	a) Gravimetric b) Oscillating microbalance	Graseby Andersen PM10 R&P TEOM Series 1400a-AB-PM10 Thermo Scientific TEOM 1405-DF
FSP (PM2.5)	a) Gravimetric b) Oscillating microbalance	Thermo Scientific Partisol-Plus 2025 R&P TEOM Series 1400a-AB-PM2.5 Thermo Scientific TEOM 1405-DF

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

Toxic Air Pollutants	Sampling and Analysis method	Sampling Instrument	Sampling Media	Sampling Schedule	Sampling Period
Benzene	USEPA Method TO-14A	Xontech 910A / RM 910A	Canister	Twice per month	24 hours
Perchloro-ethylene	USEPA Method TO-14A	Xontech 910A / RM 910A	Canister	Twice per month	24 hours
1,3-Butadiene	USEPA Method TO-14A	Xontech 910A / RM 910A	Canister	Twice per month	24 hours
Formaldehyde	USEPA Method TO-11A	Xontech 925 / RM 925	DNPH coated silica gel cartridge	Once per month	24 hours
Benzo(a)pyrene	USEPA Method TO-13	Graseby GPS1 / Tisch TE-1000	Quartz fibre filter and polyurethane foam with XAD-2 resin	Once per month	24 hours
Dioxin	USEPA Method TO-9A	Graseby GPS1 / Tisch TE-1000	Quartz fibre filter and polyurethane foam	Once per month	24 hours
Hexavalent Chromium	CARB SOP MLD 039	Xontech 920	Bicarbonate Impregnated Filter	Once per month	24 hours

Figure B1: Accuracy of Air Quality Monitoring Network, 2011

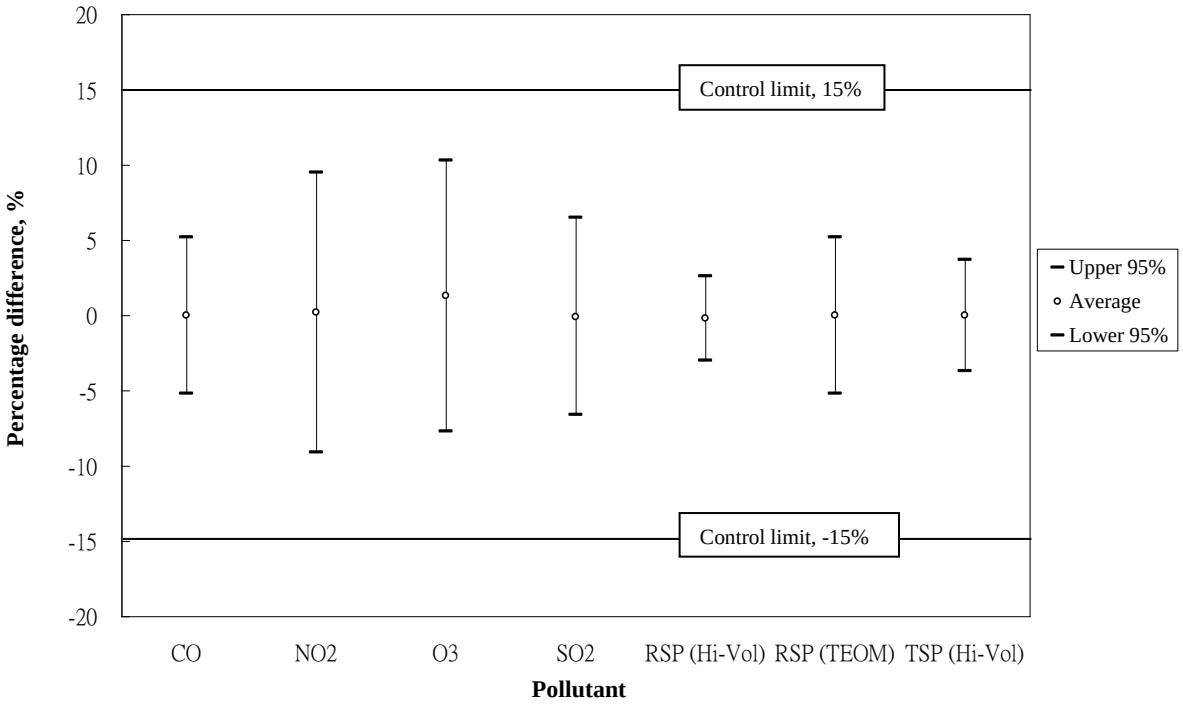
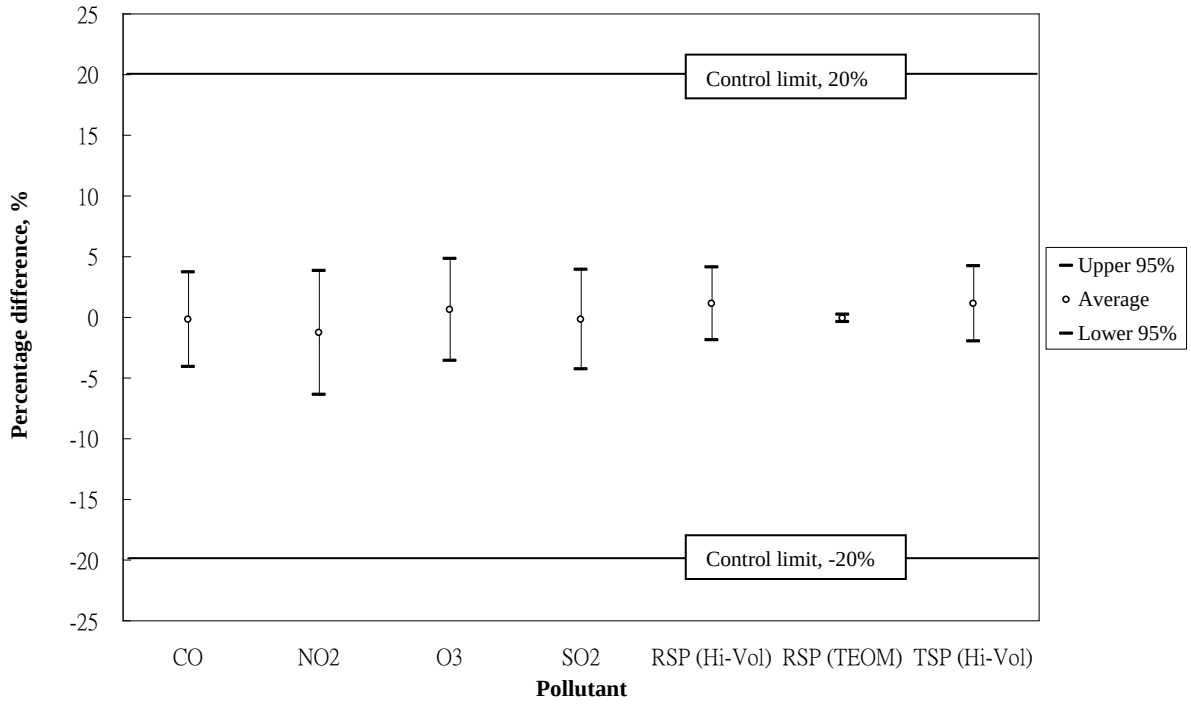


Figure B2: Precision of Air Quality Monitoring Network, 2011



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 2011

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

Station	1st High	2nd High	3rd High	4th High
Central / Western	188	169	151	140
Eastern	103	85	85	79
Kwai Chung	228	210	204	201
Kwun Tong	115	88	88	88
Sham Shui Po	261	198	183	176
Tsuen Wan	156	138	130	123
Sha Tin	88	86	84	83
Tai Po	46	44	43	39
Tung Chung	90	83	83	83
Yuen Long	92	80	79	71
Tap Mun	57	55	54	51
Causeway Bay	130	120	113	105
Central	143	127	127	124
Mong Kok	177	160	140	132

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

Station	1st High	2nd High	3rd High	4th High
Central / Western	244	232	227	227
Eastern	257	251	238	238
Kwai Chung	290	282	276	268
Kwun Tong	285	279	276	273
Sham Shui Po	296	293	291	287
Tsuen Wan	264	250	244	244
Sha Tin	232	219	202	200
Tai Po	215	195	195	182
Tung Chung	228	221	220	214
Yuen Long	257	252	251	237
Tap Mun	103	95	91	81
Causeway Bay	511	474	451	424
Central	431	425	394	383
Mong Kok	426	403	401	400

Pollutant: Nitrogen Oxides

Station	1st High	2nd High	3rd High	4th High
Central / Western	1045	957	911	850
Kwai Chung	1077	1048	983	983
Kwun Tong	798	782	715	712
Sham Shui Po	1050	903	898	858
Tsuen Wan	1227	996	918	901
Sha Tin	601	578	575	533
Tung Chung	498	489	473	470
Yuen Long	819	794	722	654
Tap Mun	211	129	125	122
Causeway Bay	1551	1455	1329	1324
Central	1502	1431	1416	1274
Mong Kok	1194	1192	1186	1174

Pollutant: Nitric Oxide

Station	1st High	2nd High	3rd High	4th High
Central / Western	540	517	478	432
Kwai Chung	591	590	566	540
Kwun Tong	378	368	363	344
Sham Shui Po	501	484	453	431
Tsuen Wan	697	551	511	491
Sha Tin	275	268	254	236
Tung Chung	227	225	222	213
Yuen Long	403	391	346	277
Tap Mun	76	52	36	34
Causeway Bay	780	712	638	621
Central	835	783	777	694
Mong Kok	620	608	595	589

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

Station	1st High	2nd High	3rd High	4th High
Tsuen Wan	2730	2410	2280	2150
Tung Chung	2290	2280	2250	2220
Yuen Long	3210	3110	3040	2780
Tap Mun	1490	1480	1480	1480
Causeway Bay	4030	3910	3790	3450
Central	3790	3340	2990	2880
Mong Kok	3110	2990	2410	2410

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

Station	1st High	2nd High	3rd High	4th High
Central / Western	278	255	254	248
Eastern	257	233	230	217
Kwai Chung	213	200	195	189
Kwun Tong	181	181	170	161
Sham Shui Po	240	238	233	228
Tsuen Wan	223	215	211	207
Sha Tin	241	220	214	208
Tai Po	260	230	216	213
Tung Chung	312	311	310	299
Yuen Long	310	299	284	279
Tap Mun	316	308	268	266
Causeway Bay	99	97	93	87
Central	157	141	132	128
Mong Kok	95	84	82	81

Pollutant: Respirable Suspended Particulates (PM10)

Station	1st High	2nd High	3rd High	4th High
Central / Western	186	184	182	180
Eastern	183	178	165	161
Kwai Chung	204	185	184	183
Kwun Tong	205	200	184	174
Sham Shui Po	213	213	209	207
Tsuen Wan	192	190	189	187
Sha Tin	181	160	160	152
Tai Po	197	189	187	185
Tung Chung	250	246	236	214
Yuen Long	222	219	212	208
Tap Mun	168	168	153	152
Causeway Bay	222	213	207	196
Central	221	218	214	211
Mong Kok	234	220	212	209

Pollutant: Fine Suspended Particulates (PM2.5)

Station	1st High	2nd High	3rd High	4th High
Central / Western	114	113	112	112
Eastern^	128	127	121	115
Kwai Chung	135	133	127	126
Kwun Tong	124	119	119	118
Sham Shui Po	99	97	94	92
Tsuen Wan^	128	124	121	118
Sha Tin	106	106	101	97
Tai Po	99	97	94	88
Tung Chung^	174	171	170	157
Yuen Long^	139	138	137	136
Tap Mun^	107	102	99	99
Causeway Bay	141	138	131	131
Central^	156	149	148	144
Mong Kok^	157	151	146	142

Only the 7 stations marked with ^ have full year PM2.5 data.

Notes:

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

TABLE C2: THE HIGHEST 2 DAILY POLLUTANT CONCENTRATIONS MEASURED IN 2011

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

Station	1st High	2nd High
Central / Western	128	126
Eastern	121	116
Kwai Chung	165	137
Kwun Tong	155	143
Sham Shui Po	155	151
Tsuen Wan	160	133
Sha Tin	115	100
Tai Po	99	91
Tung Chung	137	130
Yuen Long	157	113
Tap Mun	37	34
Causeway Bay	247	241
Central	252	222
Mong Kok	243	210

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

Station	1st High	2nd High
Central / Western	58	44
Eastern	41	30
Kwai Chung	85	75
Kwun Tong	42	37
Sham Shui Po	79	68
Tsuen Wan	62	56
Sha Tin	37	36
Tai Po	30	24
Tung Chung	52	47
Yuen Long	36	34
Tap Mun	40	35
Causeway Bay	35	32
Central	64	42
Mong Kok	60	57

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

Station	1st High	2nd High
Central / Western	120	113
Eastern	111	103
Kwai Chung	120	113
Kwun Tong	117	114
Sham Shui Po	119	113
Tsuen Wan	120	114
Sha Tin	121	109
Tai Po	119	112
Tung Chung	142	139
Yuen Long	173	131
Tap Mun	122	108
Causeway Bay	125	125
Central	135	127
Mong Kok	118	118

Pollutant: Nitrogen Oxides

Station	1st High	2nd High
Central / Western	308	306
Kwai Chung	605	413
Kwun Tong	277	277
Sham Shui Po	357	346
Tsuen Wan	528	426
Sha Tin	286	214
Tung Chung	294	250
Yuen Long	391	236
Tap Mun	49	43
Causeway Bay	838	748
Central	652	644
Mong Kok	860	664

Pollutant: Nitric Oxide

Station	1st High	2nd High
Central / Western	134	131
Kwai Chung	323	205
Kwun Tong	128	104
Sham Shui Po	146	143
Tsuen Wan	269	227
Sha Tin	112	77
Tung Chung	114	96
Yuen Long	153	97
Tap Mun	11	10
Causeway Bay	417	335
Central	315	303
Mong Kok	498	383

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

Station	1st High	2nd High
Tsuen Wan	2158	2089
Tung Chung	2188	2186
Yuen Long	2610	2584
Tap Mun	1459	1459
Causeway Bay	3309	3179
Central	2516	2516
Mong Kok	2400	2371

Pollutant: Ozone

Station	1st High	2nd High
Central / Western	128	119
Eastern	126	111
Kwai Chung	102	93
Kwun Tong	126	119
Sham Shui Po	106	90
Tsuen Wan	112	100
Sha Tin	157	125
Tai Po	153	126
Tung Chung	144	138
Yuen Long	131	108
Tap Mun	167	158
Causeway Bay	54	50
Central	69	67
Mong Kok	37	36

Pollutant: Fine Suspended Particulates (PM2.5)

Station	1st High	2nd High
Central / Western	88	76
Eastern^	75	72
Kwai Chung	88	83
Kwun Tong	83	83
Sham Shui Po	76	71
Tsuen Wan^	79	79
Sha Tin	84	77
Tai Po	74	74
Tung Chung^	96	96
Yuen Long^	109	84
Tap Mun^	80	75
Causeway Bay	92	90
Central^	94	85
Mong Kok^	86	84

Only the 7 stations marked with ^ have full year PM2.5 data

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

Station	1st High	2nd High
Central / Western	166	160
Kwai Chung	149	144
Kwun Tong	176	153
Sham Shui Po	158	156
Tsuen Wan	173	157
Sha Tin	161	126
Tai Po	139	127
Tung Chung	141	141
Yuen Long	196	183
Mong Kok	199	187

Notes:

1. All concentration units are in microgram 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: 2011 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	18	11	13	15	10	7	12	16	11	13	10	18	13
Eastern	9	5	9	10	7	5	8	12	7	7	8	13	8
Kwai Chung	16	16	21	33	22	28	33	34	11	7	13	19	21
Kwun Tong	14	11	14	15	11	8	9	14	9	10	11	18	12
Sham Shui Po	19	14	15	25	18	13	20	21	10	11	14	19	17
Tsuen Wan	19	21	19	16	14	15	17	19	10	10	12	22	16
Sha Tin	19	12	12	16	11	9	14	15	10	13	13	20	14
Tai Po	12	7	10	7	5	7	8	11	7	8	7	11	8
Tung Chung	22	12	15	11	10	5	9	11	12	13	14	22	13
Yuen Long	14	10	9	11	13	10	13	15	14	14	15	21	13
Tap Mun	13	7	11	7	7	5	7	9	9	11	14	23	10
Causeway Bay	15	6	7	7	8	8	11	14	9	10	9	16	10
Central	22	9	13	16	14	12	13	15	12	12	12	22	14
Mong Kok	15	9	11	15	12	8	10	19 *	8	9	10	16	12

Pollutant: Nitrogen Oxides

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	108	127	115	122	81	53	61	76	58	62	70	98	86
Kwai Chung	148	162	165	163	132	127	138	151	92	102	116	135	136
Kwun Tong	133	121	119	131	115	103	131	132	88	89	107	128	116
Sham Shui Po	133	151	145	152	118	96	104	114	96	105	112	121	120
Tsuen Wan	125	158	145	118	105	96	97	99	80	87	97	112	110
Sha Tin	83	87	70	81	50	55	66	85	47	65	66	85	70
Tung Chung	113	122	98	83	61	31	45	61	49	65	79	98	75
Yuen Long	109	120	103	99	90	79	81	96	70	79	91	102	93
Tap Mun	24	19	20	17	11	9	18	20	14	16	16	19	17
Causeway Bay	434	422	323	316	333	320	323	406	276	259	308	409	344
Central	413	352	354	362	335	292	296	357	253	248	283	368	326
Mong Kok	274	327	304	363	328	321	387	408 *	245	262	270	255	309

Pollutant: Nitric Oxide

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	25	36	28	32	18	19	19	21	11	11	15	20	21
Kwai Chung	46	56	56	53	45	52	55	58	26	26	33	37	45
Kwun Tong	40	35	32	36	35	38	48	46	23	21	30	35	35
Sham Shui Po	35	43	39	43	33	34	35	37	23	23	26	27	33
Tsuen Wan	32	51	45	28	28	32	31	31	19	18	23	26	30
Sha Tin	20	23	14	19	11	16	17	25	7	12	16	17	16
Tung Chung	27	35	21	17	11	8	11	16	8	10	14	18	16
Yuen Long	28	40	26	24	24	27	26	33	16	18	23	23	25
Tap Mun	3	3	2	2	2	2	4	6	4	4	2	2	3
Causeway Bay	183	178	130	130	142	142	143	184	110	95	121	165	144
Central	170	141	139	147	139	131	129	162	96	87	109	142	133
Mong Kok	102	126	111	139	135	150	187	184 *	93	92	99	90	123

Pollutant: Nitrogen Dioxide (Annual AQO = 80)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	70	72	72	73	53	23	32	43	42	46	46	68	54
Eastern	67	71	69	71	60	39	42	47	52	56	60	69	59
Kwai Chung	78	76	79	83	63	48	54	61	53	63	65	79	67
Kwun Tong	71	67	70	75	61	45	57	63	53	56	61	74	63
Sham Shui Po	79	86	85	85	68	45	51	57	61	70	72	80	70
Tsuen Wan	77	80	77	74	63	47	50	51	52	59	62	72	64
Sha Tin	53	53	49	51	33	31	40	47	36	46	42	59	45
Tai Po	51	50	53	52	44	33	34	40	42	46	42	54	45
Tung Chung	72	69	66	57	44	19	28	37	36	51	57	71	51
Yuen Long	66	60	64	63	53	38	42	46	45	52	56	67	54
Tap Mun	19	14	17	14	8	6	11	12	7	9	12	16	12
Causeway Bay	153	149	124	117	117	102	104	124	108	113	123	156	124
Central	153	137	142	136	123	91	98	110	107	115	116	151	123
Mong Kok	119	134	135	151	122	92	101	128 *	103	121	119	118	120

Pollutant: Carbon Monoxide

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tsuen Wan	973	754	735	405	462	312	257	471	489	582	549	1018	585
Tung Chung	1072	770	894	490	443	343	514	598	616	599	629	930	660
Yuen Long	1204	1013	844	639	625	358	358	454	473	623	724	850	677
Tap Mun	933	758	932	748	777	585	660	707	736	623	729	824	752
Causeway Bay	1746	1368	1418	1004	710	587	701	817	696	692	844	1420	1010
Central	1064	983	1010	814	788	683	693	729	608	686	818	976	820
Mong Kok	1290	1249	1170	1064	885	721	777	880 *	945	972	1099	1297	1034

Pollutant: Ozone

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	25	29	43	44	39	25	28	28	41	57	41	34	36
Eastern	37	45	57	61	52	34	32	35	47	57	50	45	46
Kwai Chung	24	26	34	34	28	13	13	15	35	41	39	37	28
Kwun Tong	31	42	50	50	35	16	15	17	44	55	47	42	37
Sham Shui Po	29	30	39	41	31	17	18	22	33	42	34	33	31
Tsuen Wan	25	26	40	40	32	14	17	20	36	43	38	34	31
Sha Tin	44	49	58	58	34	18	22	24	54	59	50	48	43
Tai Po	53	64	60	79	53	21	21	22	61	60	45	44	48
Tung Chung	29	33	50	57	49	36	38	37	53	58	50	38	44
Yuen Long	30	32	47	52	41	22	26	29	43	52	48	42	39
Tap Mun	62	75	81	86	75	44	48	47	77	91	83	79	71
Causeway Bay	11	12	12	11	9	8	12	10	19	26	20	11	13
Central	14	17	21	20	17	8	9	6	19	27	22	16	16
Mong Kok	11	10	15	12	10	4	4	8 *	14	16	14	16	11

Notes: 1. All units are in microgram 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.

TABLE C4: 2011 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	114	93	119	103	58	40	29	70	55	83	66	106	78
Kwai Chung	80	101	91	82	56	35	51	50	60	68	64	110	71
Kwun Tong	128	80	108	77	45	44	30	62	61	80	64	116	74
Sham Shui Po	124	87	107	103	63	45	34	65	61	86	64	110	79
Tsuen Wan	113	79	126	77	48	29	38	54	55	55	62	90	69
Sha Tin	97	69	104	73	63	35	28	34	57	72	58	102	66
Tai Po	117	69	99	75	52	22	41	41	56	64	68	106	69
Tung Chung	105	89	95	61	41	19	30	50	45	59	64	114	65
Yuen Long	155	94	134	81	64	27	41	48	70	79	83	138	86
Mong Kok	134	124	159	105	89	62	47	57	79	106	108	147	102

Pollutant: Respirable Suspended Particulates (Annual AQO = 55)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	72	61	70	62	40	22	23	32	44	50	48	76	50
Eastern	63	49	61	56	36	20	22	25	40	46	40	62	43
Kwai Chung	72	56	70	57	46	25	27	30	39	48	43	68	48
Kwun Tong	66	55	65	63	42	27	30	33	44	52	46	68	49
Sham Shui Po	69	57	68	66	44	26	30	35	48	53	45	66	51
Tsuen Wan	70	55	65	58	41	28	30	33	45	51	47	76	50
Sha Tin	68	50	68	57	37	23	25	29	42	47	43	68	47
Tai Po	70	49	62	58	40	23	27	28	42	48	39	58	46
Tung Chung	83	56	72	52	40	18	21	27	38	45	39	71	47
Yuen Long	88	59	75	62	44	25	26	31	46	56	55	84	54
Tap Mun	63	52	65	61	37	22	26	25	44	51	48	72	47
Causeway Bay	81	72	80	77	60	43	45	55	64	70	63	81	66
Central	82	67	80	77	59	38	39	48	56	61	55	81	62
Mong Kok	72	59	68	70	49	32	33	38	56	60	53	75	55

Pollutant: Fine Suspended Particulates (PM2.5)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central / Western	--	--	--	--	--	--	--	--	--	--	31	52	--
Eastern^	45	38	40	36	26	13	15	18	28	31	27	43	30
Kwai Chung	--	--	--	41	34	15	18	22	29	34	31	49	--
Kwun Tong	--	--	--	42	30	17	20	23	32	34	30	46	--
Sham Shui Po	--	--	--	--	--	--	--	--	33	34	30	46	--
Tsuen Wan^	48	42	46	40	30	18	21	23	33	35	32	50	35
Sha Tin	--	--	--	--	--	--	--	--	--	--	30	50	--
Tai Po	--	--	--	--	--	--	--	--	--	--	30	48	--
Tung Chung^	55	40	47	31	27	11	14	19	28	32	32	54	32
Yuen Long^	56	44	48	41	30	17	18	22	34	36	38	53	36
Tap Mun^	46	37	40	38	27	12	17	18	28	31	30	48	31
Causeway Bay	--	--	54	52	43	31	32	38	47	44	44	56	--
Central^	54	46	51	49	39	20	25	28	33	35	33	51	39
Mong Kok^	47	40	46	45	34	21	22	27	37	39	34	50	37

Only the 7 stations marked with ^ have full year PM2.5 data.

Notes:

1. All units are in microgram per cubic metre.
2. Shaded annual averages are above their respective AQO.
3. Annual averages are not calculated for lack of representativeness if the minimum data requirement of 66% for one or more quarters of the year is not satisfied.

TABLE C5: 2011 HOURLY STATISTICS OF GASEOUS POLLUTANTS

Pollutant: Sulphur Dioxide

Station	No. of hours	Data capture rate %	<----------Percentiles---------->								Arithmetic mean	Highest 1 hour	Highest 24 hour
			10	25	50	75	90	95	98	99			
Central / Western	8600	98.2	4	6	9	15	25	34	47	58	13	188	58
Eastern	8658	98.8	2	4	7	10	17	23	31	40	8	103	41
Kwai Chung	8620	98.4	4	7	11	26	55	71	95	113	21	228	85
Kwun Tong	8617	98.4	6	7	10	14	19	25	35	44	12	115	42
Sham Shui Po	8575	97.9	6	8	12	18	30	48	75	99	17	261	79
Tsuen Wan	8576	97.9	5	7	12	20	34	43	55	66	16	156	62
Sha Tin	8543	97.5	5	8	12	17	24	31	39	47	14	88	37
Tai Po	8310	94.9	3	5	7	10	15	19	24	28	8	46	30
Tung Chung	8541	97.5	4	7	10	16	25	32	42	48	13	90	52
Yuen Long	8584	98.0	5	7	11	17	24	30	39	45	13	92	36
Tap Mun	8445	96.4	4	6	8	13	19	24	31	35	10	57	40
Causeway Bay	8523	97.3	3	5	8	12	20	26	36	46	10	130	35
Central	8546	97.6	6	8	11	17	28	37	48	56	14	143	64
Mong Kok	8347	95.3	3	5	8	13	22	32	57	72	12	177	60

Pollutant: Nitrogen Oxides

Station	No. of hours	Data capture rate %	<----------Percentiles---------->								Arithmetic mean	Highest 1 hour	Highest 24 hour
			10	25	50	75	90	95	98	99			
Central / Western	8533	97.4	23	41	67	106	161	217	310	388	86	1045	308
Kwai Chung	8618	98.4	46	78	118	169	237	303	391	476	136	1077	605
Kwun Tong	8628	98.5	41	69	102	147	204	249	311	366	116	798	277
Sham Shui Po	8630	98.5	44	74	109	147	194	239	338	438	120	1050	357
Tsuen Wan	8575	97.9	40	70	96	130	182	236	315	380	110	1227	528
Sha Tin	8552	97.6	22	33	52	83	138	196	261	301	70	601	286
Tung Chung	8451	96.5	19	34	60	102	154	192	234	262	75	498	294
Yuen Long	8592	98.1	40	56	79	111	160	205	268	328	93	819	391
Tap Mun	8449	96.4	7	10	15	21	28	34	46	55	17	211	49
Causeway Bay	8591	98.1	142	207	299	451	602	693	831	931	344	1551	838
Central	8542	97.5	114	183	294	431	583	689	811	906	326	1502	652
Mong Kok	8258	94.3	121	193	306	394	491	568	674	761	309	1194	860

Pollutant: Nitric Oxide

Station	No. of hours	Data capture rate %	<----------Percentiles---------->								Arithmetic mean	Highest 1 hour	Highest 24 hour
			10	25	50	75	90	95	98	99			
Central / Western	8533	97.4	1	4	10	23	50	77	129	173	21	540	134
Kwai Chung	8618	98.4	6	15	33	60	94	128	173	218	45	591	323
Kwun Tong	8628	98.5	5	13	25	46	77	101	135	161	35	378	128
Sham Shui Po	8630	98.5	4	13	25	41	64	89	145	194	33	501	146
Tsuen Wan	8575	97.9	5	11	21	37	60	85	130	171	30	697	269
Sha Tin	8552	97.6	1	3	6	18	44	70	105	127	16	275	112
Tung Chung	8451	96.5	3	4	8	19	42	60	85	100	16	227	114
Yuen Long	8592	98.1	5	9	17	31	54	76	113	141	25	403	153
Tap Mun	8449	96.4	1	2	2	4	6	7	8	12	3	76	11
Causeway Bay	8591	98.1	45	71	120	197	271	324	394	441	144	780	417
Central	8542	97.5	30	60	111	184	261	320	384	437	133	835	315
Mong Kok	8258	94.3	34	67	115	163	215	263	342	400	123	620	498

Pollutant: Nitrogen Dioxide

Station	No. of hours	Data capture rate %	<----------Percentiles---------->								Arithmetic mean	Highest 1 hour	Highest 24 hour
			10	25	50	75	90	95	98	99			
Central / Western	8533	97.4	16	28	49	71	98	119	143	160	54	244	128
Eastern	8659	98.8	28	39	55	74	91	104	126	144	59	257	121
Kwai Chung	8618	98.4	31	43	60	82	112	136	159	173	67	290	165
Kwun Tong	8628	98.5	29	41	59	78	99	115	142	165	63	285	155
Sham Shui Po	8630	98.5	32	44	64	90	115	132	152	168	70	296	155
Tsuen Wan	8575	97.9	30	43	58	78	105	124	146	162	64	264	160
Sha Tin	8552	97.6	18	27	39	55	80	102	127	139	45	232	115
Tai Po	8310	94.9	19	28	40	57	77	91	109	122	45	215	99
Tung Chung	8451	96.5	13	25	44	69	97	117	139	157	51	228	137
Yuen Long	8592	98.1	27	35	49	67	89	107	131	145	54	257	157
Tap Mun	8449	96.4	3	6	11	16	22	27	35	41	12	103	37
Causeway Bay	8591	98.1	60	85	118	155	195	223	261	297	124	511	247
Central	8542	97.5	58	81	115	157	199	227	259	285	123	431	252
Mong Kok	8258	94.3	55	82	114	153	190	211	240	265	120	426	243

Pollutant: Carbon Monoxide

Station	No. of hours	Data capture rate %	<----------Percentiles---------->								Arithmetic mean	Highest 1 hour	Highest 8 hour
			10	25	50	75	90	95	98	99			
Tsuen Wan	8573	97.9	230	350	530	770	1050	1180	1310	1380	585	2730	2158
Tung Chung	8538	97.5	350	440	610	830	1070	1230	1380	1490	660	2290	2188
Yuen Long	8575	97.9	280	410	630	850	1140	1330	1520	1700	677	3210	2610
Tap Mun	8478	96.8	470	580	740	910	1050	1150	1250	1310	752	1490	1459
Causeway Bay	8313	94.9	410	600	920	1350	1730	1960	2300	2530	1010	4030	3309
Central	8352	95.3	380	550	780	1030	1300	1490	1640	1840	820	3790	2516
Mong Kok	8334	95.1	640	800	1030	1270	1430	1560	1730	1840	1034	3110	2400

Pollutant: Ozone

Station	No. of hours	Data capture rate %	<----------Percentiles---------->								Arithmetic mean	Highest 1 hour	Highest 24 hour
			10	25	50	75	90	95	98	99			
Central / Western	8551	97.6	5	14	28	51	79	98	117	135	36	278	128
Eastern	8659	98.8	17	25	39	62	84	97	114	128	46	257	126
Kwai Chung	8612	98.3	4	8	20	42	64	80	96	107	28	213	102
Kwun Tong	8561	97.7	6	13	30	55	79	93	109	122	37	181	126
Sham Shui Po	8578	97.9	6	11	24	43	65	81	101	116	31	240	106
Tsuen Wan	8564	97.8	4	9	22	44	69	85	107	120	31	223	112
Sha Tin	8501	97.0	4	11	33	66	100	116	138	153	43	241	157
Tai Po	8310	94.9	5	18	40	72	104	120	140	152	48	260	153
Tung Chung	8521	97.3	5	15	34	60	94	116	151	200	44	312	144
Yuen Long	8565	97.8	4	11	28	54	90	111	143	173	39	310	131
Tap Mun	8465	96.6	24	40	62	96	128	145	165	182	71	316	167
Causeway Bay	8540	97.5	3	6	10	17	29	38	49	59	13	99	54
Central	8475	96.7	3	5	9	21	40	55	74	88	16	157	69
Mong Kok	8152	93.1	2	3	7	15	26	35	45	52	11	95	37

Notes: 1. All concentration units are in microgram per cubic metre.

TABLE C6: 2011 HOURLY STATISTICS OF PARTICULATE POLLUTANTS

Pollutant: Respirable Suspended Particulates (Continuous monitoring)

Station	No. of hours	Data capture rate %	<----------Percentiles---------->								Arithmetic mean	Highest 1 hour	Highest 24 hour
			10	25	50	75	90	95	98	99			
Central / Western	8540	97.5	15	25	47	69	91	104	120	130	50	186	120
Eastern	8672	99.0	13	21	41	59	78	91	105	112	43	183	111
Kwai Chung	8616	98.4	16	26	45	64	86	98	115	131	48	204	120
Kwun Tong	8612	98.3	18	28	46	65	85	98	111	123	49	205	117
Sham Shui Po	8624	98.4	19	29	48	67	87	99	112	124	51	213	119
Tsuen Wan	8551	97.6	18	28	46	66	88	103	120	133	50	192	120
Sha Tin	8632	98.5	16	24	44	64	84	95	109	117	47	181	121
Tai Po	8490	96.9	15	24	43	62	80	92	105	117	46	197	119
Tung Chung	8404	95.9	12	20	42	64	91	110	130	145	47	250	142
Yuen Long	8595	98.1	17	26	51	74	99	113	133	149	54	222	173
Tap Mun	8511	97.2	14	23	44	65	85	98	111	116	47	168	122
Causeway Bay	8463	96.6	31	46	63	83	103	116	130	141	66	222	125
Central	8359	95.4	26	38	58	79	103	117	135	144	62	221	135
Mong Kok	8421	96.1	22	33	52	73	94	107	122	134	55	234	118

Pollutant: Fine Suspended Particulates (PM2.5) (Continuous monitoring)

Station	No. of hours	Data capture rate %	<----------Percentiles---------->								Arithmetic mean	Highest 1 hour	Highest 24 hour
			10	25	50	75	90	95	98	99			
Central / Western	1444	16.5	17	25	38	55	74	83	90	96	41	114	88
Eastern^	8667	98.9	8	14	28	42	55	64	74	80	30	128	75
Kwai Chung	6526	74.5	9	15	27	42	56	68	79	87	30	135	88
Kwun Tong	6533	74.6	10	15	27	42	56	65	78	84	31	124	83
Sham Shui Po	2864	32.7	15	23	35	47	58	67	76	81	36	99	76
Tsuen Wan^	8448	96.4	12	19	33	47	61	72	82	89	35	128	79
Sha Tin	1436	16.4	15	25	38	53	72	78	84	88	40	106	84
Tai Po	1367	15.6	16	26	39	53	68	73	79	81	40	99	74
Tung Chung^	8477	96.8	7	13	29	45	64	76	90	100	32	174	96
Yuen Long^	8499	97.0	11	18	35	50	65	75	86	97	36	139	109
Tap Mun^	8222	93.9	7	15	29	44	57	66	76	81	31	107	80
Causeway Bay	7084	80.9	20	30	42	56	70	78	88	97	44	141	92
Central^	8446	96.4	13	22	36	52	68	78	89	98	39	156	94
Mong Kok^	8548	97.6	13	21	35	50	65	74	84	92	37	157	86

Only the 7 stations marked with ^ have full year PM2.5 data.

Notes: 1. All concentration units are in microgram per cubic metre.

TABLE C7: 2011 DIURNAL VARIATIONS OF GASEOUS POLLUTANTS

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	11	11	11	12	12	12	12	14	15	14	14	14	13	13	13	13	13	13	13	13	14	13	13	12
Eastern	7	7	8	8	8	8	8	10	9	9	9	9	9	8	8	8	8	8	8	9	11	9	8	8
Kwai Chung	20	18	17	19	17	17	17	17	19	19	20	23	24	23	24	25	27	28	27	25	23	21	20	20
Kwun Tong	11	11	11	13	12	12	12	12	13	13	13	12	12	12	12	12	12	12	12	12	12	12	12	11
Sham Shui Po	17	16	16	18	16	16	16	16	16	16	16	16	15	15	16	16	17	17	18	19	19	18	17	16
Tsuen Wan	13	13	13	14	13	13	13	13	16	18	18	19	19	19	20	19	20	20	19	18	16	15	14	14
Sha Tin	12	12	12	14	13	12	12	13	14	15	15	14	14	14	14	14	15	16	16	15	14	14	13	13
Tai Po	8	7	7	8	8	8	8	8	9	10	9	9	9	9	8	9	9	9	9	9	8	8	8	8
Tung Chung	11	11	10	13	11	11	11	12	15	16	16	16	16	16	16	15	15	14	12	12	12	12	11	11
Yuen Long	12	12	11	15	12	12	12	13	13	14	14	14	13	13	14	14	15	15	15	14	14	13	13	13
Tap Mun	9	9	9	11	10	10	10	11	12	13	13	13	12	11	11	11	10	10	9	9	9	8	8	8
Causeway Bay	9	9	10	10	9	10	10	11	13	13	12	11	11	11	11	10	10	10	9	9	10	9	9	9
Central	12	13	12	14	13	13	14	16	18	17	16	15	14	14	14	15	15	15	15	16	15	15	14	13
Mong Kok	10	11	10	11	11	11	11	11	12	12	12	12	11	11	12	12	12	12	13	13	13	13	11	11

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	80	60	51	45	43	42	55	91	117	118	110	98	84	85	88	92	96	103	105	106	103	99	96	92
Kwai Chung	124	90	76	70	67	74	115	151	186	175	150	143	139	135	146	153	163	169	182	177	157	142	141	139
Kwun Tong	107	73	59	54	52	62	109	150	166	162	139	126	113	113	124	127	137	148	151	143	126	118	119	117
Sham Shui Po	112	82	70	66	63	65	103	134	155	147	130	122	116	118	123	130	139	150	162	157	146	138	134	127
Tsuen Wan	99	69	59	49	48	53	86	117	143	140	131	122	116	115	117	119	130	141	151	145	128	121	119	115
Sha Tin	87	71	58	50	48	52	70	91	87	72	64	56	51	48	49	53	60	73	85	91	90	91	92	91
Tung Chung	82	62	52	46	45	52	75	88	86	78	79	77	77	74	73	71	73	80	92	94	91	88	87	87
Yuen Long	101	86	75	63	59	62	88	115	107	91	83	77	75	76	79	86	96	107	119	122	118	116	114	112
Tap Mun	17	16	16	16	16	16	17	18	20	21	23	20	18	16	15	15	15	16	16	16	16	16	15	16
Causeway Bay	294	238	216	181	171	168	246	388	447	457	421	389	376	376	373	382	380	394	414	410	401	391	389	357
Central	269	208	175	150	154	147	214	341	472	475	416	373	340	339	352	372	387	415	446	414	375	350	329	316
Mong Kok	282	194	173	145	137	136	218	308	352	358	330	324	331	355	367	379	393	424	425	389	347	349	361	340

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	20	14	11	9	9	9	13	27	39	39	34	28	21	20	20	20	19	21	21	22	23	24	24	23
Kwai Chung	42	28	22	20	19	22	41	58	76	69	54	49	45	40	43	44	48	51	59	59	52	46	47	48
Kwun Tong	31	19	14	13	12	16	35	55	63	61	49	42	34	32	35	34	38	41	42	40	35	33	34	35
Sham Shui Po	30	21	17	16	15	16	30	44	54	50	42	36	32	31	31	32	34	36	41	41	38	36	36	34
Tsuen Wan	27	16	13	10	9	11	24	38	51	49	44	38	33	30	29	28	31	34	39	39	34	32	32	32
Sha Tin	25	19	14	11	10	12	19	29	26	19	16	12	10	8	8	8	9	11	16	19	21	23	24	25
Tung Chung	21	13	10	8	8	11	21	27	25	20	20	18	16	14	12	11	11	12	17	18	19	19	20	22
Yuen Long	31	25	21	17	15	16	29	41	36	28	24	20	18	17	16	18	20	22	28	31	32	33	34	35
Tap Mun	3	3	3	3	3	3	3	4	4	5	5	4	3	3	3	3	3	3	3	2	3	2	2	3
Causeway Bay	126	103	93	76	71	69	102	170	200	204	184	165	156	152	147	149	145	154	165	166	168	165	163	152
Central	110	82	65	55	57	53	85	148	215	212	179	154	133	130	133	140	148	164	181	170	156	146	136	132
Mong Kok	115	78	69	55	51	50	87	132	154	154	137	130	127	136	140	145	151	166	169	155	137	139	147	141

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	50	39	34	31	29	28	36	50	57	59	57	56	52	55	58	62	67	72	74	71	68	63	60	56
Eastern	56	46	39	35	33	36	49	62	64	63	60	59	57	59	62	66	72	75	75	73	72	68	63	61
Kwai Chung	59	48	42	39	38	40	52	62	69	69	67	68	71	74	81	85	89	90	92	86	78	71	69	66
Kwun Tong	59	44	38	35	34	38	55	65	69	68	64	62	61	65	71	74	79	85	86	82	73	68	67	64
Sham Shui Po	66	50	44	41	39	40	57	67	72	71	67	67	68	72	76	81	87	94	99	94	87	82	79	75
Tsuen Wan	59	45	39	34	34	36	50	60	65	65	64	65	66	69	73	76	83	88	91	85	76	71	70	66
Sha Tin	49	42	37	33	32	34	42	48	47	43	40	38	36	35	37	41	47	56	61	62	59	57	55	52
Tai Po	47	40	34	31	30	33	42	51	50	44	38	34	32	34	36	40	49	58	66	67	60	56	56	53
Tung Chung	50	42	37	34	33	36	43	47	48	47	49	50	52	53	54	54	56	62	67	66	62	59	56	54
Yuen Long	54	48	43	37	36	37	44	52	52	49	47	46	47	49	54	59	65	73	77	75	70	66	62	59
Tap Mun	12	12	12	12	12	12	12	13	14	14	15	13	12	11	10	11	11	12	12	12	13	12	12	12
Causeway Bay	102	81	74	65	63	63	90	128	141	146	140	136	138	144	148	154	158	158	161	155	144	139	140	125
Central	101	83	75	66	68	65	85	115	143	151	142	139	137	140	148	158	161	164	170	155	136	127	121	114
Mong Kok	106	75	68	61	59	60	84	107	116	122	120	126	137	147	153	158	163	171	166	151	137	137	136	126

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	555	509	487	462	462	488	555	603	637	621	616	587	567	570	572	576	598	619	666	687	675	657	647	611
Tung Chung	641	629	620	611	621	628	642	663	677	675	679	675	682	687	682	668	660	666	675	682	678	674	663	653
Yuen Long	704	657	629	598	586	595	642	706	705	668	651	631	618	635	636	646	665	689	739	775	778	772	762	734
Tap Mun	744	740	739	739	734	741	755	763	763	766	765	763	759	759	750	748	752	753	751	753	755	755	752	748
Causeway Bay	1084	1248	1227	1110	1040	949	802	786	880	927	1018	1042	1032	1011	975	979	928	928	978	1050	1122	1116	1024	1016
Central	813	756	651	602	563	596	584	710	847	933	1001	904	836	939	893	875	833	865	932	944	962	958	853	839
Mong Kok	1048	1121	1059	954	927	909	860	875	940	1005	1002	981	977	1054	1086	1096	1103	1123	1180	1186	1154	1103	1049	1019

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	31	39	42	43	43	42	34	23	21	23	29	38	48	52	53	52	46	38	32	30	29	29	29	30
Eastern	41	45	47	48	48	45	36	29	30	35	42	50	58	63	62	61	56	50	47	45	41	41	41	40
Kwai Chung	27	34	35	35	35	32	24	18	16	20	26	32	36	39	38	36	32	27	22	21	23	24	24	25
Kwun Tong	34	40	43	43	43	38	27	22	22	26	34	42	49	53	51	49	44	36	32	31	33	34	32	32
Sham Shui Po	25	35	37	38	38	36	24	18	18	23	30	37	43	47	47	44	38	30	21	21	22	23	22	23
Tsuen Wan	25	34	36	38	37	34	23	18	19	23	29	36	43	46	47	45	39	31	23	21	23	24	22	22
Sha Tin	33	36	37	37	36	33	27	24	28	36	46	57	66	72	74	71	64	52	42	37	35	33	32	32
Tai Po	37	39	40	40	39	36	31	28	33	43	53	64	73	78	79	77	69	59	47	42	41	40	38	36
Tung Chung	34	38	40	40	39	34	27	25	28	34	40	49	58	70	77	78	72	58	44	37	36	35	34	34
Yuen Long	26	29	30	32	32	29	23	20	23	32	43	56	68	75	76	72	60	46	34	28	27	26	26	25
Tap Mun	59	57	55	52	51	49	48	50	54	60	68	80	90	97	101	102	99	94	87	79	73	69	65	61
Causeway Bay	12	14	15	18	18	19	14	9	8	9	10	12	14	15	15	15	15	14	13	13	12	12	11	11
Central	17	22	25	27	26	25	18	11	9	9	11	14	18	18	18	17	15	13	12	11	12	13	14	15
Mong Kok	9	13	15	18	19	19	11	6	6	8	10	13	14	15	15	13	11	8	7	7	8	7	7	6

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

TABLE C8: 2011 DIURNAL VARIATIONS OF PARTICULATE POLLUTANTS

Pollutant: Respirable Suspended Particulates (Continuous Monitoring)

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	44	44	43	43	44	44	47	51	53	54	54	51	52	55	56	57	57	55	54	53	52	49	47
Eastern	40	39	39	39	39	40	41	42	44	44	45	46	45	45	47	47	47	47	47	47	46	44	42	41
Kwai Chung	45	43	42	42	41	42	42	44	47	49	49	49	50	51	53	54	55	55	55	54	52	50	48	46
Kwun Tong	44	42	42	41	42	43	44	47	50	52	52	52	51	54	55	55	56	56	55	54	51	49	46	45
Sham Shui Po	46	44	43	43	44	44	46	50	51	51	51	51	51	53	55	55	56	58	57	57	56	53	50	47
Tsuen Wan	44	42	42	41	41	42	44	46	50	51	51	51	51	54	56	58	60	60	59	58	55	51	48	46
Sha Tin	44	43	42	42	42	43	44	46	46	46	47	47	47	47	47	49	50	52	52	51	50	48	46	45
Tai Po	43	41	41	41	41	42	43	46	46	47	47	47	46	46	47	48	49	50	50	50	49	46	45	44
Tung Chung	43	42	42	41	41	41	42	42	43	46	47	48	51	54	56	56	56	54	52	50	48	47	45	44
Yuen Long	49	47	46	46	46	47	49	52	54	55	55	56	57	58	59	61	62	62	62	60	59	56	53	51
Tap Mun	43	43	43	44	44	45	47	47	47	48	48	50	49	50	50	51	51	51	49	48	46	45	44	44
Causeway Bay	57	49	47	46	46	48	54	61	65	70	67	68	69	74	75	76	78	80	83	84	80	73	68	64
Central	53	52	50	50	50	52	56	61	69	70	66	64	60	62	66	68	69	71	69	69	67	65	60	56
Mong Kok	47	44	43	42	43	45	48	52	56	57	58	57	55	60	62	63	65	66	66	69	66	60	55	51

Pollutant: Fine Suspended Particulates (PM2.5) (Continuous Monitoring)

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	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eastern^	27	27	27	27	27	28	29	30	31	31	31	31	31	31	32	32	32	32	32	33	32	31	29	28
Kwai Chung	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Kwun Tong	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sham Shui Po	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tsuen Wan^	31	30	29	29	30	30	32	36	39	38	37	36	35	36	39	39	38	37	37	39	39	37	34	32
Sha Tin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tai Po	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tung Chung^	30	29	29	29	29	29	30	30	31	32	32	32	34	36	37	39	38	37	36	35	34	33	32	31
Yuen Long^	34	33	32	32	33	33	34	35	35	34	34	34	35	37	39	40	41	42	42	41	41	39	37	35
Tap Mun^	28	28	28	29	30	31	32	34	35	36	35	34	33	32	33	34	33	32	30	30	30	29	28	28
Causeway Bay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Central^	33	32	31	31	32	34	36	39	44	43	39	38	36	37	40	42	44	45	45	46	45	42	38	35
Mong Kok^	31	30	29	29	30	32	34	36	37	36	33	32	34	38	40	43	44	46	47	49	46	42	37	34

Only the 7 stations marked with ^ have full year PM2.5 data.

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

TABLE C9: 2011 TOTAL WET AND DRY DEPOSITION

(a) WET DEPOSITION

	Monitoring Station	Central / Western	Kwun Tong	Yuen Long
	WET DEPOSITION (TON/HA)	2971	16366	14870
	WEIGHTED MEAN pH (based on volume-weighted mean hydrogen ion concentrations ($[H^+]$)	4.64	4.64	4.51
	WEIGHTED MEAN pH (based on volume-weighted mean pH)	5.13	5.08	4.82
	NO. OF SAMPLES	28	87	83
Filtrate (Kg/Ha)	NH_4^+	1.20	6.02	6.21
	NO_3^-	3.67	20.52	20.91
	$SO_4^=$	5.38	23.60	24.23
	Cl^-	7.97	20.62	11.64
	F-	0.08	0.42	0.39
	Na^+	4.40	11.62	7.05
	K^+	0.77	4.10	3.69
	Formate	0.63	3.52	3.24
	Acetate	0.58	2.96	2.73
	Ca^{++}	1.05	3.82	2.56
	Mg^{++}	0.55	1.50	0.93

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

(b) DRY DEPOSITION

	Monitoring Station	Central / Western	Kwun Tong	Yuen Long
	NO. OF SAMPLES	13	26	26
Filtrate (Kg/Ha)	NH_4^+	0.25	0.46	0.39
	NO_3^-	5.70	13.49	10.00
	$SO_4^=$	5.42	8.12	6.34
	Cl^-	6.95	9.12	3.71
	F-	0.070	0.137	0.164
	Na^+	3.90	5.73	2.32
	K^+	0.39	0.60	0.58
	Formate	0.15	0.16	0.18
	Acetate	0.13	0.16	0.16
	Ca^{++}	4.47	7.38	6.45
	Mg^{++}	0.53	0.85	0.49

TABLE C10: 2011 AMBIENT LEVELS OF TOXIC AIR POLLUTANTS

Toxic Air Pollutants	Concentration Unit	Annual Averages [1]	
		Tsuen Wan	Central/Western
Heavy Metals			
Hexavalent chromium	ng/m^3	0.10	0.10
Lead [2]	ng/m^3	47	49
Organic Substances			
Benzene	$\mu g/m^3$	1.62	1.53
Benzo[a]pyrene	ng/m^3	0.22	0.22
1,3-Butadiene	$\mu g/m^3$	0.13	0.13
Formaldehyde [4]	$\mu g/m^3$	-	3.61
Perchloroethylene	$\mu g/m^3$	0.47	0.51
Dioxins [3]	$pgI\text{-}TEQ/m^3$	0.069	0.049

Notes:

[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 lead the reported figures are the respective 2011 annual average concentrations in the elemental analysis of total suspended particulates.

[3] The ambient level of dioxins is expressed here as toxic equivalent (I-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).

[4] The measurement of formaldehyde was affected by influence from renovation works at Princess Alexandra Community Centre as well as nearby buildings of Tsuen Wan Station. Hence, only formaldehyde concentration at the Central/Western station is reported in 2011.

Appendix D

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

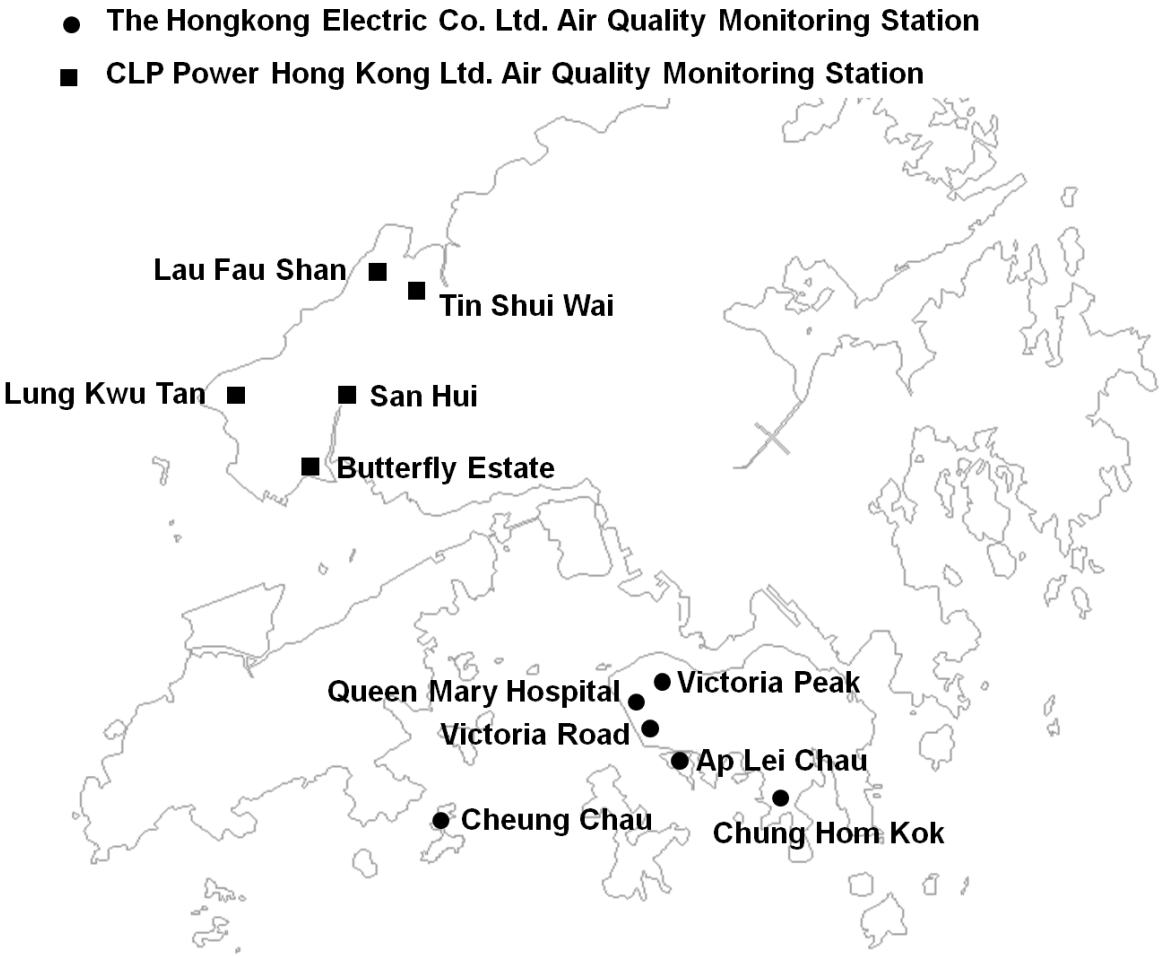


Figure D Location of HEC's & CLP's Air Quality Monitoring Stations for Sulphur Dioxide and Nitrogen Dioxide

D.1 The Hongkong Electric Co. Ltd. (HEC)

Air Quality Monitoring Stations	Annual Mean Concentration [1]	Range of Monthly Mean Concentration [1]
Sulphur Dioxide (SO_2) [2]		
Victoria Peak	8	4 - 15
Chung Hom Kok	7	0 - 16
Victoria Road	10	2 - 21
Queen Mary Hospital	10	5 - 16
Ap Lei Chau	12	7 - 17
Cheung Chau [4]	-- [5]	0 - 16
Nitrogen Dioxide (NO_2) [2]		
Victoria Peak	35	17 - 58
Chung Hom Kok	20	16 - 30
Victoria Road	38	13 - 60
Queen Mary Hospital	30	5 - 53
Ap Lei Chau	28	11 - 49
Cheung Chau [4]	-- [5]	3 - 42

D.2 CLP Power Hong Kong Ltd. (CLP)

Air Quality Monitoring Station	Annual Mean Concentration [1]	Range of Monthly Mean Concentration [1]
Sulphur Dioxide (SO_2) [2]		
San Hui	17	6 - 30
Tin Shui Wai	7	2 - 13
Butterfly Estate	6	2 - 16
Lung Kwu Tan	12	5 - 19
Lau Fau Shan	11	6 - 18
Nitrogen Dioxide (NO_2)		
San Hui [3]	72	47 - 87
Tin Shui Wai	39	22 - 57
Butterfly Estate	41	24 - 61
Lung Kwu Tan	30	15 - 49
Lau Fau Shan	36	24 - 48

Notes:

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

[2] There was no exceedance of AQO limit for the pollutants in 2011.

[3] Both 1-hr and 24-hr AQO limits for NO_2 have been exceeded for one time at San Hui.

[4] Cheung Chau Station resumed operation from June 2011 due to relocation in 2010.

[5] There was no sufficient data for calculation of a representative annual average.