AIR QUALITY
IN HONG KONG 2016

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) (2016)

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Security Classification	:	Unrestricted

Summary

This report summarises the 2016 air quality monitoring data collected by the Environmental Protection Department's monitoring network comprising 13 general stations and 3 roadside stations, with the new Tseung Kwan O General Air Quality Monitoring Station commenced its operation on 16 March 2016.

Air quality in Hong Kong has been showing steady signs of improvement for most pollutants over the past decade. As a result of the wide range of vehicle emission control measures implemented by the Government since 2000, concentrations of respirable suspended particulates (RSP), fine suspended particulates (FSP) and sulphur dioxide (SO_2) at roadside have been reduced substantially. Although roadside nitrogen dioxide (NO_2) concentrations remained high in the period, it has dropped progressively from its peak in 2011. Additional control measures targeting motor vehicles are being introduced to further reduce its concentration.

With the concerted efforts by 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 NO_2, SO_2, RSP and FSP have also been reduced in recent years. Regarding the levels of ambient ozone, they have been on the rise over the years but some initial signs of flattening are observed in last two years. The two governments will continue to implement measures to alleviate photochemical smog and ozone problems in the PRD Region.

As in previous years, concentrations of carbon monoxide and lead in 2016 remained at levels well below their respective Air Quality Objectives limits.

C O N T E N T S

List of Tables

List of Figures

1. Introduction

In 2016, the Environmental Protection Department (EPD) operates a network of 16 air quality monitoring stations for measuring concentrations of major air pollutants. It consists of thirteen general stations for monitoring ambient air quality and three roadside stations for monitoring roadside 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 Central/Western and Tsuen Wan monitoring stations since 1997.

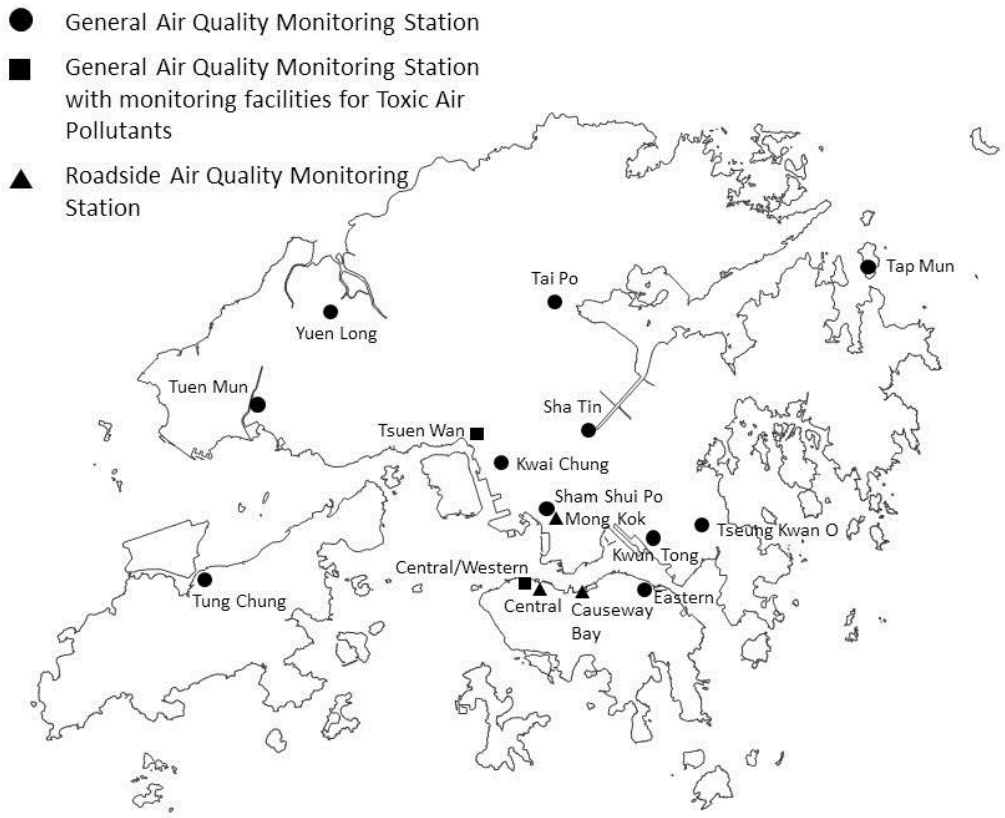


Figure 1: Location of EPD's Air Quality Monitoring Stations (2016)

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 can be found at the power companies web sites at the following links:

HEC:
https://www.hkelectric.com/en/corporate-social-responsibility/caring-for-our-environment/how-we-care-for-our-environment/air-quality-monitoring-statistics-annual-summary

CLP:
https://www.clp.com.hk/en/about-clp/power-generation/cleaner-generation/air-quality-monitoring-statistics

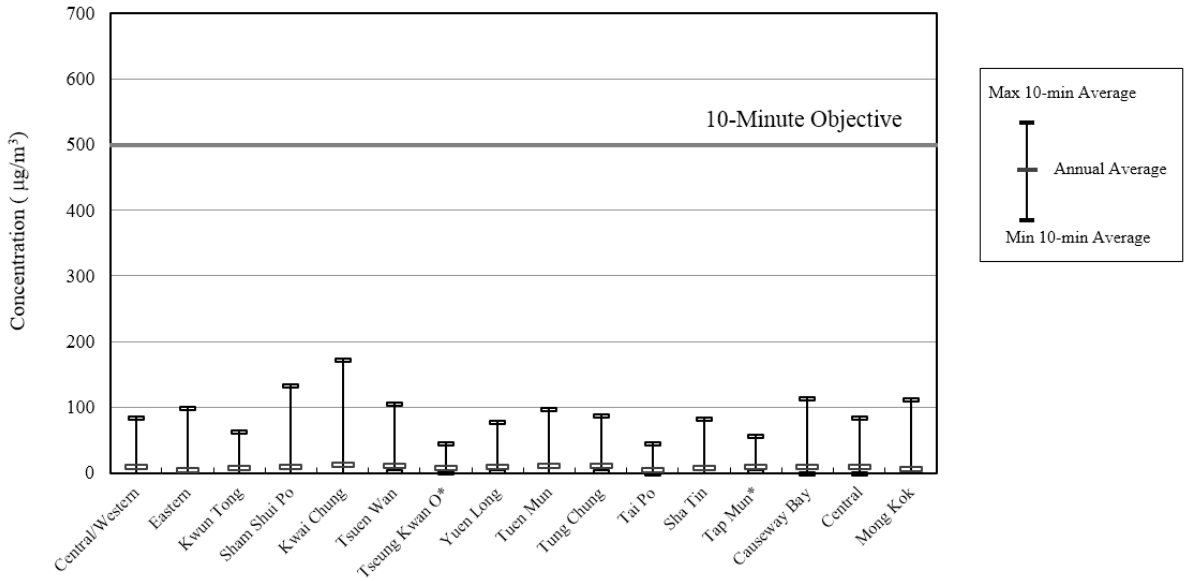
2. Gaseous Pollutants

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 sources of SO_2, followed by fuel combustion equipment and motor vehicles.

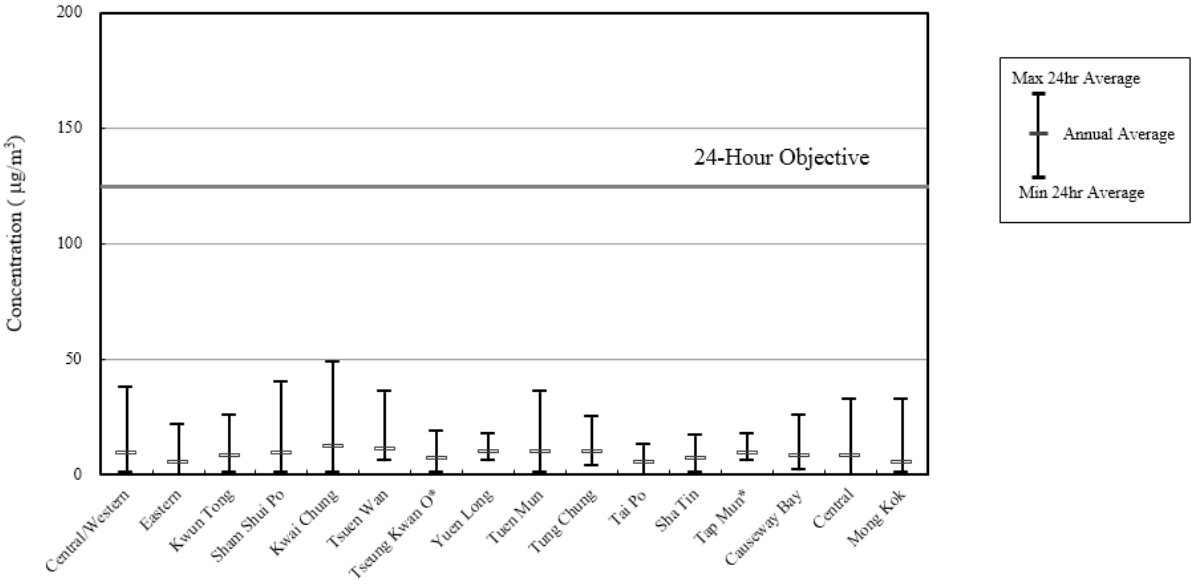
Exposure to high levels of SO_2 may cause impairment of respiratory function and aggravate existing respiratory and cardiac illnesses. Even at lower levels, prolonged exposure may also increase the risk of developing chronic respiratory diseases.

Figure 2a: Sulphur Dioxide Monitoring 2016
(10-Minute Average Statistics)



Note: *Tseung Kwan O and Tap Mun general stations had insufficient data in 2016.

Figure 2b: Sulphur Dioxide Monitoring 2016
(24-Hour Average Statistics)



Note: *Tseung Kwan O and Tap Mun general stations had insufficient data in 2016.

Sulphur dioxide was measured at all the 16 monitoring stations in 2016. As in previous years, SO_2 concentrations remained low throughout the territory. All monitoring stations[1] complied with the relevant Hong Kong Air Quality Objectives[2] (AQOs) for SO_2. The highest 10-minute average (173 μg/m^3) and 24-hour average (49 μg/m^3) were both measured at Kwai Chung general station and well below the respective AQO limits.

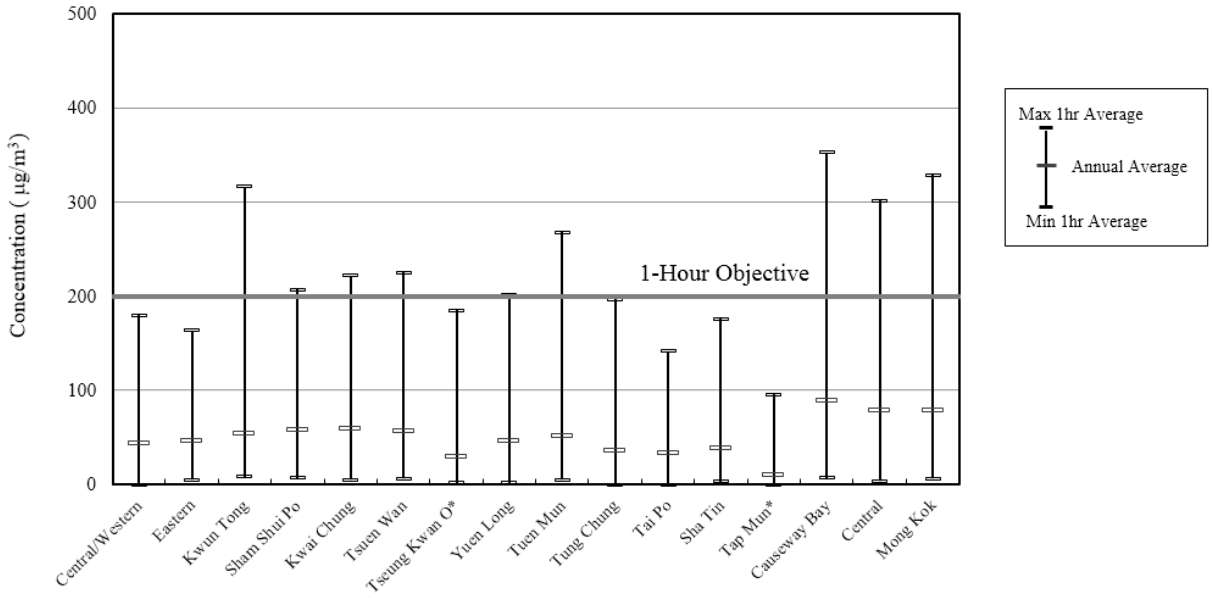
2.2 Nitrogen Oxides (NOx) and Nitrogen Dioxide (NO_2)

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 nitrogen oxides (NOx). They are usually produced in combustion processes. Emissions from power stations, marine vessels and motor vehicles are the major sources of NOx in Hong Kong. NOx emissions from motor vehicles have greater impact on roadside air quality.

NO_2 is mainly formed from the oxidation of 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.

NO_2 was measured at all the 16 monitoring stations in 2016 and the highest 1-hour average (353 μg/m^3) and the highest annual average (89 μg/m^3) were both recorded at the Causeway Bay roadside station. As regards the 1-hour AQO (200 μg/m^3) with allowance of exceedance for eighteen occasions per year, all general stations[1] were in compliance with the respective AQO in 2016. For the annual AQO (40 μg/m^3), only Tung Chung, Tai Po and Sha Tin were in compliance[1]. Non-compliance with the 1-hour and annual AQOs for NO_2 were recorded at all the three roadside stations.

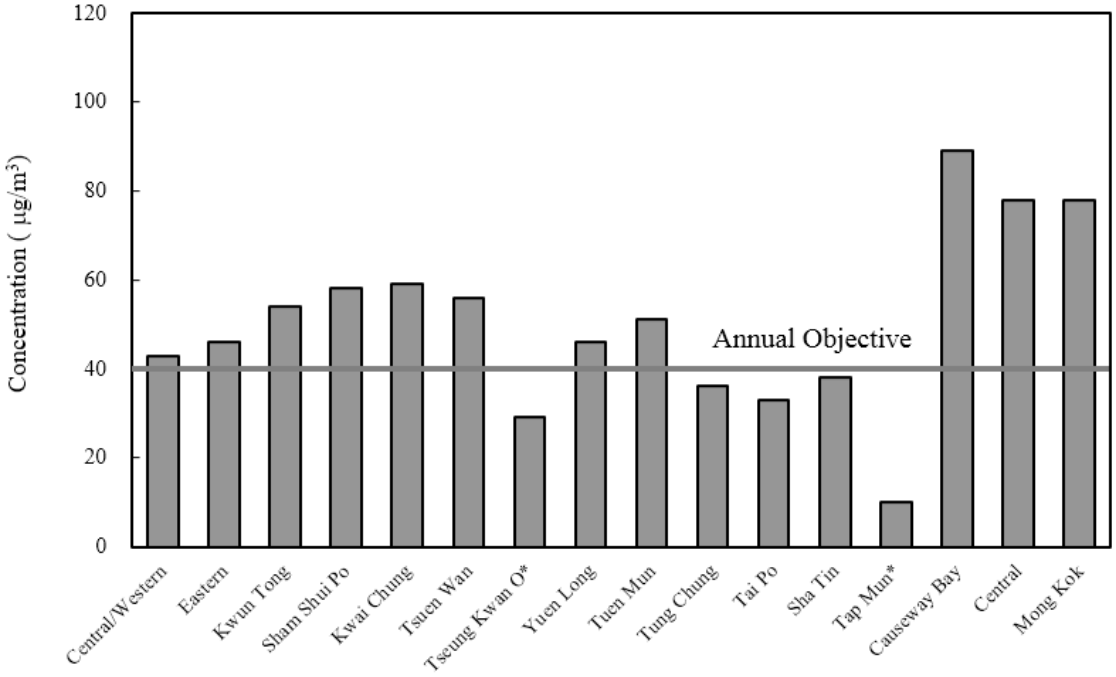
Figure 3a: Nitrogen Dioxide Monitoring 2016
(1-Hour Average Statistics)



Note: * Tseung Kwan O and Tap Mun general stations had insufficient data in 2016.

[1] Tseung Kwan O and Tap Mun general stations are excluded with insufficient data in 2016.
[2] Details of the Hong Kong Air Quality Objectives can be found in Appendix A.

Figure 3b: Nitrogen Dioxide Monitoring 2016
(Annual Average)



Note: *Tseung Kwan O and Tap Mun general stations had insufficient data in 2016.

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 NOx and volatile organic compounds (VOCs) under sunlight. As it takes several hours for these photochemical reactions to take place, O_3 recorded in one place could be attributed to VOC and NOx emissions from places afar. Hence, O_3 is more 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.

Ozone was monitored at all of the general and roadside stations in 2016. Among the 13 general stations, only Tap Mun[1] recorded non-compliance with the 8-hour AQO in 2016 (i.e. the 8-hour AQO limit of 160 $\mu g/m^3$ was exceeded more than nine times in the year). The highest 8-hour average (289 $\mu g/m^3$) was also recorded at Tap Mun general station.

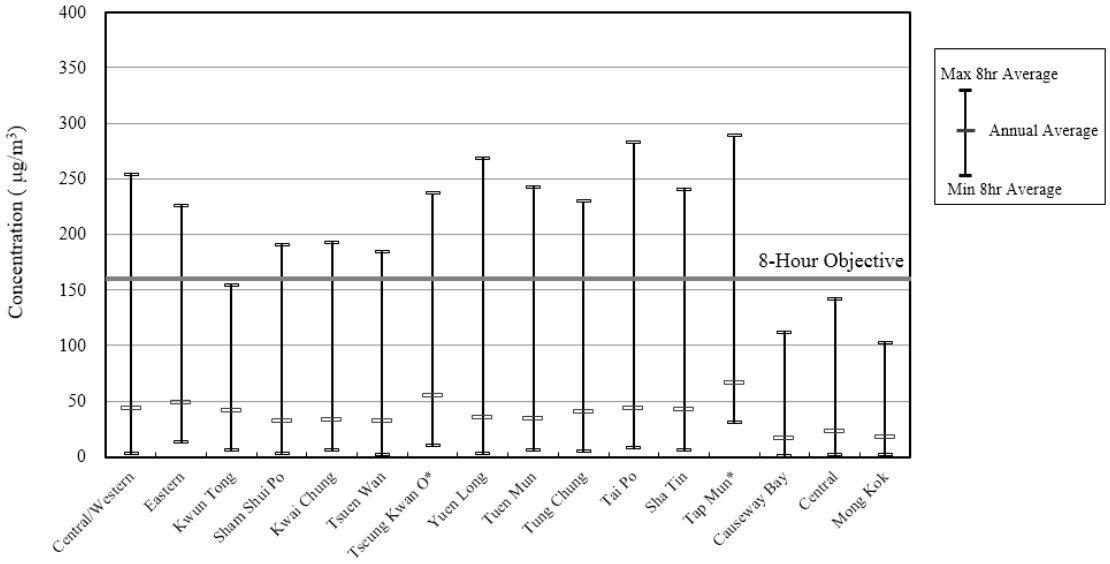
All the three roadside stations complied with the 8-hour AQO in the year. At the roadside, the NOx emitted from motor vehicles readily reacts with O_3 to form NO_2, thereby removing O_3. Because of such O_3 scavenging effect, the O_3 concentrations at the roadside are significantly lower than those at the general stations.

In Hong Kong, episode days 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 are under the influence of

[1]Tap Mun general station exceeded 8-hour AQO limit for 15 times with only about 10 months' data in 2016.

subsiding air induced by a tropical cyclone located in the Western Pacific Ocean near Taiwan.

Figure 4a: Ozone Monitoring 2016
(Maximum 8-Hour Average Statistics)



Note: *Tseung Kwan O and Tap Mun general stations had insufficient data in 2016.

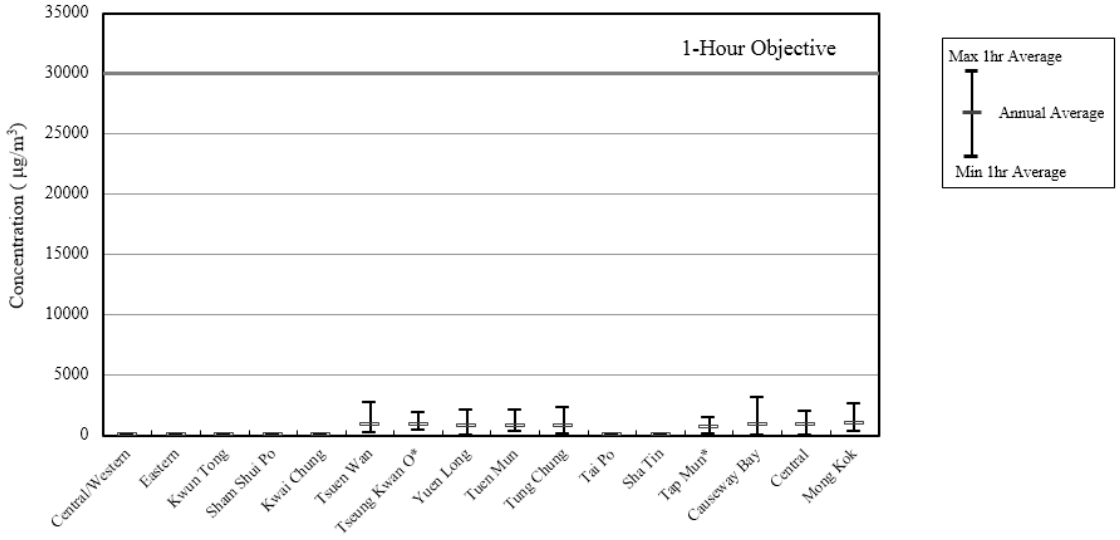
2.4 Carbon Monoxide (CO)

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 monitored at nine stations including six general stations and three roadside stations in 2016. Similar to previous years, both the ambient and roadside CO concentrations remained very low throughout the year. All the monitoring stations[1] complied with the 1-hour (30,000 μg/m^3) and 8-hour (10,000 μg/m^3) AQOs for CO. In 2016, the highest 1-hour average (3,130 μg/m^3) was recorded at Causeway Bay roadside station and the highest 8-hour average (2,339 μg/m^3) was recorded at Tsuen Wan general station, both were well below the respective AQO limits.

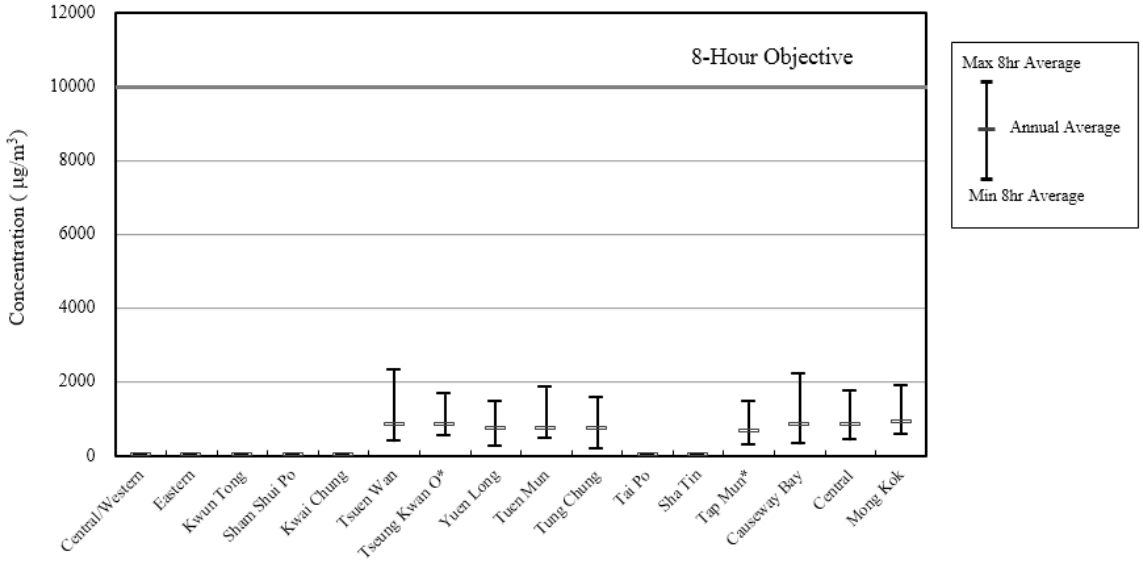
[1] Tseung Kwan O and Tap Mun general stations are excluded with insufficient data in 2016.

Figure 5a: Carbon Monoxide Monitoring 2016
(1-Hour Average Statistics)



Notes:
CO was only monitored at Tsuen Wan, Tseung Kwan O, Yuen Long, Tuen Mun, Tung Chung and Tap Mun general stations and Causeway Bay, Central and Mong Kok roadside stations.
* Tseung Kwan O and Tap Mun general stations had insufficient data in 2016.

Figure 5b: Carbon Monoxide Monitoring 2016
(8-Hour Average Statistics)



Notes:
CO was only monitored at Tsuen Wan, Tseung Kwan O, Yuen Long, Tuen Mun, Tung Chung and Tap Mun general stations and Causeway Bay, Central and Mong Kok roadside stations.
* Tseung Kwan O and Tap Mun general stations had insufficient data in 2016.

3. Suspended Particulates

3.1 Respirable Suspended Particulates (RSP)

Respirable suspended particulates (RSP or PM_{10}) refer to those suspended particulates with nominal aerodynamic diameters of 10 micrometres or less. Combustion sources, in particular marine vessels, diesel vehicles and power plants, are the major regional and local sources of the ambient particulate matters including RSP. Besides, RSP can also be formed by photochemical reactions of nitrogen oxides and volatile organic compounds and atmospheric oxidation of gaseous pollutants such as sulphur dioxide and nitrogen

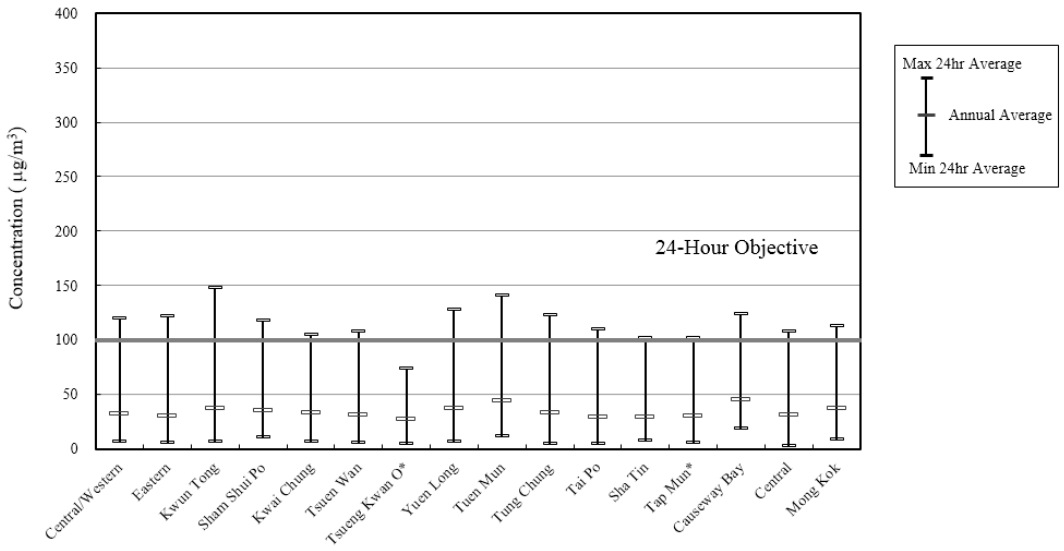
oxides. Although to a lesser extent, crustal derived dust and marine aerosols are also sources of RSP. In Hong Kong, RSP is contributed mainly by the regional sources.

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 uplifted if high RSP levels are associated with higher levels of other pollutants, such as SO_2.

RSP was measured at all 16 monitoring stations in 2016. Eight of these stations were also equipped with high-volume sampler to collect particulate samples for chemical analysis.

In 2016, 10 general stations complied with the 24-hour AQO for RSP (100 μg/m^3 with allowance of nine exceedances per year) out of the 11 general stations[1]. Only Tuen Mun general station exceeded the 24-hour AQO for RSP. The highest 24-hour average (148 μg/m^3) was recorded at Kwun Tong general station. All roadside stations complied with the 24-hour AQO for RSP. For the annual AQO (50 μg/m^3) , all general and roadside monitoring stations complied with the standard[1].

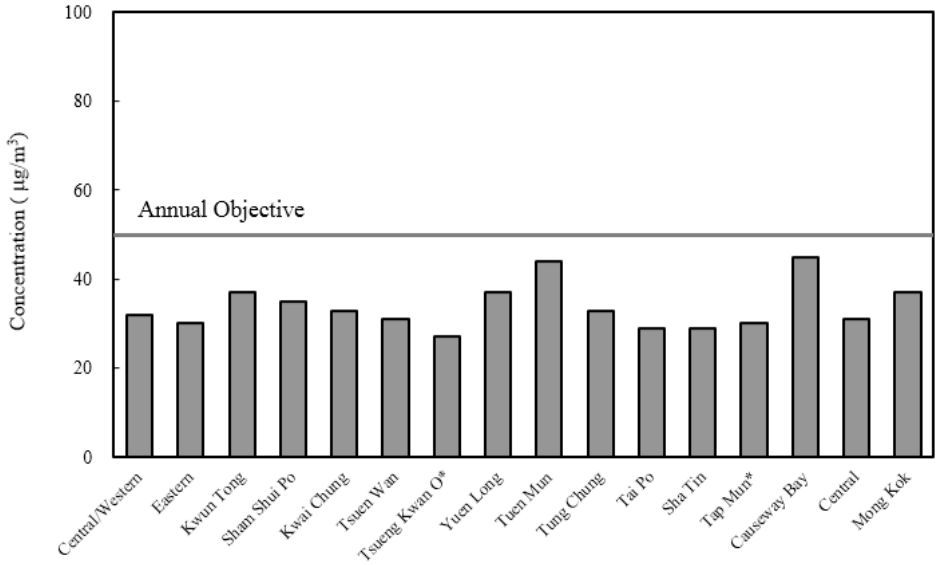
Figure 6a: RSP Monitoring 2016
(24-Hour Average Statistics)



Note: *Tseung Kwan O and Tap Mun general stations had insufficient data in 2016.

[1] Tseung Kwan O and Tap Mun general stations are excluded with insufficient data in 2016.

Figure 6b: RSP Monitoring 2016
(Annual Average)



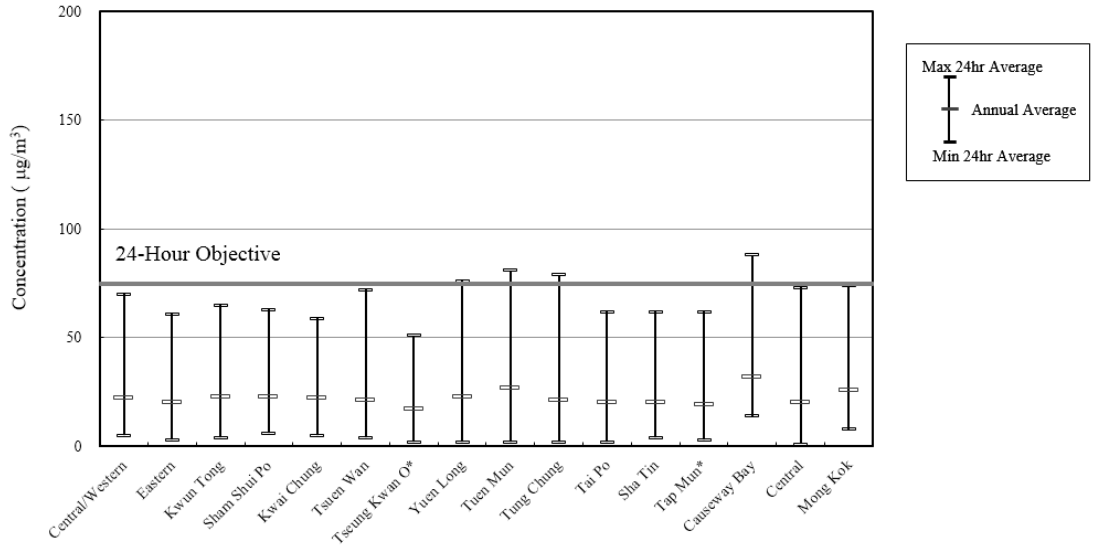
Note: *Tseung Kwan O and Tap Mun general stations had insufficient data in 2016.

3.2 Fine Suspended Particulates (FSP)

Fine suspended particulates (FSP or $PM_{2.5}$) refer to those suspended particulates with nominal aerodynamic diameters of 2.5 micrometres or less, which is the finer component of RSP. FSP has the same emission sources as RSP, which is also mainly contributed by regional sources. FSP is able to penetrate to the deepest parts of the lung because of its small size, hence poses a higher risk to health. Besides, FSP also causes visibility impairment in air.

In 2016, non-compliance was not observed in the year for both the 24-hour AQO (75 $\mu g/m^3$ with allowance of nine exceedances per year) and the annual AQO (35 $\mu g/m^3$) for FSP at all general and roadside stations[1], with the highest 24-hour average (88 $\mu g/m^3$) and annual average (32$\mu g/m^3$) recorded at the Causeway Bay roadside station.

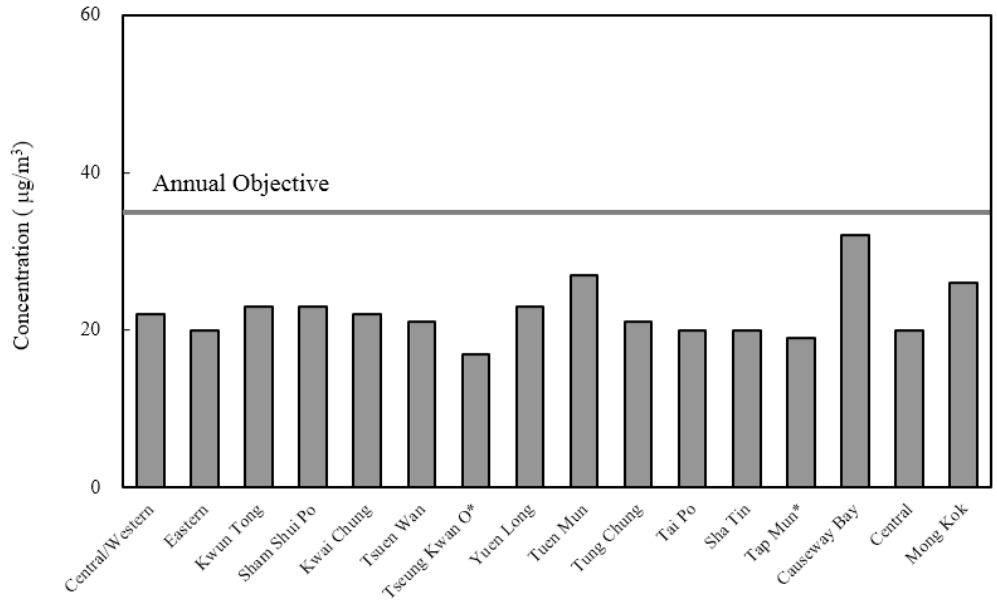
Figure 7a: FSP Monitoring 2016
(24-Hour Average Statistics)



Note: *Tseung Kwan O and Tap Mun general stations had insufficient data in 2016.

[1] Tseung Kwan O and Tap Mun general stations are excluded with insufficient data in 2016.

Figure 7b: FSP Monitoring 2016
(Annual Average)



Note: *Tseung Kwan O and Tap Mun general stations had insufficient data in 2016.

3.3 Lead (Pb)

Lead is the only criteria pollutant included in the AQOs 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 2016. The overall annual averages, ranging from 14 ng/m^3 (at Central/Western) to 20 ng/m^3 (at Yuen Long and Tuen Mun), were well below the respective annual AQO of 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 of 1997. Among the various TAPs monitored in 2016, eight of them are considered more important in terms of their health impacts and their annual averages are summarised in Table C6. Detailed description of the TAPs monitoring operation is given in Appendix B4.

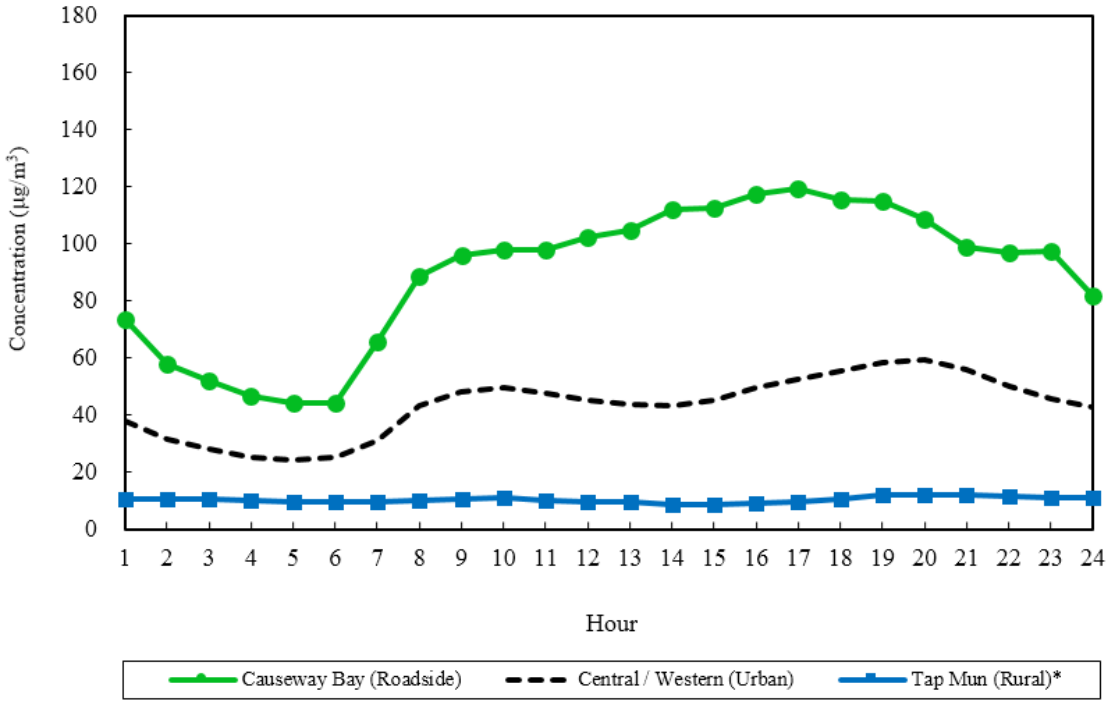
5. Variation of Air Pollution Levels over Time

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

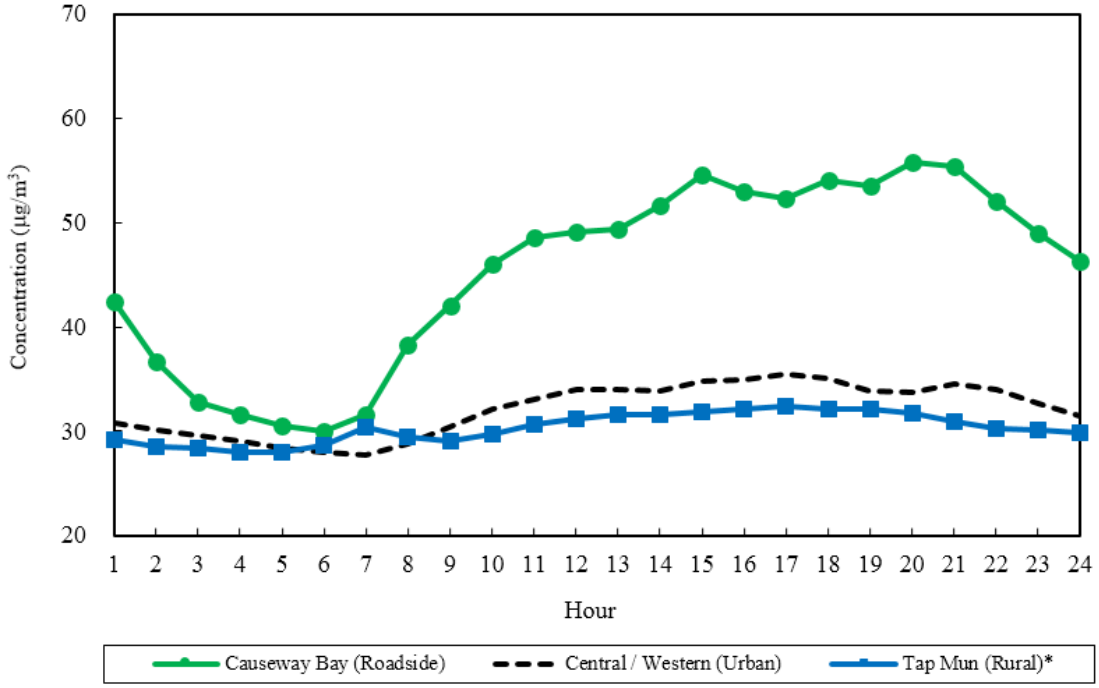
The concentrations of most air pollutants generally follow the diurnal pattern of human activities and traffic. For instance, higher levels of NO_2, RSP and FSP are usually observed in the morning and the evening rush hours when there are more traffic and human activities. Likewise, the lowest concentrations 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 8: 2016 Diurnal variations of NO_2



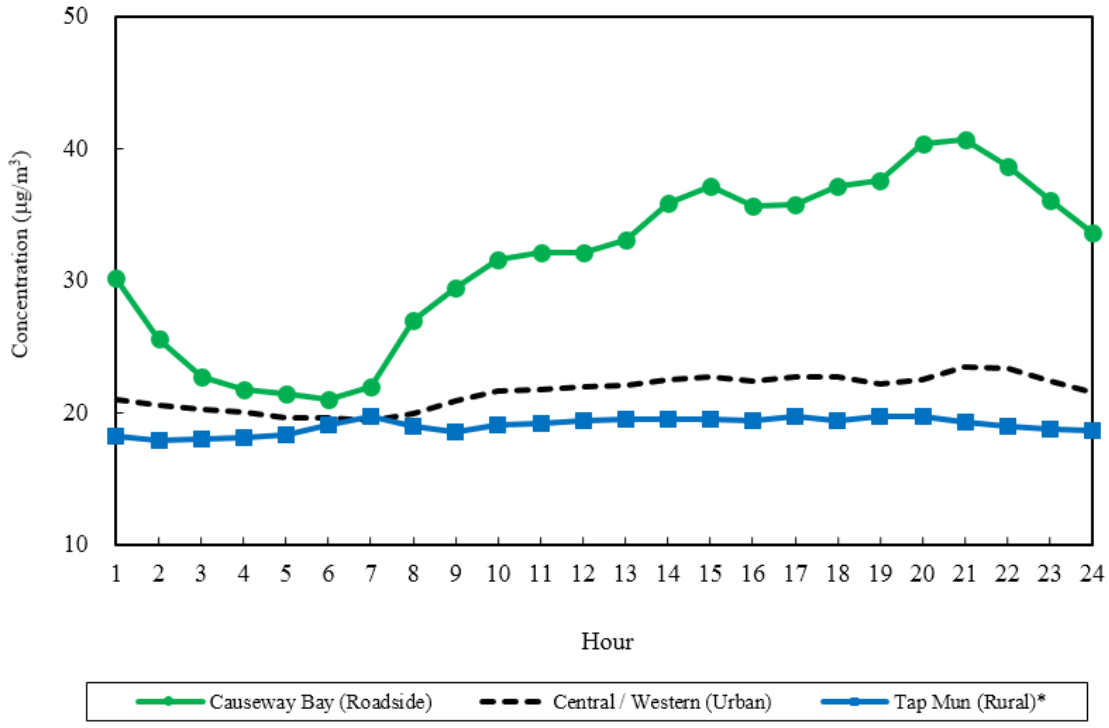
Note: *Tap Mun general station had insufficient data in 2016.

Figure 9: 2016 Diurnal variations of RSP



Note: *Tap Mun general station had insufficient data in 2016.

Figure 10: 2016 Diurnal variations of FSP

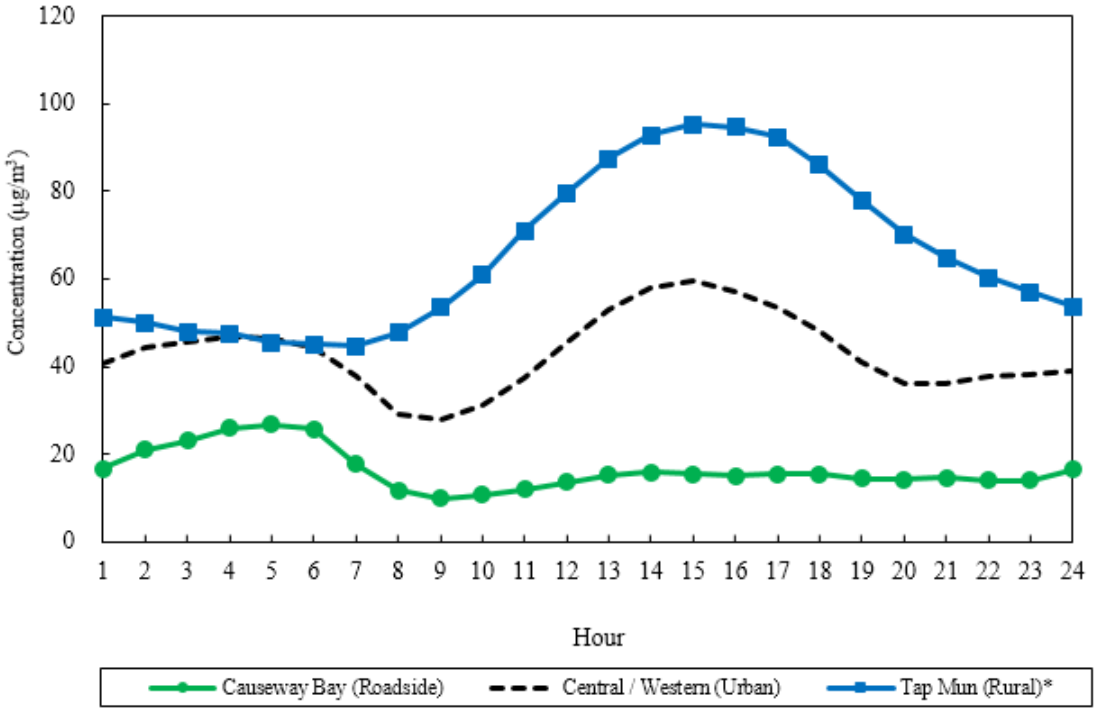


Note: *Tap Mun general station had insufficient data in 2016.

The diurnal pattern of O_3 is different from that of NO_2, RSP and FSP. O_3 is formed by photochemical reactions of its precursor pollutants such as NOx and VOCs under sunlight. Outside urban centres the ambient O_3 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 O_3 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 O_3. At the roadside, O_3 levels are significantly lower than those at

the general stations because of the scavenging effect due to higher concentrations of NOx from vehicular emissions.

Figure 11: 2016 Diurnal variations of O_3



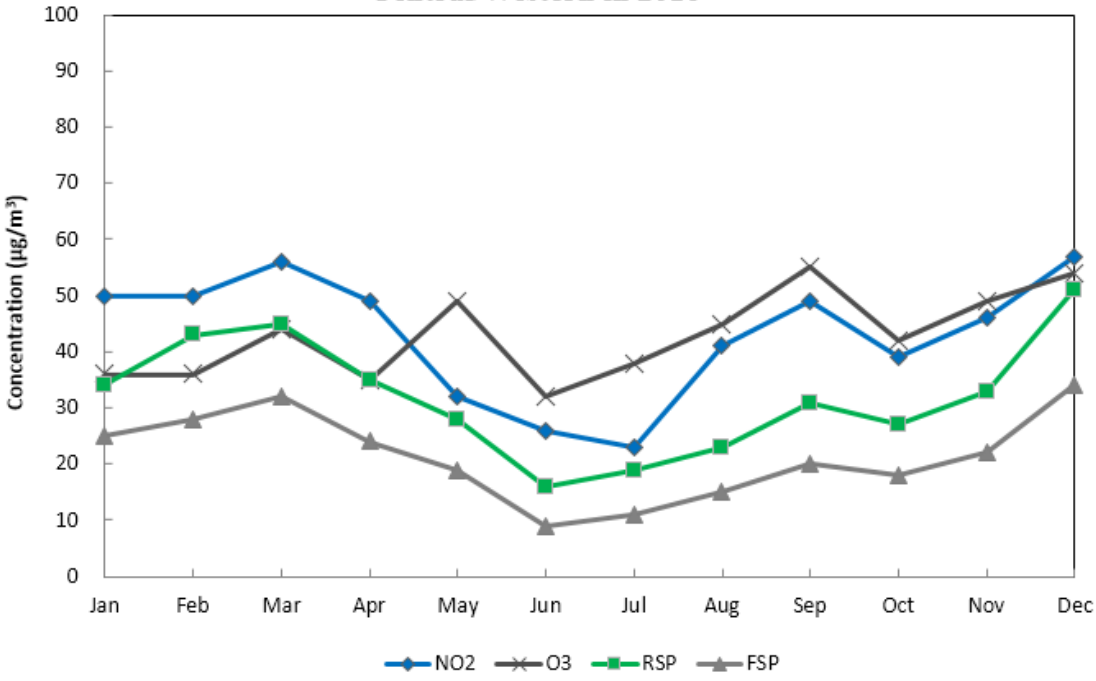
Note: *Tap Mun general station had insufficient data in 2016.

5.2 Over a Year

Concentrations of NO_2, RSP and FSP are in general lower in summer 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.

As regards the levels of O_3, the highest monthly averages usually occur in autumn (i.e. September or October) because of more days with favourable meteorological conditions (such as strong solar radiation, less amount of clouds, low wind speed etc.) for photochemical reactions and hence causing more ozone formation.

Figure 12: Monthly variations of NO_2, O_3, RSP and FSP at Central/Western in 2016



5.3 Long Term Trends

Air quality is affected by both emissions and meteorology. Over a short period, for instance a few months to a year, air quality is more subject to variations in weather and meteorological changes, such as stronger solar radiation which promotes photochemical smog formation or more rainfall that cleans the pollutants from the air, even though the emission levels remain more or less the same. Air quality is primarily affected by emission sources in the long run. Therefore a scientific way to assess air quality changes and the effectiveness of emission control measures is to examine the long-term trend of annual average pollutant concentrations over several years.

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, Kwun Tong, Sham Shui Po, Kwai Chung, Tsuen Wan and Tseung Kwan O
New Town	Mainly residential areas	Yuen Long, Tuen Mun, Tung Chung, Tai Po and Sha Tin
Rural	Rural areas	Tap Mun (background station)
Roadside	Urban roadside in mixed residential/ commercial area with	Causeway Bay, Central and Mong Kok

Land Use Type	Land Use Characteristics	Air Monitoring Stations
	heavy traffic and surrounded by many tall buildings	

The long term trends of most air pollutants are decreasing in the general and roadside stations.

As compared to 2015, the annual average concentrations of RSP, FSP, SO_2, O_3, and NO_2 recorded at general stations decreased by 4% to 13%. Although CO increased by 11% in 2016 over 2015, its concentrations remained at levels well below the AQO limits.

As for roadside stations, the annual average concentrations of all major air pollutants including NO_2, RSP, FSP and SO_2 decreased by 13% to 17% in the same period. Ozone remained at the same level as compared to 2015 and CO increased by 14% in 2016.

Compared to 2015, 2016 had a more favourable meteorological condition with more rainfall and fewer hours of sunshine which helped reduce pollutants' concentrations in the year.

5.3.1 Sulphur Dioxide (SO_2)

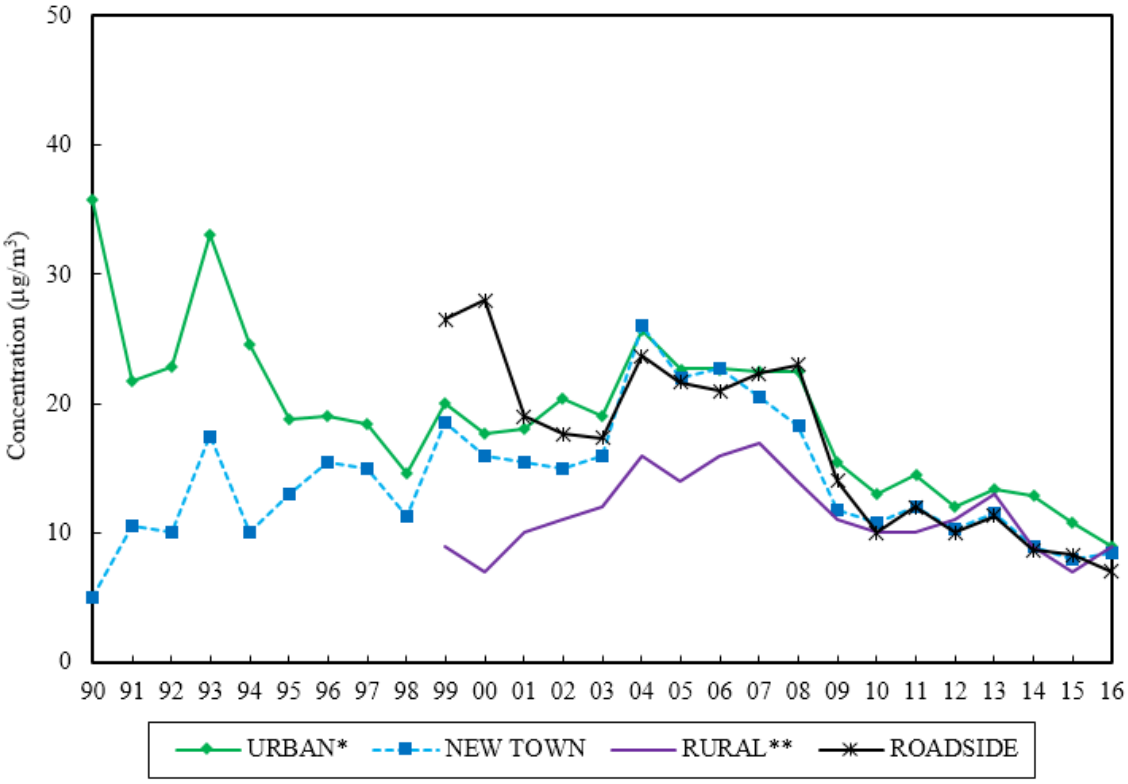
Since the implementation of the Air Pollution Control (Fuel Restriction) Regulations in 1990 for restricting sulphur content of industrial fuels, the Air Pollution Control (Motor Vehicle Fuel) Regulations in 1995 for controlling motor vehicle fuel quality, introduction of ultra-low sulphur diesel for vehicle fleet in late 2000 and the subsequent introduction of Euro V motor diesel in Dec 2007, SO_2 concentrations in Hong Kong have remained at levels well below the AQO limits.

In April 2014 and July 2015, the Air Pollution Control (Marine Light Diesel) Regulation and the Air Pollution Control (Ocean Going Vessels) (Fuel at Berth) Regulation were also introduced to further reduce SO_2 emissions.

On the regional front, the Governments in Guangdong Province and Hong Kong have been working together by introducing a wide range of control measures, 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., to reduce the emissions in the Pearl River Delta (PRD) region

As a result of the implementation of various fuel control measures, both the ambient and roadside SO_2 concentrations in 2016 remained low at 9 $\mu g/m^3$ and 7 $\mu g/m^3$ respectively.

Figure 13: SO_2 long term trend



Notes:
* Tseung Kwan O general station is excluded with insufficient data in 2016.
** Tap Mun general station had insufficient data in 2016. Since it is the only station for rural areas, its data are shown for reference.

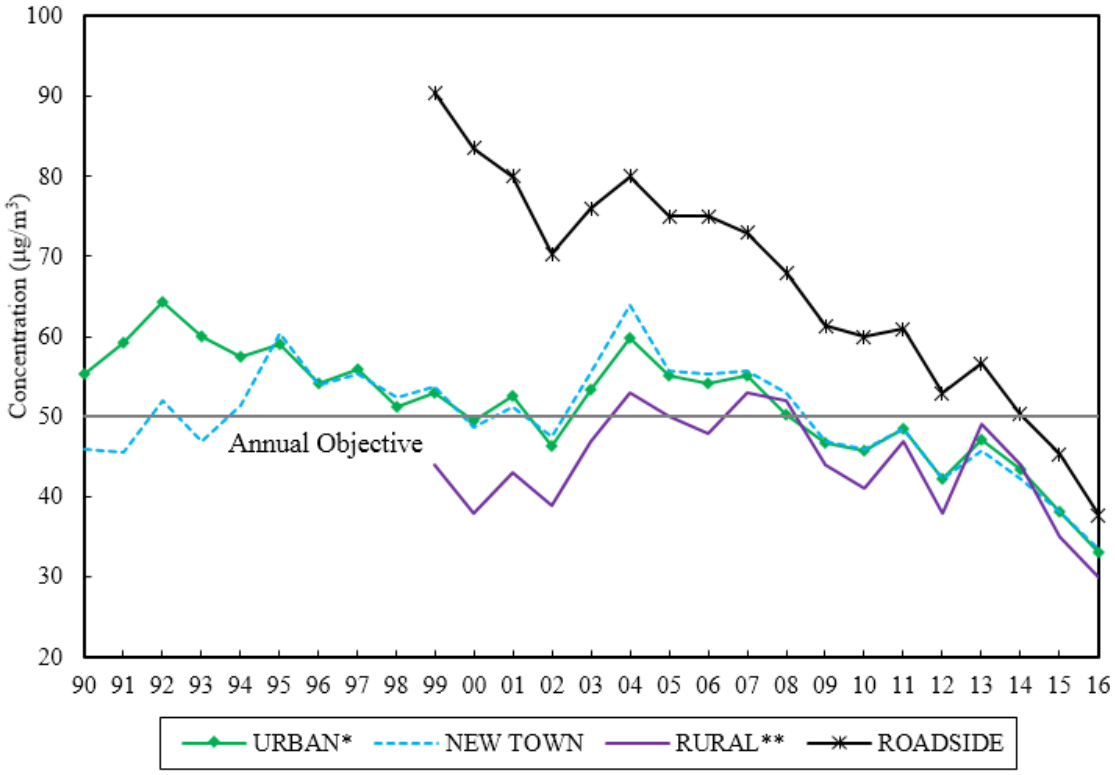
5.3.2 Respirable Suspended Particulates (RSP)

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 continuously dropped to a level below the annual AQO limit from 2009 onwards, reflecting a reduction in regional background RSP levels in the past few years.

As a result of the implementation of various vehicle emission control measures in the past decades, the annual average of RSP concentration at roadside in 2016 had been significantly reduced by 58% when compared with the 1999[1] value and remained below the annual AQO limit since 2015.

[1] 1999 is selected for comparison as this was the year when the Government started to implement a list of measures to cut vehicular emissions.

Figure 14: RSP long term trend



Notes:
* Tseung Kwan O general station is excluded with insufficient data in 2016.
** Tap Mun general station had insufficient data in 2016. Since it is the only station for rural areas, its data are shown for reference.

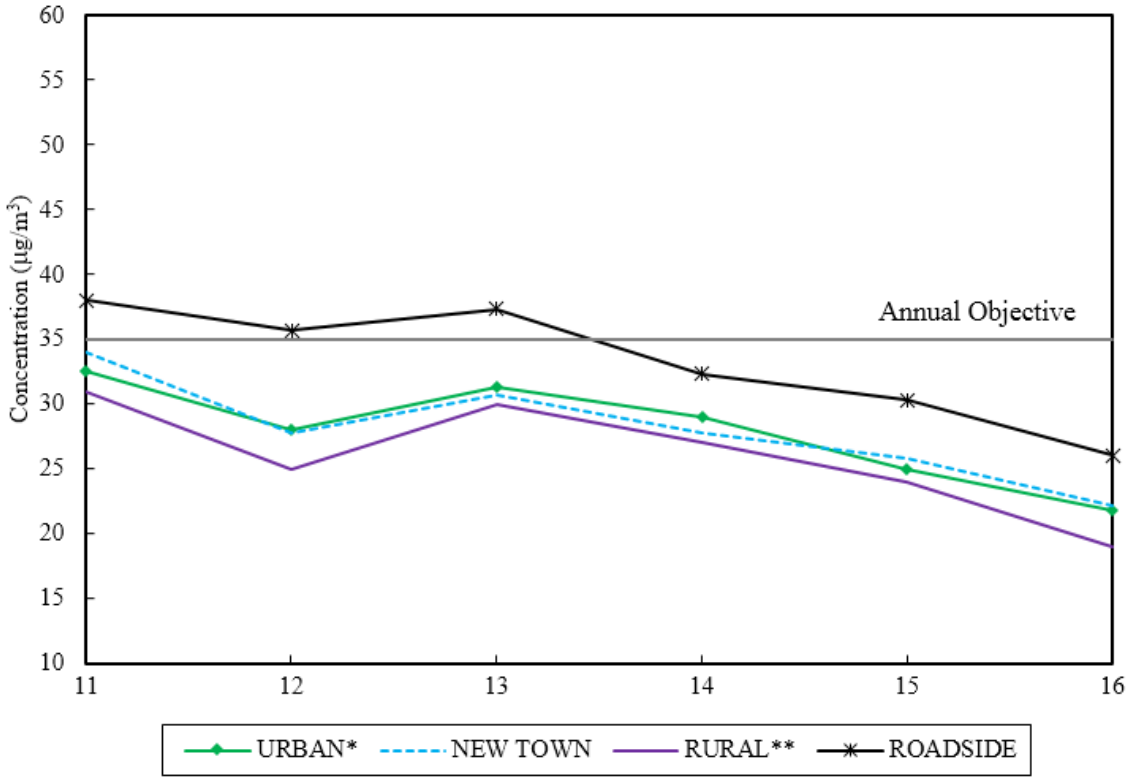
5.3.3 Fine Suspended Particulates (FSP)

We started to monitor FSP at all our monitoring stations in 2011[1]. Same as RSP, the ambient concentrations of FSP in the territory showed an overall downward trend between 2011 and 2016, reflecting a reduction in regional background FSP levels in the past few years.

The roadside FSP levels also showed a discernible improvement in recent years. In 2016, the annual average of FSP concentration at roadside compiled with the annual AQO and reduced by about 32% when compared with the 2011 value.

[1] FSP were only monitored at four to five air quality monitoring stations between 1999 and 2010.

Figure 15: FSP long term trend



Notes:
* Tseung Kwan O general station is excluded with insufficient data in 2016.
** Tap Mun general station had insufficient data in 2016. Since it is the only station for rural areas, its data are shown for reference.

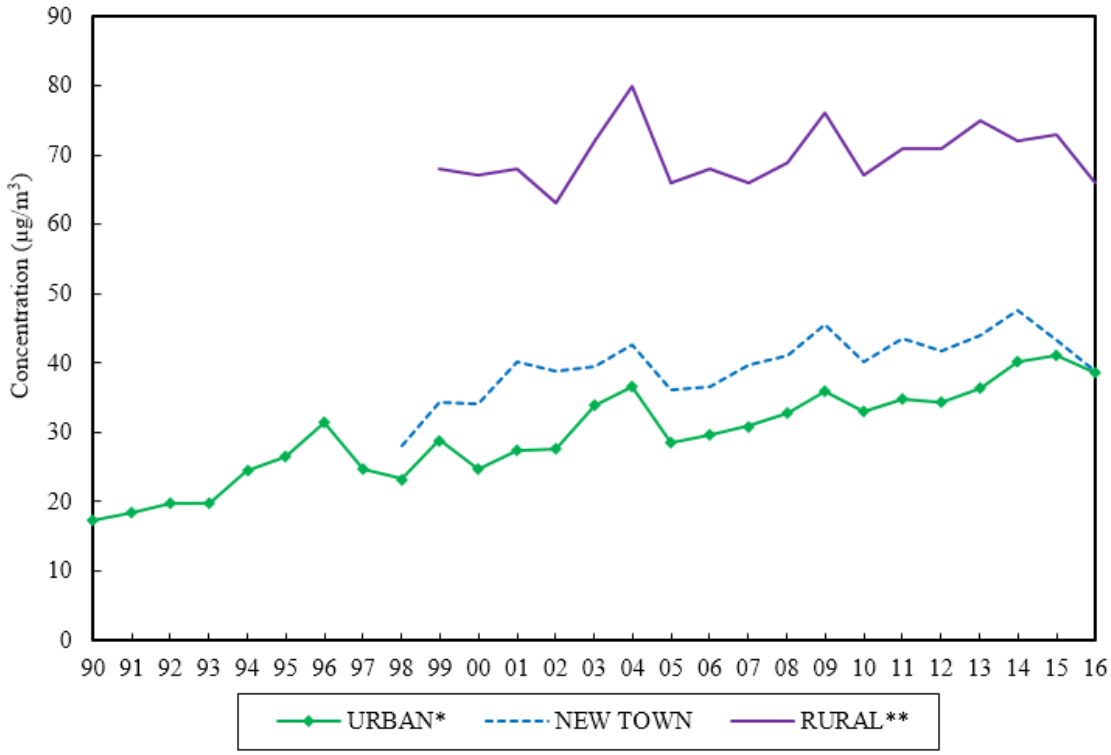
5.3.4 Ozone (O_3)

The O_3 concentrations in the territory have shown a moderate upward trend since 1990.

As nitric oxide emissions from motor vehicles can react with and remove O_3 in the air, regions with heavy traffic normally have lower O_3 levels than areas with light traffic. Hence, Tap Mun station has steadily recorded more than twice the O_3 levels measured in urban areas since the commencement of monitoring at rural area in 1999.

O_3, a major constituent of photochemical smog, is a regional air pollution issue. The Hong Kong Special Administrative Region Government and Guangdong Provincial Government have been implementing a regional air quality management plan to, among others, alleviate photochemical smog problem by reducing O_3 precursors levels in the PRD region.

Figure 16: O_3 long term trend



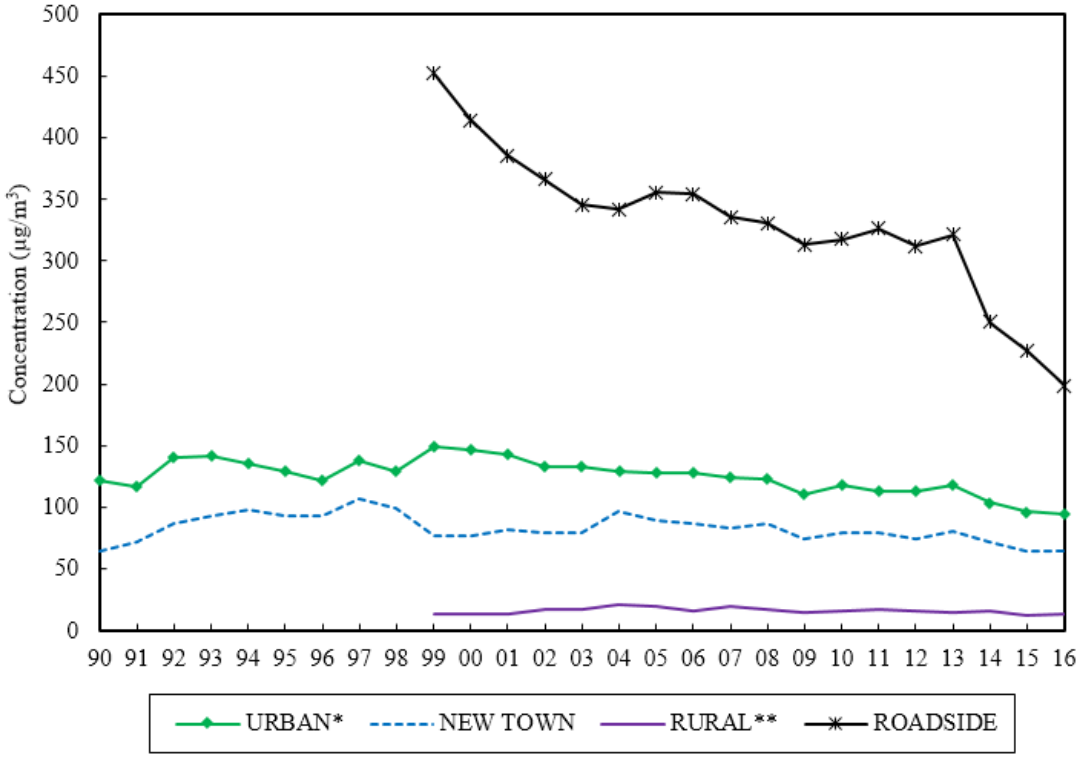
Notes:
*Tseung Kwan O general station is excluded with insufficient data in 2016.
** Tap Mun general station had insufficient data in 2016. Since it is the only station for rural areas, its data are shown for reference.

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

The annual average of NOx in urban areas exhibited a gradual declining trend between 1999 and 2016. During the same period, the roadside NOx concentration showed a more distinct descending trend, reflecting the effectiveness of various vehicle emission control measures implemented over the past decades. The roadside NOx concentration in 2016 was 56% lower than that in 1999[1].

[1] 1999 is selected for comparison as this was the year when the Government started to implement a list of measures to cut vehicular emissions.

Figure 17: NOx long term trend



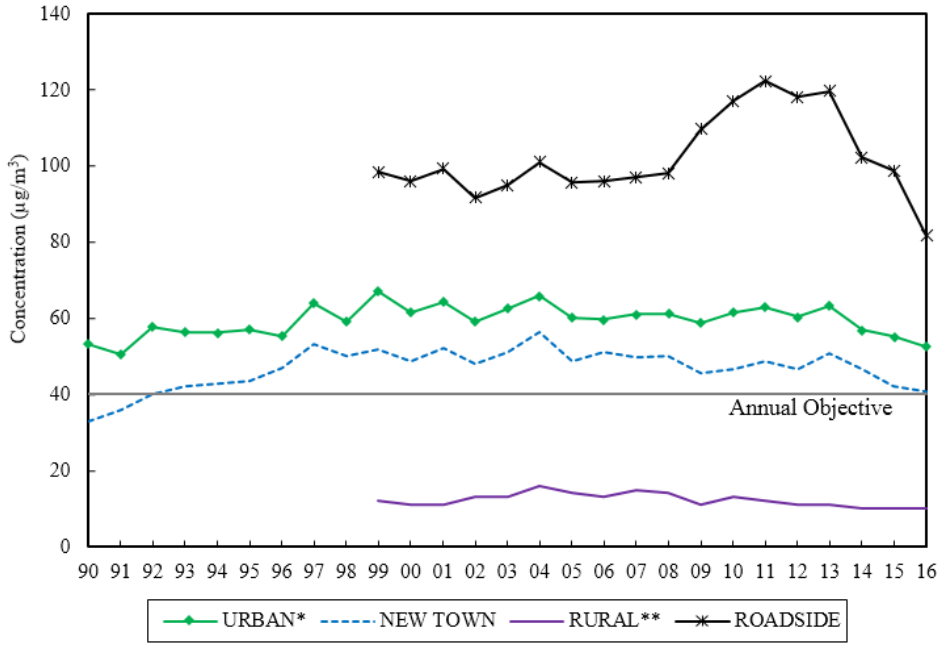
Notes:
* Tseung Kwan O general station is excluded with insufficient data in 2016.
** Tap Mun general station had insufficient data in 2016. Since it is the only station for rural areas, its data are shown for reference.

NO_2, a major component of NO_x, is mainly formed from the oxidation of nitric oxide. 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 ascending trends between 1990 and 2004 but the trends have levelled off since 2005.

Roadside NO_2 levels have been more difficult to reduce. However, the increasing trend of its concentrations 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, was stabilised and started to drop from its peak in 2011. The annual NO_2 concentration at roadside recorded in 2016 had reduced by 17% when compared with the 1999 level.

To address the problem of the elevated roadside NO_2 pollution, 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, stepping up the control on emissions from petrol and liquefied petroleum gas vehicles, providing incentives to accelerate the phasing out of old and polluting diesel commercial vehicles, as well as tightening the emission standards of newly registered motor vehicles.

Figure 18: NO_2 long term trend

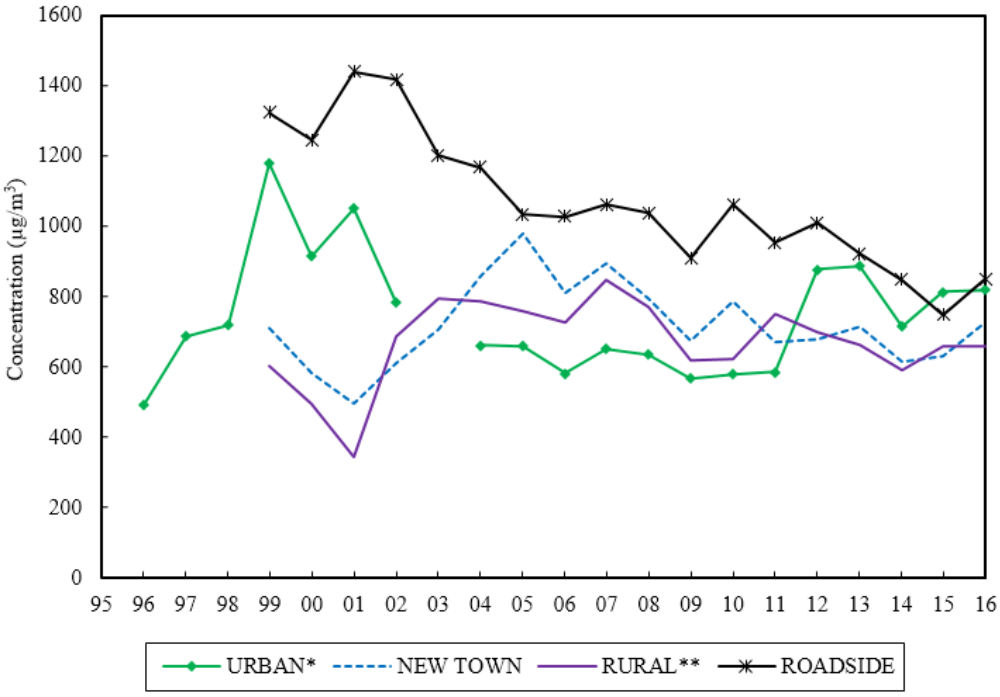


Notes:
* Tseung Kwan O general station is excluded with insufficient data in 2016.
** Tap Mun general station had insufficient data in 2016. Since it is the only station for rural areas, its data are shown for reference.

5.3.6 Carbon Monoxide (CO)

The ambient concentrations of CO in Hong Kong remained at very low levels in the last decade. 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) over the years.

Figure 19: CO long term trend

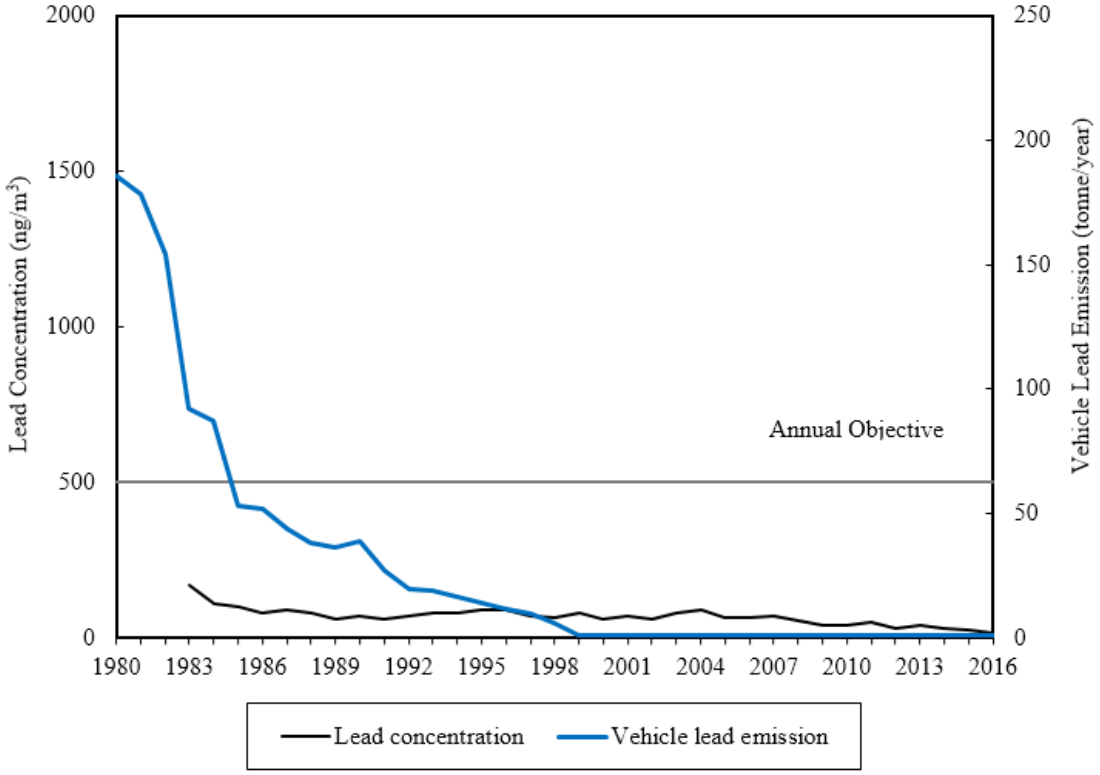


Notes:
*Tseung Kwan O general station is excluded with insufficient data in 2016.
** Tap Mun general station had insufficient data in 2016. Since it is the only station for rural areas, its data are shown for reference.

5.3.7 Lead (Pb)

The ambient lead concentrations have been lingering at very low levels over the years with 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 20: Vehicle lead emission and lead concentration



Appendix A

Air Quality Objectives and their Compliance Status

Hong Kong Air Quality Objectives (AQOs) for seven major air pollutants were set at levels to protect public health in 1987. This set of AQOs was reviewed and updated with effect on 1 January 2014. The updated set of AQOs is given in Table A1. The compliance status of the new AQOs has been used as the indicator of air quality in different districts in Hong Kong.

Table A1: Hong Kong Air Quality Objectives (AQOs)

Pollutant	Averaging time	Concentration limit [i] ($\mu g/m^3$)	Number of exceedances allowed
Sulphur dioxide	10-minute	500	3
	24-hour	125	3
Respirable suspended particulates (PM_{10}) [ii]	24-hour	100	9
	Annual	50	Not applicable
Fine suspended particulates ($PM_{2.5}$)[iii]	24-hour	75	9
	Annual	35	Not applicable
Nitrogen dioxide	1-hour	200	18
	Annual	40	Not applicable
Ozone	8-hour	160	9
Carbon monoxide	1-hour	30,000	0
	8-hour	10,000	0
Lead	Annual	0.5	Not applicable

Notes:

[i] All measurements of the concentration of gaseous air pollutants, i.e. sulphur dioxide, nitrogen dioxide, ozone and carbon monoxide, are adjusted to a reference temperature of 293 Kelvin and a reference pressure of 101.325 kPa.

[ii] Respirable suspended particulates mean suspended particles in air with a nominal aerodynamic diameter of 10 μm or less.

[iii] Fine suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 2.5 μm or less.

Compliance with the short-term AQOs

Table A2 shows the compliance status with the short-term AQOs (i.e. 10-min, 1-hour, 8-hour and 24-hour AQOs) recorded at each monitoring station in 2016. Tap Mun general station was not in operation from 1 January 2016 to 25 February 2016 owing to renovation work while the new Tseung Kwan O general station came into operation starting from 16 March 2016. As such, both Tseung Kwan O and Tap Mun stations had insufficient data in 2016. Nevertheless, Tap Mun Station was still found not to comply with the 8-hour AQO for O_3, whereas eleven general stations and all three roadside stations complied with the short-term AQO for O_3. For compliance status of other criteria pollutants[1], eleven general stations complied with the 1-hour AQO for NO_2, ten general and three roadside stations complied with the 24-hour AQO for RSP, while all general and roadside stations complied with the short-term AQO for FSP, SO_2 and CO.

[1] Tap Mun and Tseung Kwan O general stations are excluded with insufficient data in 2016.

Table A2: Compliance Status of Short-Term Air Quality Objectives in 2016

Station		O_3	NO_2	RSP	FSP	SO_2		CO	
		8-hr	1-hr	24-hr	24-hr	10-min	24-hr	1-hr	8-hr
General Station	Central/Western	✓	✓	✓	✓	✓	✓	--	--
	Eastern	✓	✓	✓	✓	✓	✓	--	--
	Kwun Tong	✓	✓	✓	✓	✓	✓	--	--
	Sham Shui Po	✓	✓	✓	✓	✓	✓	--	--
	Kwai Chung	✓	✓	✓	✓	✓	✓	--	--
	Tsuen Wan	✓	✓	✓	✓	✓	✓	✓	✓
	Tseung Kwan O[#]	NA	NA	NA	NA	NA	NA	NA	NA
	Yuen Long	✓	✓	✓	✓	✓	✓	✓	✓
	Tuen Mun	✓	✓	×	✓	✓	✓	✓	✓
	Tung Chung	✓	✓	✓	✓	✓	✓	✓	✓
	Tai Po	✓	✓	✓	✓	✓	✓	--	--
	Sha Tin	✓	✓	✓	✓	✓	✓	--	--
	Tap Mun[##]	×	NA	NA	NA	NA	NA	NA	NA
Roadside Station	Causeway Bay	✓	×	✓	✓	✓	✓	✓	✓
	Central	✓	×	✓	✓	✓	✓	✓	✓
	Mong Kok	✓	×	✓	✓	✓	✓	✓	✓

Notes: "✓" *Complied with the AQO* "×" *Violated the AQO* "--" *Not measured*
"#" Tseung Kwan O Station was commissioned on 16 March 2016.
"##" Owing to renovation works, all pollutant data were not available at Tap Mun Station from 1 January to 25 February 2016.
*"*NA*" Measured data either insufficient or unevenly distributed for compliance assessment*

Compliance with the long-term AQO

Table A3 shows the compliance status of the long-term (annual) AQO for all monitoring stations in 2016[1]. All stations complied with the annual AQO for RSP and FSP whereas eleven stations could not comply with the annual AQO for NO_2 in 2016[1]. For lead, all monitoring stations with lead measurement achieved full compliance with the long term AQO in 2016.

[1] Tap Mun and Tseung Kwan O general stations are excluded with insufficient data in 2016.

Table A3: Compliance Status of Long-Term (Annual) Air Quality Objectives in 2016

Station		Annual			
		NO_2	**RSP**	**FSP**	**Lead**
General Station	Central/Western	×	✓	✓	✓
	Eastern	×	✓	✓	--
	Kwun Tong	×	✓	✓	✓
	Sham Shui Po	×	✓	✓	✓
	Kwai Chung	×	✓	✓	✓
	Tsuen Wan	×	✓	✓	✓
	Tseung Kwan O#	NA	NA	NA	NA
	Yuen Long	×	✓	✓	✓
	Tuen Mun	×	✓	✓	--
	Tung Chung	✓	✓	✓	✓
	Tai Po	✓	✓	✓	--
	Sha Tin	✓	✓	✓	--
	Tap Mun##	NA	NA	NA	--
Roadside Station	Causeway Bay	×	✓	✓	--
	Central	×	✓	✓	--
	Mong Kok	×	✓	✓	✓

Notes: "✓" *Complied with the AQO* "×" *Violated the AQO* "--" *Not measured*
"#" Tseung Kwan O Station was commissioned on 16 March 2016.
"##" *Owing to renovation works, all pollutant data were not available at Tap Mun Station from 1 January to 25 February 2016.*
"NA" - *Measured data either insufficient or unevenly distributed for compliance assessment*

Appendix B

Air Quality Monitoring Operation

B.1 Network Operation

The Air Science Group of the Environmental Protection Department operates the Air Quality Monitoring Network which had 16 monitoring stations in 2016. Table B1 shows the station site information. The measurement of respirable suspended particulates (RSP), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3) and carbon monoxide (CO) concentrations 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 16 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 concentrations 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 RSP concentrations. The concentrations of lead are determined in the subsequent elemental analysis of the RSP samples. 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 data lines for further processing. After careful checking and validation, the monitoring data are disseminated to the public in the following manner:-

- Hourly Air Quality Health Index ## (AQHI) reporting for individual station
- Monthly release of the AQHI 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"*

Note: The Air Pollution Index (API) was replaced by the Air Quality Health Index (AQHI) on 30 December 2013.

- 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 AQHI 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. Performance goal of ±15% and ±20% are adopted for suspended particulates (RSP and FSP) and gaseous pollutants respectively. In 2016, 331 audit checks were carried out on the stations' analysers and samplers. Based on the 95% probability limits, the accuracy varied from -13.0 % to 10.7 % for gases, and from -7.5 % to 9.0 % for particulates. All parameters were well within the specified performance goal 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 2016, 2779 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 -6.2% and 4.6%, which was again within the performance goal of ±15% for both particulates (RSP and FSP) and gaseous pollutants.

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		Date Start Operation
			Above P.D.H.K.	Above Ground	
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
Kwun Tong (Yue Wah Mansion)	407-431 Kwun Tong Road, Kwun Tong	Urban : Mixed residential/ commercial/industrial	37m	25m	Apr 12
Sham Shui Po (Police Station)	37A Yen Chow Street, Sham Shui Po	Urban : Mixed residential/ commercial	21m	17m (4 floors)	Jul 84
Kwai Chung (Kwai Chung Police Station)	999 Kwai Chung Road, Kwai Chung	Urban : Mixed residential/ commercial/industrial	19m	13m (2 floors)	Jan 99
Tsuen Wan (Princess Alexandra Community Centre)	60 Tai Ho Road, Tsuen Wan	Urban : Mixed residential/ commercial/industrial	21m	17m (4 floors)	Aug 88
Tseung Kwan O (Tseung Kwan O Sports Centre)	9 Wan Lung Road, Tseung Kwan O	Urban: Residential	23m	16m (2 floors)	Mar 16
Yuen Long (Yuen Long District Branch Offices Bldg.)	269 Castle Peak Road Yuen Long	New Town : Residential	31m	25m (6 floors)	July 95
Tuen Mun (Tuen Mun Public Library)	1 Tuen Hi Road, Tuen Mun	New Town : Residential	31m	27m (4 floors)	Dec 13
Tung Chung (Tung Chung Health Centre)	6 Fu Tung Street, Tung Chung	New Town : Residential	34.5m	27.5m (4 floors)	Apr 99
Tai Po (Tai Po Govt. Office Bldg.)	1 Ting Kok Road, Tai Po	New Town : Residential	31m	28m (6 floors)	Feb 90
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
Tap Mun (Tap Mun Police Post)	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[1] / 7m[2]	3m [1] / 3.5m [2]	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

Monitoring Station	Address	Area Type	Sampling Height		Date Start Operation
			Above P.D.H.K.	Above Ground	
Mong Kok	Junction of Nathan Road and Lai Chi Kok Road	Urban Roadside : Mixed commercial/ residential area surrounded by many tall buildings	8.5m[1] / 10.9m[2]	3m[1] /5.4m [2]	Jan 01

Notes: P.D. = Principal Datum
[1] Sampling height for gaseous pollutants.
[2] Sampling height for suspended particulates.

Table B2: Summary of the Parameters Monitored in the Network (2016)

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

Notes:
[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	T-API 100E, T-API T100, T-API T100U, TECO 43A, TECO 43i
NO, NO_2, NO_x	Chemiluminescence	T-API 200A, T-API T200, TECO 42i
O_3	UV absorption	T-API 400, T-API 400A, T-API T400, TECO 49i
SO_2, NO_2, O_3	Differential Optical Absorption Spectroscopy	Opsis AR 500 System
CO	Non-dispersive infra-red absorption with gas filter correlation	T-API 300, T-API T300, TECO 48C
RSP (PM_{10})	a) Gravimetric b) Oscillating microbalance c) Beta Attenuation	Graseby Andersen PM10, Tisch PM10+,R&P TEOM Series 1400a-AB-PM10, Thermo Scientific TEOM 1405-DF, Met One BAM 1020, T-API 602 Beta Plus
FSP ($PM_{2.5}$)	a) Gravimetric b) Oscillating microbalance c) Beta Attenuation	Thermo Scientific Partisol-Plus 2025, R&P TEOM Series 1400a-AB-PM2.5, Thermo Scientific TEOM 1405-DF, Met One BAM1020, T-API 602 Beta Plus

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 / ATEC 2200	Canister	Twice per month	24 hours
Perchloro-ethylene	USEPA Method TO-14A	Xontech 910A / RM 910A / ATEC 2200	Canister	Twice per month	24 hours
1,3-Butadiene	USEPA Method TO-14A	Xontech 910A / RM 910A / ATEC 2200	Canister	Twice per month	24 hours
Formaldehyde	USEPA Method TO-11A	Xontech 925/ RM 925 / ATEC 2200	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 924	Bicarbonate Impregnated Filter	Once per month	24 hours

Figure B1: Accuracy of Air Quality Monitoring Network, 2016

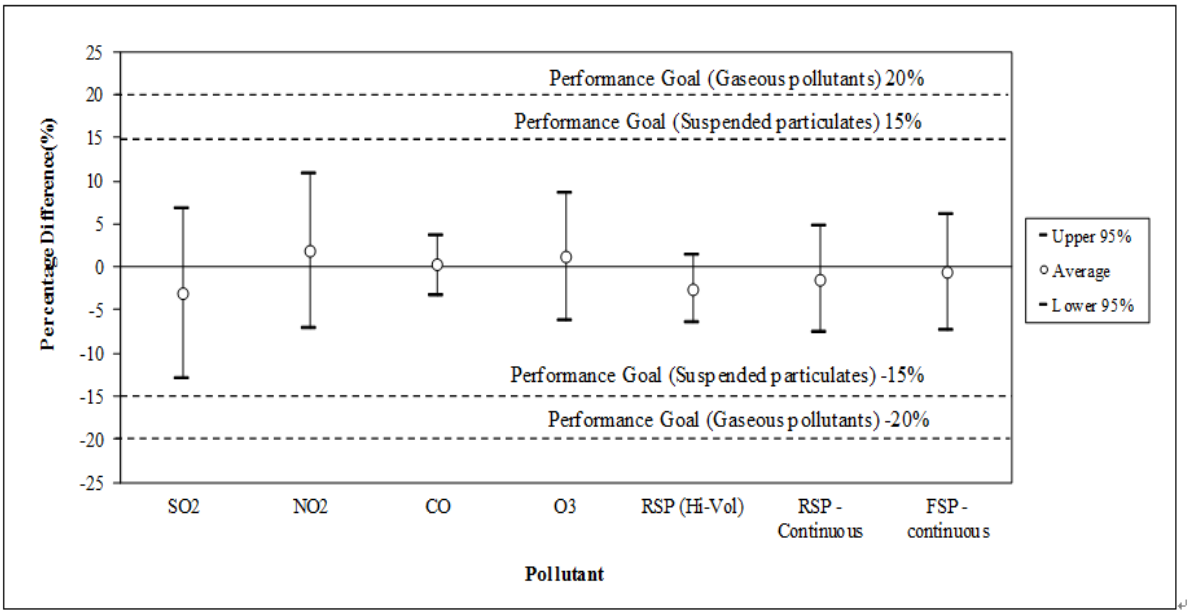
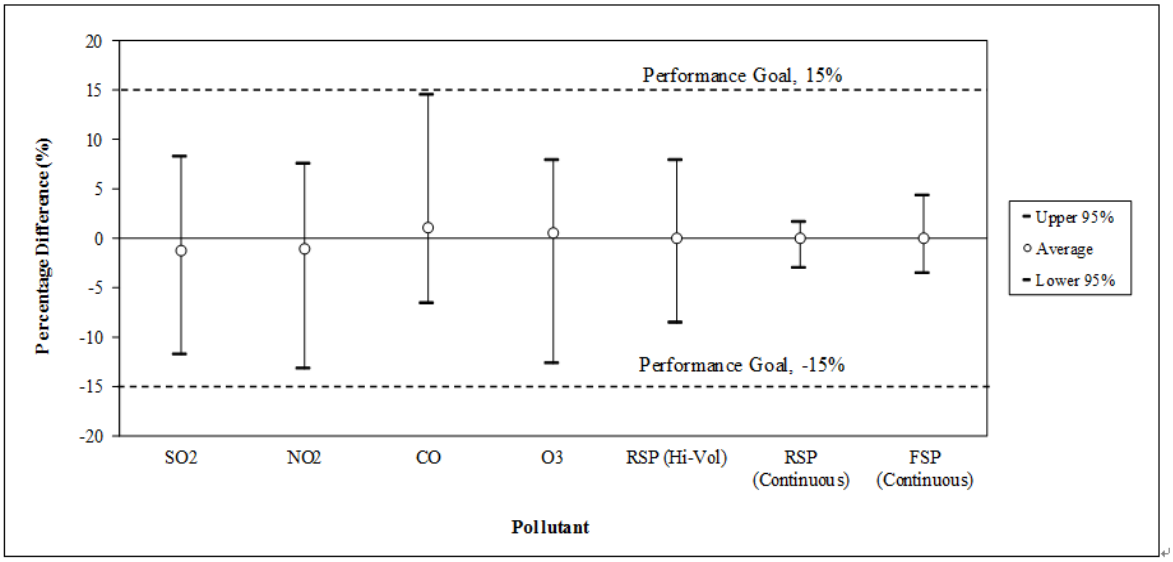


Figure B2: Precision of Air Quality Monitoring Network, 2016



Appendix C

Tables of Air Quality Data

Table C1: 2016 Exceedance of Short Term Limits of Air Quality Objectives

Pollutant: Sulphur Dioxide

(10-minute limit = 500 μg/m^3 ; allowable no. of exceedance = 3)

Station	No. of exceedance	1st High	2nd High	3rd High	4th High
Central/Western	0	111	110	110	103
Eastern	0	98	90	83	82
Kwun Tong	0	63	58	57	53
Sham Shui Po	0	134	131	128	126
Kwai Chung	0	173	171	159	147
Tsuen Wan	0	106	97	94	94
Tseung Kwan O	0	46	44	42	40
Yuen Long	0	77	66	64	58
Tuen Mun	0	98	80	76	75
Tung Chung	0	87	78	66	63
Tai Po	0	46	44	39	37
Sha Tin	0	83	78	68	67
Tap Mun	0	56	47	47	45
Causeway Bay	0	114	104	93	89
Central	0	85	83	78	75
Mong Kok	0	111	102	102	83

Pollutant: Carbon Monoxide

(1-hour limit = 30,000 μg/m^3 ; allowable no. of exceedance = 0)

Station	No. of exceedance	1st High
Tsuen Wan	0	2750
Tseung Kwan O	0	1850
Yuen Long	0	2080
Tuen Mun	0	2050
Tung Chung	0	2260
Tap Mun	0	1470
Causeway Bay	0	3130
Central	0	2000
Mong Kok	0	2570

Pollutant: Sulphur Dioxide

(24-hour limit = 125 μg/m^3 ; allowable no. of exceedance = 3)

Station	No. of exceedance	1st High	2nd High	3rd High	4th High
Central/Western	0	38	33	31	27
Eastern	0	22	18	17	16
Kwun Tong	0	26	23	18	17
Sham Shui Po	0	40	31	29	26
Kwai Chung	0	49	46	36	36
Tsuen Wan	0	36	31	24	24
Tseung Kwan O	0	19	15	13	13
Yuen Long	0	18	17	17	17
Tuen Mun	0	36	30	29	28
Tung Chung	0	25	21	20	20
Tai Po	0	13	12	10	10
Sha Tin	0	17	16	16	16
Tap Mun	0	18	15	15	15
Causeway Bay	0	26	25	15	15
Central	0	33	30	26	24
Mong Kok	0	33	28	22	21

Pollutant: Carbon Monoxide

(8-hour limit = 10,000 μg/m^3 ; allowable no. of exceedance = 0)

Station	No. of exceedance	1st High
Tsuen Wan	0	2339
Tseung Kwan O	0	1673
Yuen Long	0	1474
Tuen Mun	0	1843
Tung Chung	0	1581
Tap Mun	0	1453
Causeway Bay	0	2215
Central	0	1739
Mong Kok	0	1911

Pollutant: Nitrogen Dioxide (1-hour limit = 200 μg/m^3 ; allowable no. of exceedance = 18)

Station	No. of exceedance	1st High	2nd High	3rd High	4th High	5th High	6th High	7th High	8th High	9th High	10th High	11th High	12th High	13th High	14th High	15th High	16th High	17th High	18th High	19th High
Central/Western	0	180	179	179	178	171	168	166	165	163	161	158	157	155	154	154	154	153	153	152
Eastern	0	164	164	162	160	151	150	149	147	146	146	145	142	142	140	139	138	137	137	134
Kwun Tong	18	317	297	295	284	258	254	246	244	241	237	234	223	219	214	208	208	208	203	200
Sham Shui Po	4	207	205	204	202	199	195	186	183	176	174	173	170	168	165	165	164	163	163	161
Kwai Chung	8	222	215	209	203	203	203	203	201	196	192	192	191	191	191	188	187	187	185	185
Tsuen Wan	8	225	220	208	208	207	206	205	203	195	194	194	191	191	185	184	182	180	178	175
Tseung Kwan O	0	185	149	147	146	141	141	141	136	135	134	133	133	132	131	130	130	130	129	127
Yuen Long	1	202	192	192	184	173	172	169	164	160	157	156	154	153	153	153	153	150	150	149
Tuen Mun	4	268	256	210	201	191	191	188	186	186	185	185	182	182	178	175	169	168	168	167
Tung Chung	0	197	194	190	178	176	175	173	172	170	165	164	160	158	158	157	157	156	150	150
Tai Po	0	142	139	137	132	127	124	123	121	121	117	116	116	116	115	113	113	112	112	112
Sha Tin	0	176	162	161	161	155	155	155	154	153	149	148	145	144	143	143	141	140	138	137
Tap Mun	0	96	91	86	86	84	84	81	75	75	66	66	63	63	63	62	62	60	59	58
Causeway Bay	134	353	340	335	329	322	320	318	308	306	297	295	290	285	283	283	276	276	274	274
Central	79	302	301	298	294	291	290	288	288	285	280	280	278	276	273	272	270	265	263	258
Mong Kok	36	329	301	277	275	269	260	259	258	241	238	235	232	232	227	224	223	223	222	218

Table C1 (Cont.): 2016 Exceedance of Short Term Limits of Air Quality Objectives

Pollutant: Ozone (Daily maximum 8-hour limit = 160 μg/m^3 ; allowable no. of exceedance = 9)

Station	No. of exceedance	1st High	2nd High	3rd High	4th High	5th High	6th High	7th High	8th High	9th High	10th High
Central/Western	3	254	224	174	152	152	149	145	142	140	138
Eastern	4	226	213	164	161	141	138	137	135	135	132
Kwun Tong	0	155	144	140	135	124	124	123	123	117	116
Sham Shui Po	2	191	173	145	136	128	117	112	112	107	106
Kwai Chung	1	193	155	140	134	114	114	112	111	110	107
Tsuen Wan	3	185	162	161	136	134	128	128	125	116	116
Tseung Kwan O	7	237	236	179	171	168	164	162	157	156	152
Yuen Long	5	269	233	185	174	163	160	148	146	145	143
Tuen Mun	7	243	226	182	179	175	174	163	153	150	143
Tung Chung	4	230	217	180	168	157	156	147	144	142	142
Tai Po	5	283	261	167	165	164	159	151	148	147	147
Sha Tin	2	241	204	157	156	154	153	152	151	141	141
Tap Mun	15	289	212	184	176	174	173	173	171	170	169
Causeway Bay	0	112	91	86	82	74	73	72	72	70	69
Central	0	142	141	119	118	103	102	101	99	97	96
Mong Kok	0	103	88	76	75	75	74	74	72	72	71

Pollutant: Respirable Suspended Particulates (PM_{10}) (24-hour limit = 100 μg/m^3 ; allowable no. of exceedance = 9)

Station	No. of exceedance	1st High	2nd High	3rd High	4th High	5th High	6th High	7th High	8th High	9th High	10th High
Central/Western	2	120	102	100	98	89	88	84	84	82	80
Eastern	3	122	108	103	99	86	86	82	76	75	71
Kwun Tong	4	148	125	123	102	100	94	94	93	89	89
Sham Shui Po	3	118	107	106	96	89	87	87	83	78	77
Kwai Chung	1	105	94	90	88	77	77	77	73	72	71
Tsuen Wan	1	108	95	94	87	87	86	83	78	77	75
Tseung Kwan O	0	74	72	68	67	67	67	65	64	60	59
Yuen Long	4	128	105	103	102	98	92	91	90	90	86
Tuen Mun	10	141	123	120	117	117	116	113	111	106	103
Tung Chung	6	123	118	110	109	104	101	97	97	95	92
Tai Po	1	110	95	90	83	83	81	80	77	77	74
Sha Tin	2	102	101	95	77	75	74	72	71	67	66
Tap Mun	1	102	89	85	82	77	76	74	70	68	68
Causeway Bay	4	124	110	104	102	99	96	95	92	90	89
Central	1	108	99	99	97	91	89	89	86	86	82
Mong Kok	2	113	102	100	99	91	89	87	84	84	80

Pollutant: Fine Suspended Particulates ($PM_{2.5}$) (24-hour limit = 75 μg/m^3 ; allowable no. of exceedance = 9)

Station	No. of exceedance	1st High	2nd High	3rd High	4th High	5th High	6th High	7th High	8th High	9th High	10th High
Central/Western	0	70	64	64	62	61	57	55	54	53	50
Eastern	0	61	57	57	54	53	52	49	46	45	45
Kwun Tong	0	65	61	57	56	55	55	53	52	51	50
Sham Shui Po	0	63	60	58	57	56	55	50	49	49	48
Kwai Chung	0	59	59	54	54	51	51	51	51	50	50
Tsuen Wan	0	72	66	60	58	57	56	56	56	53	53
Tseung Kwan O	0	51	50	50	50	48	48	43	42	41	41
Yuen Long	1	76	69	68	68	67	65	65	64	63	63
Tuen Mun	2	81	81	74	74	70	70	69	68	66	63
Tung Chung	2	79	77	75	75	70	67	67	65	64	63
Tai Po	0	62	61	61	60	59	57	56	55	55	55
Sha Tin	0	62	60	56	54	51	50	47	47	46	44
Tap Mun	0	62	55	54	52	50	49	46	46	43	43
Causeway Bay	2	88	77	67	67	66	66	65	62	60	59
Central	0	73	66	64	63	62	58	56	53	51	50
Mong Kok	0	74	69	68	64	63	62	60	60	57	57

Notes:

1. All concentration units are in microgram per cubic metre (μg/m^3).
2. Shaded no. of exceedance are above their respective allowable limits.
3. Shaded concentrations are above their respective limits of air quality objectives.

Table C2: 2016 Monthly and Annual Averages of Air Pollutants

Pollutant: Sulphur Dioxide

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	6	15	11	10	5	7	8	13	13	9	6	9	9
Eastern	4	4	5	9	6	4	5	5	5	3	3	5	5
Kwun Tong	9	7	9	9	6	6	10	11	7	3	6	9	8
Sham Shui Po	6	8	8	10	8	9	11	13	10	8	10	10	9
Kwai Chung	5	8	11	16	11	15	17	14	14	9	9	11	12
Tsuen Wan	9	10	11	13	12	12	13	13	11	9	9	13	11
Tseung Kwan O	--	--	5 *	5	5	5	7	7	7	8	8	10	7 *
Yuen Long	11	12	9	8	9	10	10	9	10	9	9	11	10
Tuen Mun	9	9	9	10	8	10	11	12	17	20	4	6	10
Tung Chung	10	10	11	9	10	11	12	12	9	8	8	10	10
Tai Po	5	5	5	2	3	4	5	4	5	5	5	7	5
Sha Tin	6	6	5	6	6	7	10	8	8	5	7	10	7
Tap Mun	--	8 *	8	9	8	7	8	8	9	9	9	12	9 *
Causeway Bay	8	8	8	6	5	10	11	9	8	6	8	12	8
Central	8	9	9	9	8	11	9	7	8	7	6	8	8
Mong Kok	4	5	6	5	6	6	6	6	5	3	4	6	5

Pollutant: Nitrogen Oxides

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	70	74	100	87	42	40	35	60	68	50	58	69	63
Kwun Tong	78	97	94	115	95	130	142	107	112	61	70	74	98
Sham Shui Po	97	96	133	125	80	77	79	99	89	70	81	89	93
Kwai Chung	113	120	152	153	104	117	120	123	116	81	93	97	116
Tsuen Wan	108	109	150	159	87	89	89	98	81	67	71	88	100
Tseung Kwan O	--	--	52 *	53	41	52	55	53	60	30	31	39	46 *
Yuen Long	90	80	100	73	53	60	62	70	75	65	80	85	74
Tuen Mun	107	86	126	97	59	59	56	71	76	63	84	93	82
Tung Chung	83	68	80	51	34	39	36	55	59	50	62	74	58
Tai Po	60	55	62	51	40	47	47	46	50	42	48	67	51
Sha Tin	60	61	76	71	40	51	51	57	59	42	53	63	57
Tap Mun	--	15 *	15	14	10	9	14	14	15	12	13	17	13 *
Causeway Bay	244	286	293	242	188	211	217	241	290	224	219	257	243
Central	173	214	208	197	148	171	172	206	204	158	170	207	186
Mong Kok	171	180	192	188	163	160	181	174	168	136	147	162	168

Pollutant: Nitrogen Dioxide (Annual limit = 40 µg/m^3)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	50	50	56	49	32	26	23	41	49	39	46	57	43
Eastern	50	52	62	56	43	32	31	45	45	36	44	52	46
Kwun Tong	43	50	51	57	52	61	69	64	65	42	46	53	54
Sham Shui Po	60	59	71	65	51	46	47	61	60	49	57	66	58
Kwai Chung	58	62	67	63	55	53	53	64	62	47	57	65	59
Tsuen Wan	58	58	66	69	53	48	49	58	54	46	51	67	56
Tseung Kwan O	--	--	34 *	33	27	29	31	33	33	19	23	29	29 *
Yuen Long	49	46	56	43	33	32	36	46	48	42	53	63	46
Tuen Mun	54	51	68	56	41	38	37	49	53	43	57	68	51
Tung Chung	44	39	44	32	24	22	23	36	40	32	41	54	36
Tai Po	35	33	36	32	24	27	29	33	33	29	34	49	33
Sha Tin	40	40	47	45	29	29	32	39	36	28	37	46	38
Tap Mun	--	11 *	11	11	8	6	11	11	12	9	10	15	10 *
Causeway Bay	89	94	99	86	79	74	77	91	106	84	88	105	89
Central	74	81	84	76	70	63	65	84	88	72	79	102	78
Mong Kok	80	80	89	82	78	63	71	81	82	67	77	91	78

Pollutant: Carbon Monoxide

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tsuen Wan	1043	910	991	1003	893	785	492	564	654	726	887	868	818
Tseung Kwan O	--	--	857 *	884	946	658	864	785	809	781	911	891	838 *
Yuen Long	851	833	851	735	692	516	600	668	726	714	745	819	729
Tuen Mun	907	840	772	702	627	528	580	678	697	690	748	880	721
Tung Chung	870	915	742	855	585	494	556	673	610	835	832	795	730
Tap Mun	--	406 *	483	574	652	599	462	641	818	758	754	864	657 *
Causeway Bay	967	1028	1028	944	703	626	593	819	918	754	630	928	826
Central	736	832	846	741	656	609	722	854	916	893	911	1057	814
Mong Kok	1078	1103	1019	911	946	946	651	736	807	783	894	1015	906

Table C2 (Cont.): 2016 Monthly and Annual Averages of Air Pollutants

Pollutant: Ozone

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	36	36	44	35	49	32	38	45	55	42	49	54	43
Eastern	37	31	43	48	68	44	41	51	57	50	53	66	49
Kwun Tong	44	41	51	37	46	18	20	38	46	45	53	57	41
Sham Shui Po	31	30	33	25	37	19	21	30	42	34	38	45	32
Kwai Chung	35	33	42	35	35	16	20	30	38	34	36	44	33
Tsuen Wan	31	30	37	24	37	17	21	31	44	34	39	46	33
Tseung Kwan O	--	--	66 *	50	61	31	35	50	62	57	65	77	55 *
Yuen Long	24	28	29	30	44	26	32	43	50	37	35	48	35
Tuen Mun	26	30	31	31	44	22	27	36	48	33	35	43	34
Tung Chung	28	31	46	48	60	33	41	41	48	35	33	37	40
Tai Po	39	41	49	43	54	27	33	48	53	40	44	50	43
Sha Tin	42	40	47	39	54	24	27	37	51	45	46	57	42
Tap Mun	--	72 *	74	64	75	44	48	64	74	61	72	84	66 *
Causeway Bay	18	17	21	17	22	9	9	14	16	15	21	19	16
Central	23	20	28	22	32	12	14	16	23	20	29	30	22
Mong Kok	18	19	21	15	21	9	9	16	22	19	22	26	18

Pollutant: Respirable Suspended Particulates (PM_{10}) (Annual limit = 50 µg/m^3)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	34	43	45	35	28	16	19	23	31	27	33	51	32
Eastern	32	42	44	35	28	14	19	23	29	26	33	57 *	30
Kwun Tong	44	55	52	35	31	22	27	30	35	26	33	58	37
Sham Shui Po	37	45	46	35	30	19	24	28	33	30	35	52	35
Kwai Chung	31	38	37	33	30	24	29	31	37	28	33	49	33
Tsuen Wan	35	40	38	32	27	17	20	26	32	25	32	47	31
Tseung Kwan O	--	--	39 *	31	26	15	19	23	28	23	29	43	27 *
Yuen Long	39	47	46	32	28	18	21	29	39	36	44	66	37
Tuen Mun	46	54	50	44	30	22	30	38	47	43	47	72	44
Tung Chung	39	42	38	25	23	13	16	22	33	26	42	68	33
Tai Po	32	37	35	28	25	14	19	24	31	26	32	50	29
Sha Tin	30	38	38	29	26	15	19	22 *	30	26 *	28	43	29
Tap Mun	--	32 *	34	26	25	16	23	27	35	31	35	51	30 *
Causeway Bay	47	52	52	48	42	30	34	41	48	40	47	62	45
Central	35	43	40	32	28	17	22	25	30	22	33	51	31
Mong Kok	40	45	49	39	34	20	24	30	36	31	38	53	37

Pollutant: Fine Suspended Particulates ($PM_{2.5}$) (Annual limit = 35 µg/m^3)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	25	28	32	24	19	9	11	15	20	18	22	34	22
Eastern	26	26	24	20	16	7	12	16	20	18	23	38 *	20
Kwun Tong	28	30	27	23	20	13	18	20	23	19	22	34	23
Sham Shui Po	26	28	32	25	20	11	14	19	23	21	24	34	23
Kwai Chung	21	25	26	23	20	14	18	21	24	19	23	34	22
Tsuen Wan	24	26	27	22	17	11	13	18	22	18	22	33	21
Tseung Kwan O	--	--	27 *	20	17	7	10	14	17	15	19	29	17 *
Yuen Long	28	34	32	19	14	6	14	19	24	22	25	38	23
Tuen Mun	34	39	35	23	19	11	16	21	27	25	29	45	27
Tung Chung	24	24	24	16	15	7	10	15	22	19	29	45	21
Tai Po	24	25	25	20	17	8	12	16	21	18	23	36	20
Sha Tin	23	25	27	20	17	10	12	16 *	21	18 *	18	29	20
Tap Mun	--	23 *	25	19	17	8	13	16	20	19	21	32	19 *
Causeway Bay	33	35	37	35	30	21	23	29	33	28	33	43	32
Central	25	27	27	21	17	9	14	16	19	14	20	32	20
Mong Kok	31	31	37	29	24	13	17	22	26	23	27	38	26

Notes:

1. All concentration units are in microgram per cubic metre (µg/m^3).
2. Shaded annual averages are above their respective limits of air quality objectives.
3. Monthly average marked with asterisk denotes the data for calculation could not meet the 66% data capture target.
4. Annual average marked with asterisk denotes the data for calculation did not evenly distribute in the year.
5. Tseung Kwan O general air quality monitoring station comissioned on 16 March 2016.
6. Owing to renovation works, all pollutant data were not available at Tap Mun monitoring station between 1 January 2016 to 25 February 2016.

Table C3: 2016 Hourly Statistics of Air Pollutants

Pollutant: Sulphur Dioxide

Station	No. of hourly data	Data capture rate (%)	<----------Percentiles---------->									Arithmetic mean	Highest 1-hour
			10	25	50	75	90	95	97.5	99	99.8		
Central/Western	8549	97.3	3	5	8	12	17	22	28	35	52	9	103
Eastern	8540	97.2	1	2	4	6	10	12	16	21	32	5	81
Kwun Tong	8626	98.2	4	5	7	9	12	14	17	22	34	8	45
Sham Shui Po	8625	98.2	4	5	7	11	16	22	30	41	61	9	99
Kwai Chung	8534	97.2	4	6	8	13	25	32	40	49	74	12	133
Tsuen Wan	8430	96.0	7	8	9	12	18	23	29	37	52	11	88
Tseung Kwan O	6643	75.6	3	4	6	9	11	12	14	17	25	7*	40
Yuen Long	8455	96.3	7	8	9	11	14	16	19	22	30	10	48
Tuen Mun	8685	98.9	3	5	8	14	20	24	29	35	46	10	74
Tung Chung	8427	95.9	6	8	9	11	14	18	22	28	39	10	63
Tai Po	8700	99.0	2	3	4	6	8	9	10	14	20	5	35
Sha Tin	8466	96.4	3	4	6	9	12	14	17	22	32	7	59
Tap Mun	7173	81.7	6	7	8	10	12	14	16	18	26	9*	40
Causeway Bay	8487	96.6	3	5	7	10	15	18	22	27	39	8	57
Central	8574	97.6	3	5	7	10	15	20	25	33	46	8	74
Mong Kok	8659	98.6	2	3	4	6	10	15	21	31	46	5	72

Pollutant: Nitrogen Oxides

Station	No. of hourly data	Data capture rate (%)	<----------Percentiles---------->									Arithmetic mean	Highest 1-hour
			10	25	50	75	90	95	97.5	99	99.8		
Central/Western	8520	97.0	14	25	46	77	125	173	229	330	504	63	666
Kwun Tong	8619	98.1	24	41	71	131	214	263	304	369	467	98	740
Sham Shui Po	8626	98.2	31	53	80	113	159	203	265	374	542	93	812
Kwai Chung	8470	96.4	35	62	98	146	207	258	313	450	795	116	1189
Tsuen Wan	8402	95.7	33	58	82	114	173	235	310	420	707	100	981
Tseung Kwan O	6593	75.1	14	19	29	57	100	139	176	217	292	46*	490
Yuen Long	8440	96.1	29	43	65	93	129	163	196	244	338	74	717
Tuen Mun	8643	98.4	26	42	68	102	152	189	238	301	474	82	688
Tung Chung	8441	96.1	14	24	45	78	118	146	177	221	286	58	428
Tai Po	8694	99.0	18	28	45	65	93	114	135	160	208	51	306
Sha Tin	8455	96.3	18	26	44	72	117	151	180	218	291	57	372
Tap Mun	7175	81.7	5	7	11	16	23	30	39	53	84	13*	172
Causeway Bay	8443	96.1	79	129	206	324	452	535	620	738	945	243	1170
Central	8637	98.3	55	91	157	249	356	428	505	615	776	186	1167
Mong Kok	8627	98.2	64	103	156	215	281	335	387	467	601	168	805

Pollutant: Nitrogen Dioxide (1-hour limit = 200 μg/m^3; allowable no. of exceedance = 18)

Station	No. of hourly data	Data capture rate (%)	<----------Percentiles---------->									Arithmetic mean	Highest 1-hour	No. of exceed-ance
			10	25	50	75	90	95	97.5	99	99.8			
Central/Western	8520	97.0	12	22	39	58	78	95	112	127	153	43	180	0
Eastern	8599	97.9	20	29	43	58	74	86	97	110	136	46	164	0
Kwun Tong	8619	98.1	22	33	48	70	94	111	131	158	202	54	317	18
Sham Shui Po	8626	98.2	26	38	54	73	92	106	120	138	163	58	207	4
Kwai Chung	8470	96.4	25	40	55	72	97	115	134	154	185	59	222	8
Tsuen Wan	8402	95.7	25	39	53	69	90	108	122	141	178	56	225	8
Tseung Kwan O	6593	75.1	10	15	22	36	56	72	87	106	131	29*	185	0
Yuen Long	8440	96.1	21	29	42	57	74	87	100	116	150	46	202	1
Tuen Mun	8643	98.4	22	32	47	66	87	100	113	134	168	51	268	4
Tung Chung	8441	96.1	10	19	31	48	67	81	95	115	151	36	197	0
Tai Po	8694	99.0	12	20	30	43	56	67	76	88	112	33	142	0
Sha Tin	8455	96.3	14	21	32	48	70	84	97	114	138	38	176	0
Tap Mun	7175	81.7	3	5	8	13	19	25	32	42	62	10*	96	0
Causeway Bay	8443	96.1	41	60	85	111	141	161	184	223	274	89	353	134
Central	8637	98.3	33	50	73	99	127	148	169	197	262	78	302	79
Mong Kok	8627	98.2	39	55	75	97	120	138	156	178	221	78	329	36

Pollutant: Carbon Monoxide (1-hour limit = 30,000 μg/m^3 ; allowable no. of exceedance = 0)

Station	No. of hourly data	Data capture rate (%)	<----------Percentiles---------->									Arithmetic mean	Highest 1-hour	No. of exceed-ance
			10	25	50	75	90	95	97.5	99	99.8			
Tsuen Wan	8443	96.1	490	660	800	970	1150	1250	1330	1430	1796	818	2750	0
Tseung Kwan O	6643	75.6	600	700	820	950	1090	1180	1280	1416	1640	838*	1850	0
Yuen Long	8457	96.3	480	600	720	850	1000	1110	1210	1310	1561	729	2080	0
Tuen Mun	8678	98.8	500	570	690	820	1000	1112	1230	1360	1646	721	2050	0
Tung Chung	8441	96.1	440	540	710	880	1070	1160	1250	1386	1560	730	2260	0
Tap Mun	7177	81.7	390	520	680	770	890	950	1030	1170	1440	657*	1470	0
Causeway Bay	8348	95.0	460	590	770	1010	1250	1420	1600	1830	2153	826	3130	0
Central	8618	98.1	510	630	780	960	1160	1310	1430	1590	1790	814	2000	0
Mong Kok	8656	98.5	620	740	880	1040	1210	1340	1460	1605	1850	906	2570	0

Table C3 (Cont.): 2016 Hourly Statistics of Air Pollutants

Pollutant: Ozone

Station	No. of hourly data	Data capture rate (%)	<----------Percentiles---------->									Arithmetic mean	Highest 1-hour
			10	25	50	75	90	95	97.5	99	99.8		
Central/Western	8507	96.8	5	19	36	61	89	102	116	136	211	43	323
Eastern	8569	97.6	17	27	44	67	87	101	115	132	171	49	291
Kwun Tong	8554	97.4	6	14	34	62	87	101	111	125	148	41	177
Sham Shui Po	8580	97.7	4	11	25	47	72	85	97	112	151	32	260
Kwai Chung	8480	96.5	6	10	25	49	73	86	99	112	148	33	268
Tsuen Wan	8426	95.9	4	10	24	48	75	89	101	121	166	33	245
Tseung Kwan O	6632	75.5	7	22	48	81	113	126	139	158	221	55*	325
Yuen Long	8448	96.2	4	11	26	49	79	99	123	155	232	35	327
Tuen Mun	8667	98.7	6	10	24	47	79	96	115	150	234	34	297
Tung Chung	8418	95.8	7	16	34	55	83	100	119	152	212	40	283
Tai Po	8697	99.0	4	15	35	64	96	112	129	151	204	43	347
Sha Tin	8422	95.9	3	13	33	64	96	111	125	146	176	42	314
Tap Mun	7147	81.4	21	36	58	89	123	140	154	171	215	66*	355
Causeway Bay	8322	94.7	2	4	10	23	41	53	64	74	94	16	133
Central	8625	98.2	2	5	13	32	59	74	86	100	127	22	235
Mong Kok	8637	98.3	2	5	12	26	43	54	64	76	94	18	155

Pollutant: Respirable Suspended Particulates (PM_{10})

Station	No. of hourly data	Data capture rate (%)	<----------Percentiles---------->									Arithmetic mean	Highest 1-hour
			10	25	50	75	90	95	97.5	99	99.8		
Central/Western	8544	97.3	11	17	27	42	58	71	85	107	137	32	170
Eastern	7828	89.1	10	16	26	40	57	69	80	98	141	30	189
Kwun Tong	8253	94.0	14	21	32	47	67	80	95	112	162	37	209
Sham Shui Po	8351	95.1	14	20	30	44	60	73	87	107	134	35	172
Kwai Chung	8524	97.0	15	21	30	41	55	67	79	94	123	33	152
Tsuen Wan	8439	96.1	11	18	27	40	55	68	84	103	133	31	161
Tseung Kwan O	6738	76.7	10	17	23	36	48	58	68	78	93	27*	110
Yuen Long	8484	96.6	13	20	32	49	69	82	95	112	140	37	227
Tuen Mun	8366	95.2	18	26	38	55	77	95	111	130	164	44	249
Tung Chung	8506	96.8	9	15	26	43	62	81	99	118	155	33	191
Tai Po	8657	98.6	10	16	25	38	54	69	81	97	120	29	142
Sha Tin	7785	88.6	10	16	25	37	52	64	75	92	119	29	137
Tap Mun	7132	81.2	12	18	26	39	54	65	75	88	108	30*	128
Causeway Bay	8283	94.3	21	30	42	56	72	86	99	117	148	45	186
Central	8480	96.5	9	16	27	41	58	73	88	110	143	31	167
Mong Kok	8604	98.0	14	22	33	47	63	76	90	108	136	37	163

Pollutant: Fine Suspended Particulates ($PM_{2.5}$)

Station	No. of hourly data	Data capture rate (%)	<----------Percentiles---------->									Arithmetic mean	Highest 1-hour
			10	25	50	75	90	95	97.5	99	99.8		
Central/Western	8544	97.3	7	11	19	28	39	48	57	68	84	22	113
Eastern	7656	87.2	5	10	17	27	37	45	51	60	73	20	93
Kwun Tong	8302	94.5	9	13	21	29	40	48	57	65	79	23	93
Sham Shui Po	8351	95.1	9	13	21	30	41	49	57	65	78	23	100
Kwai Chung	8381	95.4	9	14	20	28	38	46	54	63	79	22	89
Tsuen Wan	8453	96.2	7	11	18	28	39	49	58	72	93	21	114
Tseung Kwan O	6628	75.5	4	8	15	24	33	41	48	55	64	17*	77
Yuen Long	8474	96.5	6	11	20	31	43	54	64	72	88	23	103
Tuen Mun	8356	95.1	8	14	24	37	50	60	69	82	104	27	122
Tung Chung	8446	96.2	5	9	17	28	42	55	66	81	103	21	133
Tai Po	8657	98.6	6	10	18	27	38	47	58	65	80	20	95
Sha Tin	7785	88.6	6	11	17	26	37	45	54	62	77	20	88
Tap Mun	7175	81.7	6	10	17	26	35	42	48	56	72	19*	83
Causeway Bay	8283	94.3	14	21	29	39	51	60	69	80	103	32	141
Central	8479	96.5	5	10	17	27	38	49	58	70	90	20	119
Mong Kok	8604	98.0	10	15	24	34	46	55	64	75	87	26	121

Notes:

1. All concentration units are in microgram per cubic metre ($\mu g/m^3$).
2. Shaded no. of exceedance are above their respective allowable limits.
3. Annual average marked with asterisk denotes the data for calculation did not evenly distribute in the year.
4. Tseung Kwan O general air quality monitoring station comissioned on 16 March 2016.
5. Owing to renovation works, all pollutant data were not available at Tap Mun monitoring station between 1 January 2016 to 25 February 2016.

Table C4: 2016 Diurnal Variations of Air Pollutants

Pollutant: Sulphur Dioxide

Station	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23	Hr24
Central/Western	9	9	9	9	9	9	9	10	10	10	10	10	9	9	9	9	9	9	9	10	10	9	9	9
Eastern	5	5	5	4	4	4	4	6	5	5	5	5	4	4	4	4	5	5	5	5	7	6	5	5
Kwun Tong	8	7	7	9	7	7	7	8	8	8	8	8	8	7	7	7	7	8	8	8	8	8	8	8
Sham Shui Po	9	9	9	12	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	10	10	9	9	10
Kwai Chung	11	10	10	9	9	9	9	11	12	12	12	12	13	13	13	14	14	14	14	13	12	11	11	11
Tsuen Wan	10	10	10	9	11	10	10	10	11	11	12	12	12	13	13	13	13	13	13	12	11	11	10	10
Tseung Kwan O	7	6	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Yuen Long	10	9	9	10	9	9	9	10	10	10	10	10	10	10	10	10	10	11	11	10	10	10	10	10
Tuen Mun	10	10	10	9	9	9	9	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	11	10
Tung Chung	9	9	9	9	9	9	9	9	10	11	11	11	11	12	12	12	11	10	10	9	9	9	9	9
Tai Po	4	4	4	5	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4
Sha Tin	6	5	5	9	7	8	7	7	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Tap Mun	8	8	8	9	8	8	8	9	10	10	10	10	10	9	9	9	9	9	9	8	8	8	8	8
Causeway Bay	7	7	7	6	6	6	7	9	10	10	9	9	9	9	9	9	9	9	9	9	8	8	8	7
Central	7	7	7	7	6	6	7	9	10	10	9	9	8	8	8	9	9	9	10	10	9	8	8	8
Mong Kok	5	5	5	5	4	4	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6

Pollutant: Nitrogen Oxides

Station	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23	Hr24
Central/Western	54	45	41	35	33	34	42	68	84	88	79	72	66	64	66	69	72	73	76	80	76	69	63	62
Kwun Tong	77	51	41	36	35	49	92	126	141	136	121	111	104	108	113	117	122	131	136	122	104	95	91	91
Sham Shui Po	77	63	54	49	48	54	79	103	119	117	107	103	95	99	103	104	110	117	125	119	106	98	93	90
Kwai Chung	93	72	61	53	56	61	97	136	164	156	138	130	127	128	132	140	148	149	156	140	120	112	108	102
Tsuen Wan	82	58	48	41	43	53	83	111	133	128	122	114	107	109	112	115	121	127	132	122	108	100	100	95
Tseung Kwan O	54	46	38	34	30	42	69	63	49	42	37	35	35	35	36	38	41	47	53	57	59	54	56	56
Yuen Long	65	54	46	40	41	50	75	104	99	84	74	68	64	69	70	75	83	88	94	93	87	83	84	78
Tuen Mun	73	60	53	44	44	53	73	98	106	102	95	86	78	76	78	82	88	99	106	104	98	91	90	81
Tung Chung	53	43	36	32	31	37	49	62	70	68	67	66	66	66	66	66	66	67	68	64	60	57	56	55
Tai Po	48	39	31	27	28	32	53	78	75	59	51	45	43	44	46	49	55	60	66	66	61	59	57	55
Sha Tin	62	51	43	37	37	40	57	75	74	64	55	48	45	46	49	51	57	63	70	73	73	69	68	66
Tap Mun	13	13	13	12	12	12	13	14	16	17	15	14	13	12	12	12	12	13	14	14	14	14	13	13
Causeway Bay	192	140	126	106	101	97	167	257	305	302	292	293	288	307	299	313	320	310	313	297	260	259	268	218
Central	134	103	91	81	78	84	127	192	268	265	241	227	212	199	213	227	220	251	280	248	206	183	170	161
Mong Kok	128	97	88	79	76	79	113	157	191	196	203	202	197	207	209	213	229	241	244	216	180	173	174	159

Pollutant: Nitrogen Dioxide

Station	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23	Hr24
Central/Western	38	31	28	25	24	25	31	43	48	49	47	45	44	43	45	49	53	55	58	59	56	50	46	43
Eastern	40	34	29	26	25	27	39	51	53	52	49	48	47	48	50	53	56	59	59	56	55	50	47	45
Kwun Tong	48	36	31	27	27	33	48	59	63	61	58	57	57	60	63	66	70	74	76	70	61	57	55	53
Sham Shui Po	50	41	36	33	32	35	47	57	61	60	58	59	58	62	65	68	72	76	80	77	70	65	61	58
Kwai Chung	49	39	34	30	31	34	46	59	66	65	63	63	65	67	72	76	79	81	81	74	65	61	58	54
Tsuen Wan	49	35	30	27	26	31	45	55	61	60	59	59	59	63	66	69	72	77	80	75	67	62	60	56
Tseung Kwan O	32	28	23	21	19	24	31	31	28	25	23	22	23	24	24	26	29	34	38	39	38	36	35	34
Yuen Long	42	36	31	28	29	32	39	46	47	44	42	41	41	44	46	50	56	60	63	61	57	54	51	47
Tuen Mun	48	42	38	32	32	36	42	49	52	52	52	50	49	51	53	56	62	68	71	69	64	59	56	52
Tung Chung	32	27	23	21	20	23	26	31	35	37	38	40	41	44	44	45	46	47	46	43	39	37	35	34
Tai Po	32	26	22	19	19	21	29	38	38	33	30	28	27	29	31	33	38	43	47	47	43	40	38	36
Sha Tin	39	33	29	25	25	27	34	41	41	38	34	31	30	31	34	36	41	46	51	52	49	46	44	43
Tap Mun	11	11	11	10	10	10	10	10	11	11	10	10	9	9	9	9	10	11	12	12	12	12	11	11
Causeway Bay	73	58	52	46	44	44	66	89	96	98	98	102	105	112	113	117	120	115	115	109	99	97	97	82
Central	59	48	44	40	40	42	55	73	90	92	89	91	91	91	97	101	100	107	111	102	89	80	74	69
Mong Kok	65	53	48	44	43	44	56	68	76	79	84	88	91	96	98	101	106	108	107	98	87	83	81	76

Pollutant: Carbon Monoxide

Station	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23	Hr24
Tsuen Wan	793	750	728	717	709	734	783	840	864	845	834	809	802	813	817	820	830	850	884	897	890	872	862	835
Tseung Kwan O	869	840	826	806	787	803	856	860	833	814	803	799	796	797	792	795	806	827	870	897	908	900	900	900
Yuen Long	728	700	693	647	657	656	701	753	756	734	726	707	705	709	708	715	729	749	783	802	796	784	781	755
Tuen Mun	714	695	681	658	694	714	717	762	752	740	733	704	693	693	685	684	698	719	759	776	780	775	755	731
Tung Chung	718	706	701	684	688	692	706	721	733	726	725	729	730	735	738	739	755	766	774	761	755	743	737	729
Tap Mun	657	654	654	652	655	664	674	673	671	670	662	656	651	650	644	645	644	649	657	656	658	660	660	659
Causeway Bay	835	886	840	781	735	706	699	709	745	787	853	855	868	873	857	852	827	837	856	906	940	925	853	805
Central	786	753	729	698	675	686	690	751	822	875	872	834	826	863	840	821	822	860	925	953	933	889	837	812
Mong Kok	908	936	901	856	836	795	789	825	874	894	876	858	864	929	939	934	967	990	1030	1029	984	936	900	902

Table C4 (Cont.): 2016 Diurnal Variations of Air Pollutants

Pollutant: Ozone

Station	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23	Hr24
Central/Western	41	44	46	47	47	44	38	29	28	31	37	46	53	58	59	57	54	48	41	36	36	38	38	39
Eastern	46	49	51	52	52	49	40	33	34	39	45	53	60	62	62	61	58	53	50	49	46	46	46	44
Kwun Tong	38	44	46	47	47	41	32	28	28	33	39	45	50	52	51	50	47	42	37	37	39	39	38	36
Sham Shui Po	30	35	37	39	38	35	27	21	21	25	31	36	42	45	45	43	39	32	25	24	25	26	27	27
Kwai Chung	30	37	38	39	38	36	28	22	21	25	32	38	41	44	43	41	37	32	28	27	29	30	29	30
Tsuen Wan	29	36	38	40	40	35	25	21	22	27	32	38	43	46	47	46	42	34	26	24	26	26	25	25
Tseung Kwan O	41	43	45	45	45	40	35	38	44	53	61	69	74	80	82	80	77	68	58	52	49	47	45	42
Yuen Long	26	28	30	31	29	26	21	18	22	30	39	49	58	62	65	62	54	43	33	28	26	25	24	24
Tuen Mun	27	29	31	32	32	28	23	20	21	26	33	42	50	57	60	57	50	38	29	25	25	26	25	26
Tung Chung	33	35	37	37	36	32	29	27	29	33	40	46	53	58	61	62	58	49	40	36	35	35	34	34
Tai Po	32	34	36	36	35	32	25	22	28	39	49	60	68	72	73	71	64	55	44	38	36	34	33	32
Sha Tin	32	35	36	38	37	34	28	25	30	38	47	57	63	67	67	65	58	51	42	37	35	34	32	31
Tap Mun	51	50	48	48	46	45	45	48	54	61	71	80	87	93	95	95	92	86	78	70	65	60	57	54
Causeway Bay	17	21	23	26	27	26	18	12	10	11	12	14	15	16	15	15	15	16	14	14	15	14	14	17
Central	26	30	32	33	33	30	23	16	13	14	16	21	25	26	25	24	23	19	16	15	17	20	21	22
Mong Kok	17	22	24	26	26	26	18	12	11	13	15	18	21	22	22	21	18	15	13	13	14	15	14	14

Pollutant: Respirable Suspended Particulates (PM_{10})

Station	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23	Hr24
Central/Western	31	30	30	29	28	28	28	29	30	32	33	34	34	34	35	35	35	35	34	34	35	34	33	32
Eastern	30	29	29	29	28	27	28	28	29	30	30	32	32	31	31	33	33	33	33	32	31	32	31	30
Kwun Tong	35	34	34	33	32	32	33	34	37	38	39	40	39	40	41	41	41	41	41	41	41	38	36	35
Sham Shui Po	35	33	32	31	30	30	30	30	31	30	30	30	30	33	36	39	40	40	40	40	41	41	39	37
Kwai Chung	30	29	28	28	28	28	29	31	34	35	36	35	34	35	37	38	38	38	38	37	36	34	33	31
Tsuen Wan	29	28	27	26	26	26	26	27	29	30	31	32	32	34	35	36	37	36	35	36	36	34	32	30
Tseung Kwan O	27	26	26	25	25	24	24	25	25	25	26	26	27	27	27	28	30	30	31	30	30	29	29	28
Yuen Long	35	33	32	32	32	31	32	33	35	38	39	40	40	40	41	41	41	42	41	41	40	39	38	36
Tuen Mun	42	41	39	38	37	38	38	39	40	42	44	45	45	45	47	49	49	48	48	49	48	47	46	44
Tung Chung	30	29	29	28	27	27	27	28	29	30	32	33	35	37	39	41	41	39	36	34	33	33	32	31
Tai Po	30	29	28	27	27	27	27	28	29	29	29	29	29	29	30	30	30	30	31	32	32	32	31	30
Sha Tin	29	28	27	27	27	26	26	28	28	29	29	29	30	29	30	30	31	31	31	31	31	31	30	29
Tap Mun	29	29	28	28	28	29	30	29	29	30	31	31	32	32	32	32	32	32	32	32	31	30	30	30
Causeway Bay	42	37	33	32	31	30	32	38	42	46	49	49	49	52	55	53	52	54	54	56	55	52	49	46
Central	30	28	26	25	25	24	25	27	30	33	33	33	33	35	35	35	35	35	35	35	36	35	33	31
Mong Kok	34	32	30	29	29	28	29	32	35	36	37	39	39	40	42	42	41	41	41	43	44	41	38	36

Pollutant: Fine Suspended Particulates ($PM_{2.5}$)

Station	Hr01	Hr02	Hr03	Hr04	Hr05	Hr06	Hr07	Hr08	Hr09	Hr10	Hr11	Hr12	Hr13	Hr14	Hr15	Hr16	Hr17	Hr18	Hr19	Hr20	Hr21	Hr22	Hr23	Hr24
Central/Western	21	21	20	20	20	20	19	20	21	22	22	22	22	22	23	22	23	23	22	22	23	23	22	21
Eastern	20	19	19	19	18	18	19	19	19	20	19	20	20	20	20	20	20	20	21	20	20	20	20	20
Kwun Tong	21	20	20	20	20	20	21	22	23	24	23	23	23	24	24	24	24	25	26	26	26	25	23	22
Sham Shui Po	24	23	22	21	21	21	21	21	21	21	20	20	20	21	23	24	24	25	25	26	28	28	27	25
Kwai Chung	21	20	19	19	19	20	21	22	23	23	23	22	22	23	24	24	24	25	25	25	24	23	22	21
Tsuen Wan	20	19	18	18	18	18	18	19	20	20	21	21	21	23	23	24	24	24	24	24	25	24	22	21
Tseung Kwan O	18	17	17	16	16	16	16	17	17	17	17	17	17	17	17	18	17	18	19	18	18	18	18	18
Yuen Long	22	22	21	20	21	21	21	22	23	24	24	24	24	25	25	25	24	24	25	24	24	24	23	23
Tuen Mun	27	26	25	25	24	24	25	25	26	26	27	26	26	26	27	28	28	28	29	30	30	30	29	28
Tung Chung	20	20	19	18	18	18	18	19	19	20	20	21	21	23	25	25	26	25	23	23	22	21	21	21
Tai Po	21	20	20	19	19	19	19	20	21	21	20	20	20	20	20	21	20	21	21	22	23	22	22	21
Sha Tin	20	20	19	19	19	18	19	20	20	21	20	20	21	20	20	20	20	20	21	21	21	21	21	20
Tap Mun	18	18	18	18	18	19	20	19	18	19	19	19	19	19	19	19	20	19	20	20	19	19	19	19
Causeway Bay	30	26	23	22	21	21	22	27	29	32	32	32	33	36	37	36	36	37	38	40	41	39	36	34
Central	19	18	17	17	16	16	16	18	20	21	21	21	20	22	22	22	22	22	22	23	24	23	21	20
Mong Kok	25	23	22	22	21	21	22	24	26	26	26	27	27	29	29	29	29	29	29	31	33	31	28	26

Notes:

1. All concentration units are in microgram per cubic metre ($\mu g/m^3$).
2. Tseung Kwan O general air quality monitoring station comissioned on 16 March 2016.
3. Owing to renovation works, all pollutant data were not available at Tap Mun monitoring station between 1 January 2016 to 25 February 2016.

Table C5: 2016 Total Wet and Dry Deposition

(a) Wet Deposition

	Monitoring Station	Central/Western	Kwun Tong	Yuen Long
	Wet Deposition (tonne/ha)	31632	34990	27064
	Weighted Mean pH (based on volume-weighted mean hydrogen ion concentrations ($[H^+]$)	4.81	4.87	4.88
	Weighted Mean pH (based on volume-weighted mean pH)	5.07	5.12	5.10
	Number of Samples	134	137	124
Filtrate (Kg/Ha)	**NH_4^+**	13.13	14.17	11.45
	NO_3^-	33.55	32.59	25.31
	SO_4^{2-}	37.99	40.06	25.50
	Cl^-	34.01	36.03	12.18
	F^-	0.79	0.86	0.69
	Na^+	19.36	21.34	8.69
	K^+	7.91	8.57	6.79
	Formate	8.97	9.76	8.22
	Acetate	7.34	7.32	6.66
	Ca^{2+}	5.73	5.59	4.15
	Mg^{2+}	2.54	2.60	1.14

** 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
	Number of Samples	26	26	26
Filtrate (Kg/Ha)	**NH_4^+**	0.26	0.79	0.15
	NO_3^-	6.67	8.96	7.26
	SO_4^{2-}	5.16	6.24	4.69
	Cl^-	7.03	7.45	2.92
	F^-	0.044	0.041	0.062
	Na^+	4.45	4.87	1.88
	K^+	0.36	0.44	0.39
	Formate	0.16	0.16	0.18
	Acetate	0.17	0.16	0.17
	Ca^{2+}	4.48	4.28	5.39
	Mg^{2+}	0.64	0.72	0.38

Table C6: 2016 Ambient levels of toxic air pollutants

Toxic Air Pollutants	Concentration Unit	Annual Averages [1]	
		Tsuen Wan [2]	Central/Western
Heavy Metals			
Hexavalent chromium	ng/m^3	0.11	0.11
Lead [3]	ng/m^3	15	14
Organic Substances			
Benzene	μg/m^3	2.27	1.17
Benzo[a]pyrene	ng/m^3	0.09	0.07
1,3-Butadiene	μg/m^3	0.10	0.07
Formaldehyde [4]	μg/m^3	4.02	-
Perchloroethylene	μg/m^3	0.60	0.62
Dioxins [5]	pgI-TEQ/m^3	0.025	0.022

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] Due to the influence from renovation works at Princess Alexandra Community Centre and nearby buildings of Tsuen Wan Station, the measurements of carbonyl compounds (formaldehyde) and volatile organic compounds (benzene, 1,3-butadiene and perchloroethylene) at Tsuen Wan Station were temporary relocated to Kwai Chung Station since January 2015.

[3] For lead the reported figures are the respective 2016 annual average concentrations in the elemental analysis of respirable suspended particulates.

[4] The measurement of carbonyl compounds (formaldehyde) at Central/Western Station was affected by influence from the construction works at Sai Ying Pun Community Complex. Hence, the measurement result is not reported in 2016.

[5] 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).