AIR QUALITY
IN HONG KONG 2019

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 (2019)

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Summary

This report summarises the 2019 air quality monitoring data collected by the Environmental Protection Department's monitoring network comprising 13 general stations and 3 roadside stations.

The air quality in Hong Kong has been continuously improving. The Hong Kong Special Administrative Region (HKSAR) Government has implemented a wide range of measures targeting different local emission sources including motor vehicles, power plants and vessels. On the regional front, the HKSAR Government has worked closely with the Guangdong Provincial Government in cutting emissions in the Pearl River Delta Region.

As a result of the numerous emission control measures implemented over the years, the concentrations of major air pollutants including respirable suspended particulates (RSP), fine suspended particulates (FSP), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) both at the roadside and in ambient air have declined steadily since 1999, falling by 19% to 81%.

While we have seen evident improvement in the overall air quality of Hong Kong, there remain challenges ahead. Roadside NO_2 levels still exceed the Hong Kong Air Quality Objectives (AQOs), despite falling 34% from its peak in 2011. Meanwhile, ambient ozone (O_3), which is mainly influenced by the regional photochemical smog problem, is still on a rise. The HKSAR Government will strengthen its collaboration with Guangdong to further reduce emissions in the region to alleviate the regional photochemical smog and O_3 problems, and continue its efforts to take forward additional measures to reduce local emissions.

As in previous years, concentrations of carbon monoxide and lead in 2019 remain at levels well below their respective AQO limits.

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1. Introduction

1.1 Air Quality Monitoring Network

The Environmental Protection Department (EPD) operates a network of air quality monitoring stations for measuring the concentrations of major air pollutants in Hong Kong. In 2019, the network was composed of 16 monitoring stations, with 13 general stations and 3 roadside stations monitoring ambient air quality and roadside air quality respectively. Details of these monitoring stations are set out 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.

The monitoring network operated smoothly in 2019. The average monthly data capture rate for the six air pollutants, namely sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), respirable suspended particulates (RSP or PM_{10}) and fine suspended particulates (FSP or $PM_{2.5}$) measured at all monitoring stations was 97.5%.

Figure 1: Locations of EPD's Air Quality Monitoring Stations (2019)

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 SO_2 and NO_2 in the vicinity of their power generating stations. The locations of these monitoring stations and the relevant monitoring results can be found on the power companies' web sites below:

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

1.2 Quality Control (QC) and Quality Assurance (QA)

To ensure that the air quality data from the monitoring stations are highly accurate and reliable, a quality system has been established in accordance with the Hong Kong Laboratory Accreditation Scheme (HOKLAS) criteria. Quality control and quality assurance work was carried out in accordance with EPD's quality manuals and with reference to international requirements. Performance audits and precision checks were conducted to check if the accuracy and precision of the network attained our performance goals. The details are set out at section B3.

1.3 Statistical Analysis of Pollutant Concentrations

In this Report, the concentrations of gaseous air pollutants are adjusted to a reference temperature of 293K and a reference pressure of 101.325 kPa. The concentrations of particulate matters are measured at real-time temperature and atmospheric pressure during monitoring.

2. Gaseous Pollutants

2.1 Sulphur Dioxide (SO_2)

SO_2 is formed primarily from the combustion of sulphur-containing fossil fuels. In Hong Kong, emissions from 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 2019
(10-Minute Average Statistics)

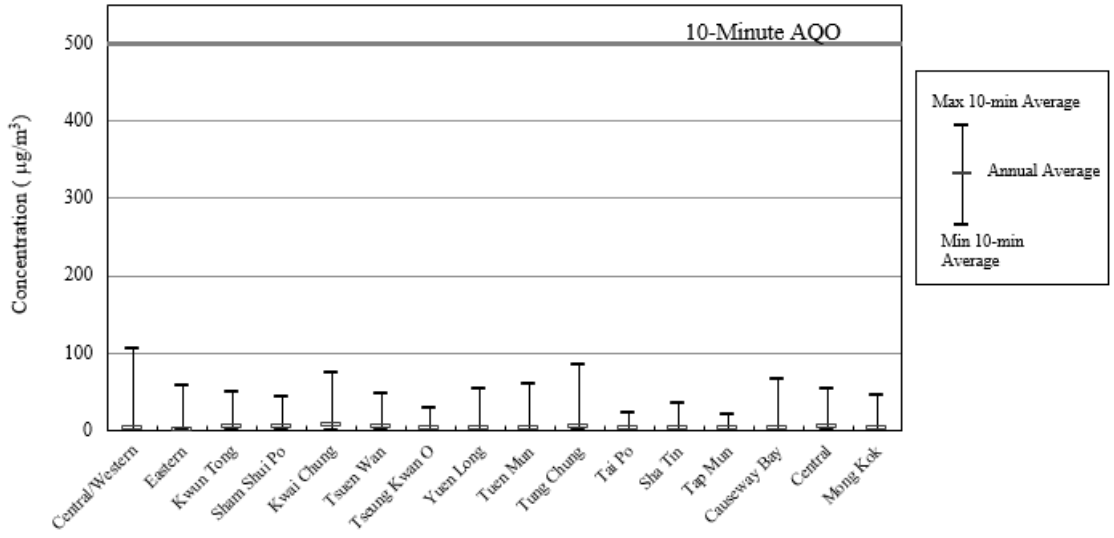
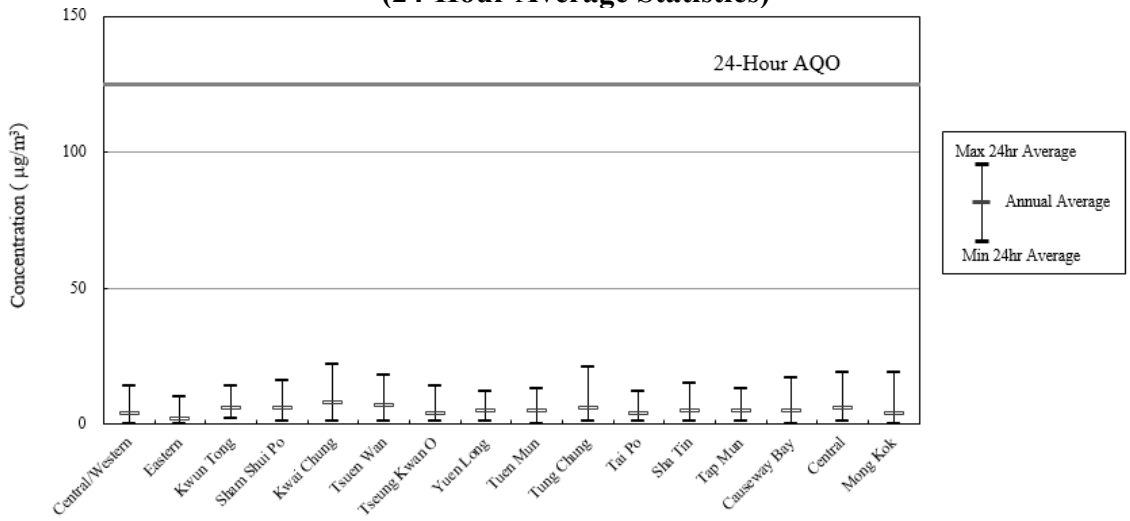


Figure 2b: Sulphur Dioxide Monitoring 2019
(24-Hour Average Statistics)



SO_2 was measured at all the 16 monitoring stations in 2019. As in previous years, SO_2 concentrations remained low throughout the territory. All monitoring stations complied with the Hong Kong Air Quality Objectives[1] (AQOs) for SO_2. The highest 10-minute average (105 µg/m^3) and 24-hour average (22 µg/m^3) were recorded at Central/Western and Kwai Chung general stations respectively. Both were well below the 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 (NOx). From an air pollution standpoint, the most important NOx in the atmosphere are nitric oxide (NO) and 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, 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.

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

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 2019. The highest 1-hour average (366 μg/m^3) and the highest annual average (81 μg/m^3) were both recorded at Causeway Bay roadside station. All general stations complied with the 1-hour AQO (200 μg/m^3 with allowance of 18 exceedances of AQO limit per year), whereas 7 general stations also complied with the annual AQO (40 μg/m^3). Non-compliance with the 1-hour and annual AQOs for NO_2 were recorded at all the 3 roadside stations.

Figure 3a: Nitrogen Dioxide Monitoring 2019
(1-Hour Average Statistics)

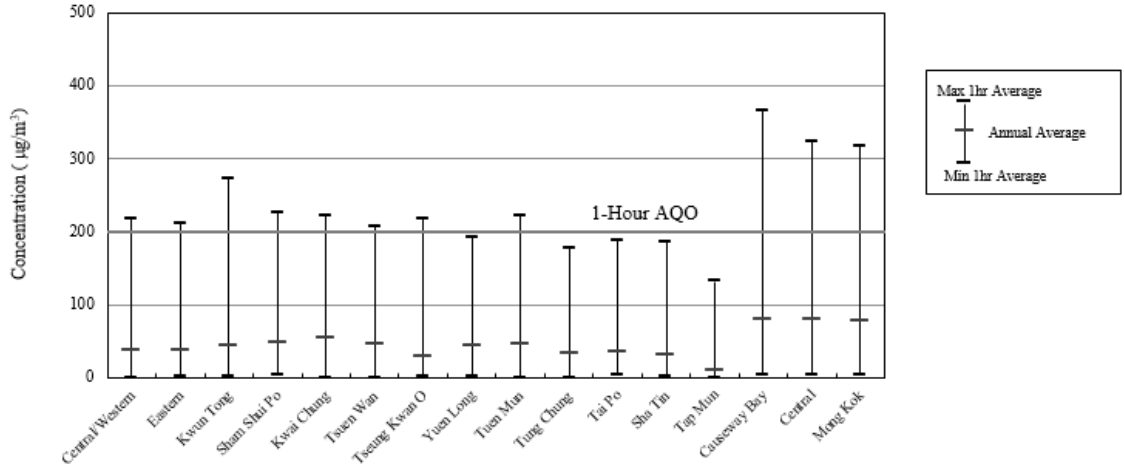
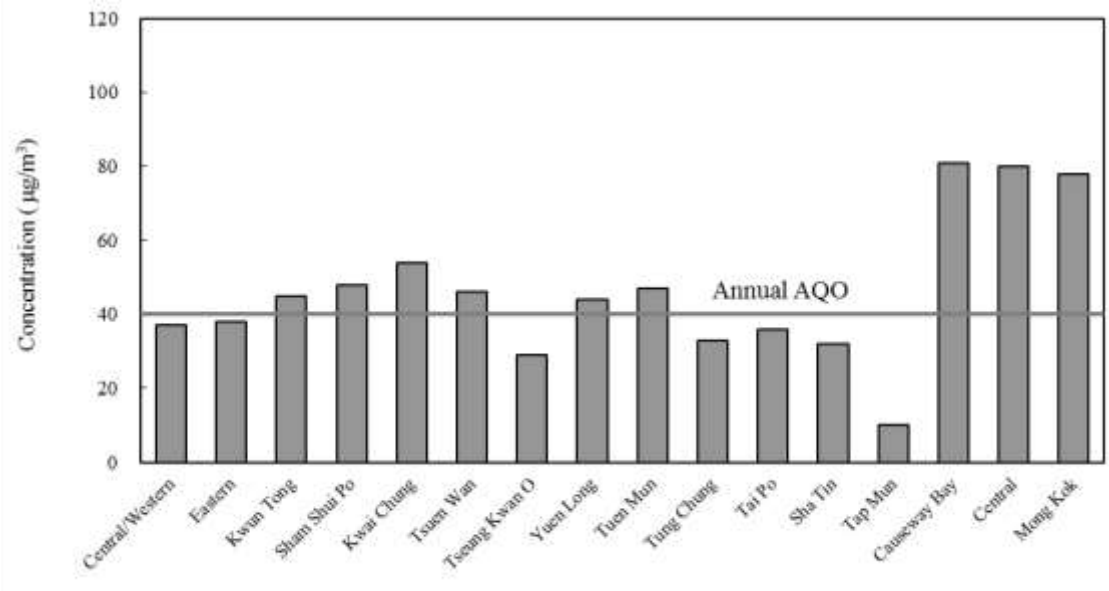


Figure 3b: Nitrogen Dioxide Monitoring 2019
(Annual Average)



2.3 Ozone (O_3)

O_3 is a major constituent of photochemical smog. It is not a pollutant directly emitted from pollution sources but formed by photochemical reactions between 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

NOx and VOCs emissions from places afar. Hence, O_3 is more a regional air pollution problem.

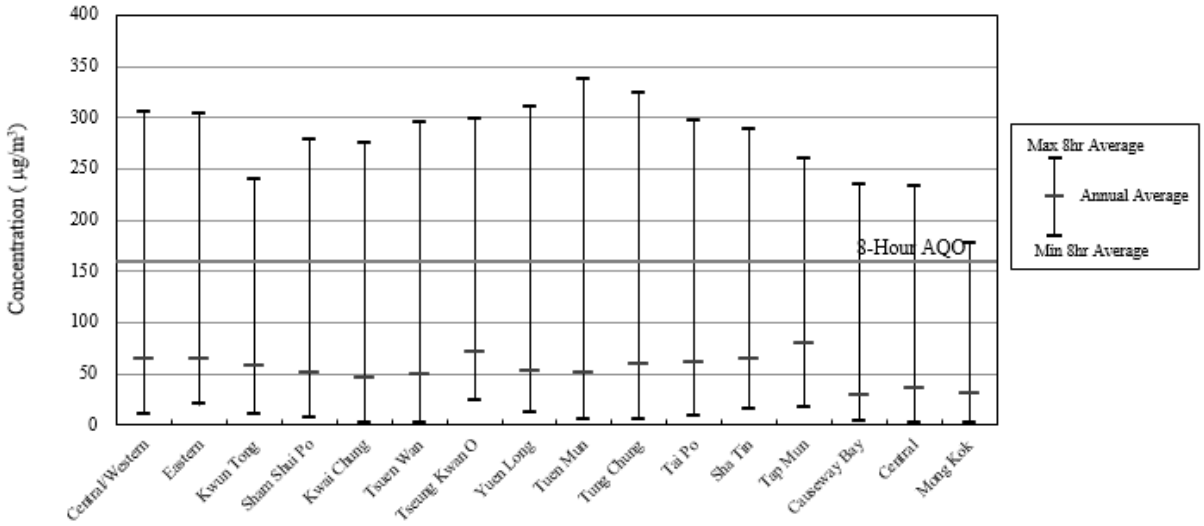
Being a strong oxidant, O_3 can cause irritation to the eyes, nose and throat even at low concentrations. At elevated levels, it can increase a person's susceptibility to respiratory infections and aggravate pre-existing respiratory illnesses such as asthma.

O_3 was monitored at all the general and roadside stations in 2019. 11 out of the 13 general stations recorded non-compliance with the 8-hour AQO in 2019 (i.e. the 8-hour AQO limit of 160 $\mu g/m^3$ was exceeded more than 9 times in the year). The highest 8-hour average (337 $\mu g/m^3$) was recorded at Tuen Mun general station.

All the 3 roadside stations complied with the 8-hour AQO in the year. At the roadside, the NO 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 stations are significantly lower than those at the general stations.

In Hong Kong, O_3 episode days are mostly associated with hot, fine and calm weather conditions in the Pearl River Delta (PRD) Region, which favour the formation and accumulation of O_3 via photochemical reactions. Such weather conditions mostly occur in summer and autumn, especially when Hong Kong and the PRD Region are under the influence of outer subsiding air induced by a tropical cyclone located near Taiwan or the Philippines.

Figure 4a: Ozone Monitoring 2019
(Maximum 8-Hour Average Statistics)



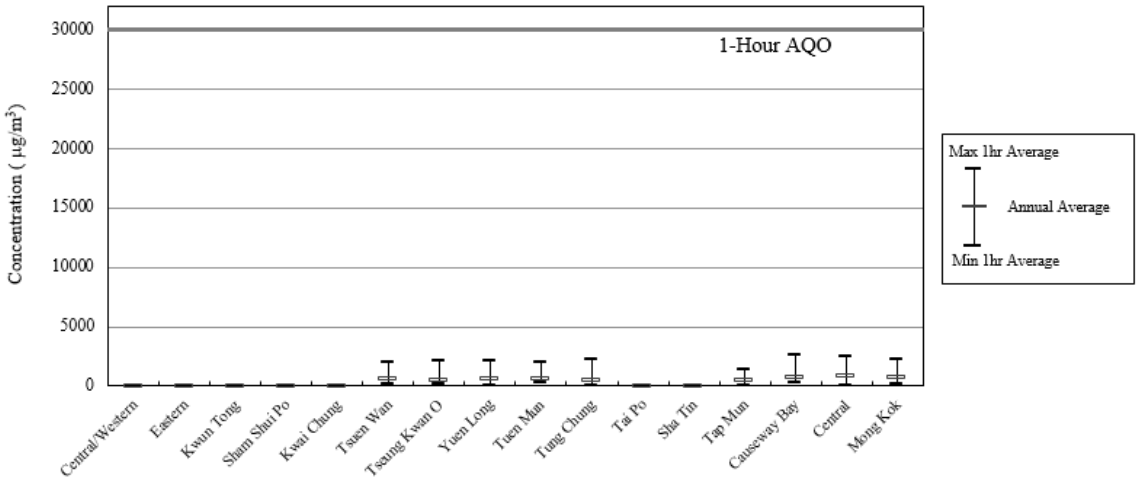
2.4 Carbon Monoxide (CO)

CO comes mainly from vehicular emissions although a small amount of it may also come from flue gases of factories and power stations. When CO enters the bloodstream, it can reduce oxygen delivery to the body's organs and tissues. Typical symptoms of CO poisoning include shortness of breath, chest pain, headache, and loss of co-ordination. The health threat from CO is more severe for those who suffer from heart diseases.

CO was monitored at 9 stations, including 6 general stations and 3 roadside stations in 2019. Similar to previous years, both ambient and roadside CO concentrations remained very low throughout the year. All the monitoring stations complied with the 1-hour

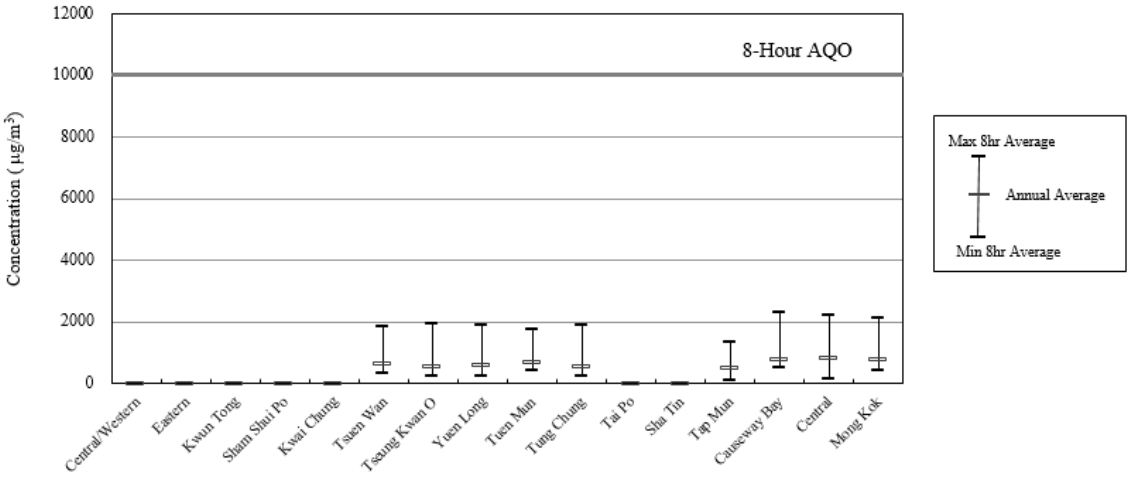
(30,000 μg/m^3) and 8-hour (10,000 μg/m^3) AQOs for CO. The highest 1-hour average (2,620 μg/m^3) and 8-hour average (2,309 μg/m^3) were recorded at Causeway Bay roadside station, both being well below the respective AQO limits.

Figure 5a: Carbon Monoxide Monitoring 2019
(1-Hour Average Statistics)



Note: CO was 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.

Figure 5b: Carbon Monoxide Monitoring 2019
(8-Hour Average Statistics)



Note: CO was 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.

3. Suspended Particulates

3.1 Respirable Suspended Particulates (RSP)

RSP refers 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 ambient RSP. Besides, RSP can also be formed by photochemical reactions of NOx and VOCs as well as atmospheric oxidation of gaseous pollutants, such as SO_2 and NOx. 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 RSP 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 2019. 10 of these stations were also equipped with high-volume samplers to collect particulate samples for chemical analysis.

In 2019, all general and roadside stations complied with the 24-hour AQO (100 μg/m^3 with allowance of 9 exceedances of AQO limit per year) and the annual AQO (50 μg/m^3) for RSP. The highest 24-hour average (154 μg/m^3) was recorded at Central roadside station, while the highest annual average (43 μg/m^3) was recorded at Causeway Bay roadside station.

Figure 6a: RSP Monitoring 2019
(24-Hour Average Statistics)

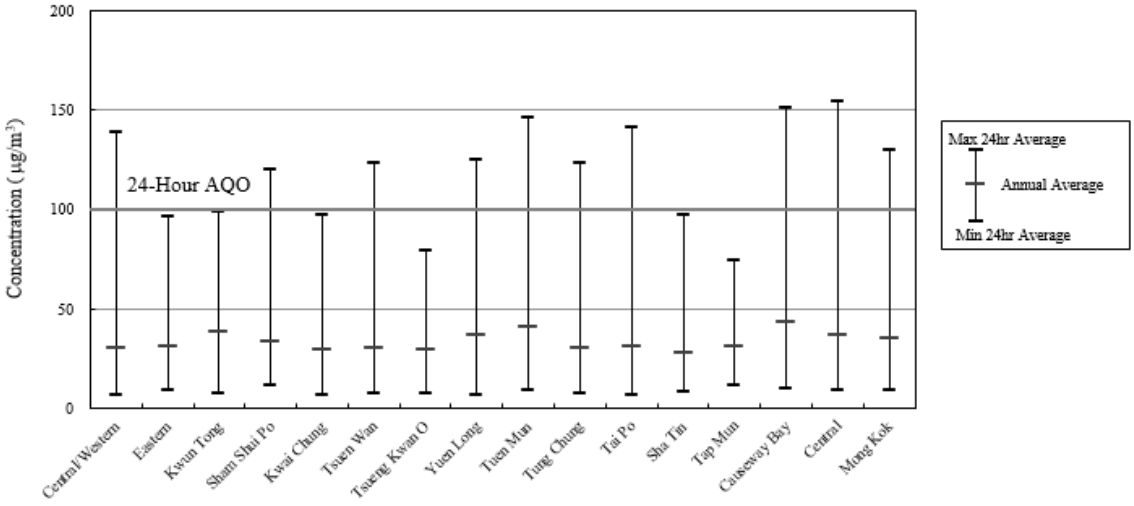
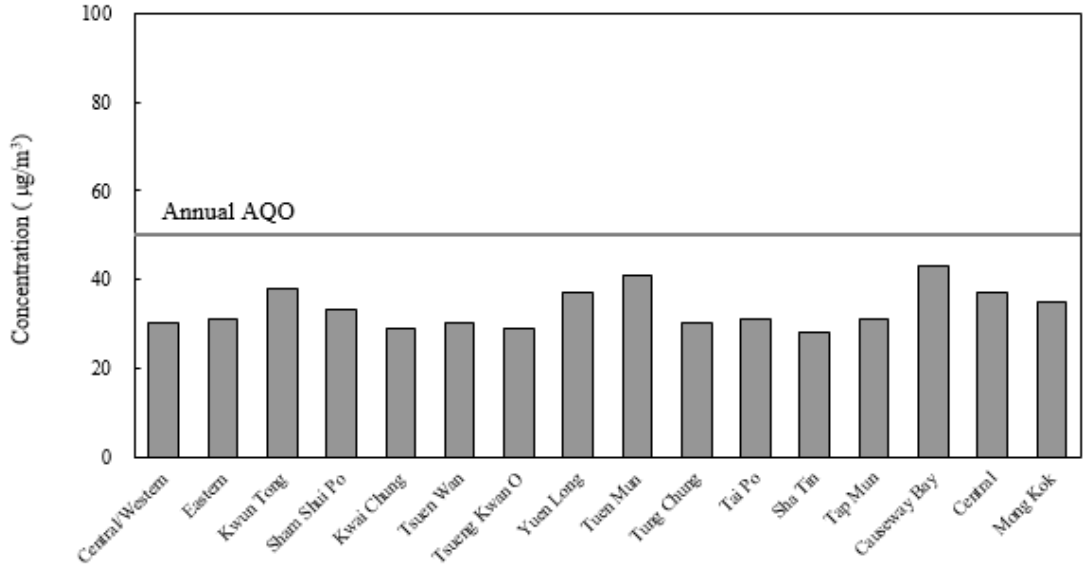


Figure 6b: RSP Monitoring 2019
(Annual Average)



3.2 Fine Suspended Particulates (FSP)

FSP refers 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 lungs because of its small size, hence posing a higher risk to health. Besides, FSP also causes visibility impairment in air.

In 2019, full compliance with both the 24-hour AQO (75 μg/m^3 with allowance of 9 exceedances of AQO limit per year) and the annual AQO (35 μg/m^3) for FSP was recorded at all general and roadside stations, with the highest 24-hour average (108 μg/m^3) and annual average (27 μg/m^3) both recorded at Causeway Bay roadside station.

Figure 7a: FSP Monitoring 2019
(24-Hour Average Statistics)

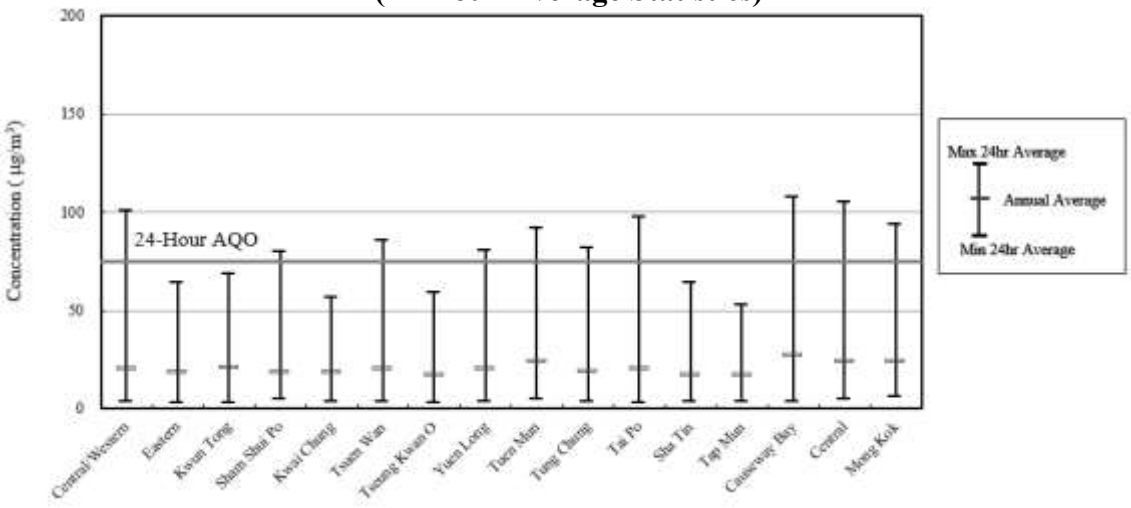
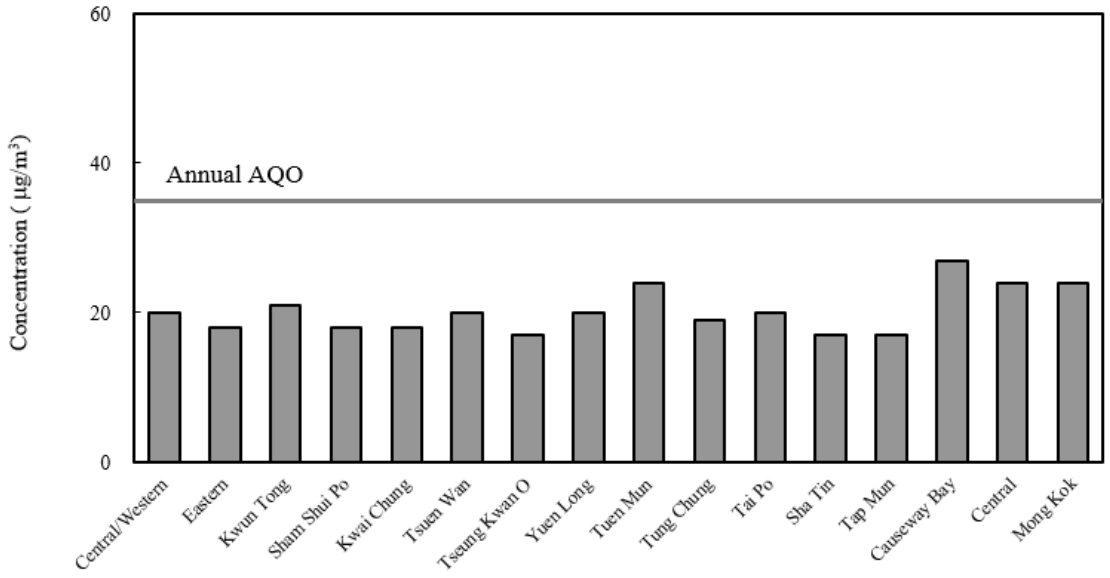


Figure 7b: FSP Monitoring 2019
(Annual Average)



3.3 Lead (Pb)

Lead (Pb) is the only criteria pollutant included in the AQOs that is also a TAP. In Hong Kong, the sale and supply of leaded petrol, which is a known major source of lead, was

banned from 1 April 1999. Pb was measured at 9 general stations and 1 roadside station in 2019[2]. As in previous years, the Pb concentrations at the roadside and in ambient air continued to linger at very low levels during 2019. The annual averages, ranging from 10 ng/m^3 (at Central/Western, Kwun Tong, Shum Shui Po and Tseung Kwan O) to 13 ng/m^3 (at Yuen Long), were well below the respective annual AQO limit of 500 ng/m^3.

4. Toxic Air Pollutants (TAPs)

Two groups of TAPs, namely heavy metals and organic substances, have been regularly monitored at Central/Western and Tsuen Wan stations since mid of 1997. Among the various TAPs monitored, 8 of them are considered more important in terms of their health impacts and their annual averages in 2019 are summarised in Table C6. Detailed description of the TAPs monitoring operation is given in Appendix B4.

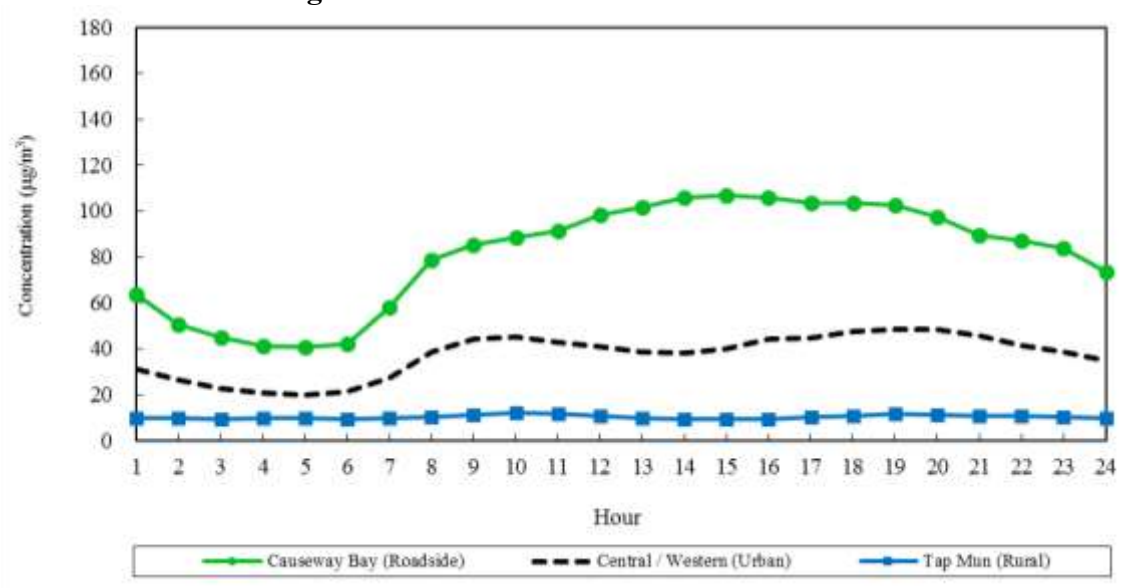
5. Variation of Air Pollution Levels over Time

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 the roadside.

Figure 8: 2019 Diurnal Variations of NO_2



[2] Lead was measured at Central/Western, Kwun Tong, Sham Shui Po, Kwai Chung, Tsuen Wan, Tung Chung, Yuen Long, Tuen Mun and Tseung Kwan O general stations and Mong Kok roadside station.

Figure 9: 2019 Diurnal Variations of RSP

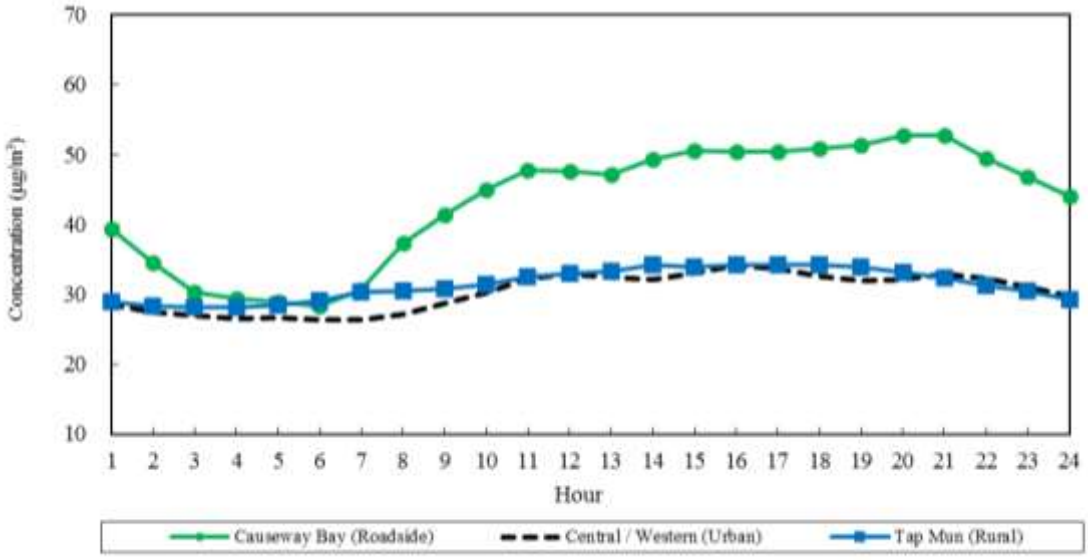
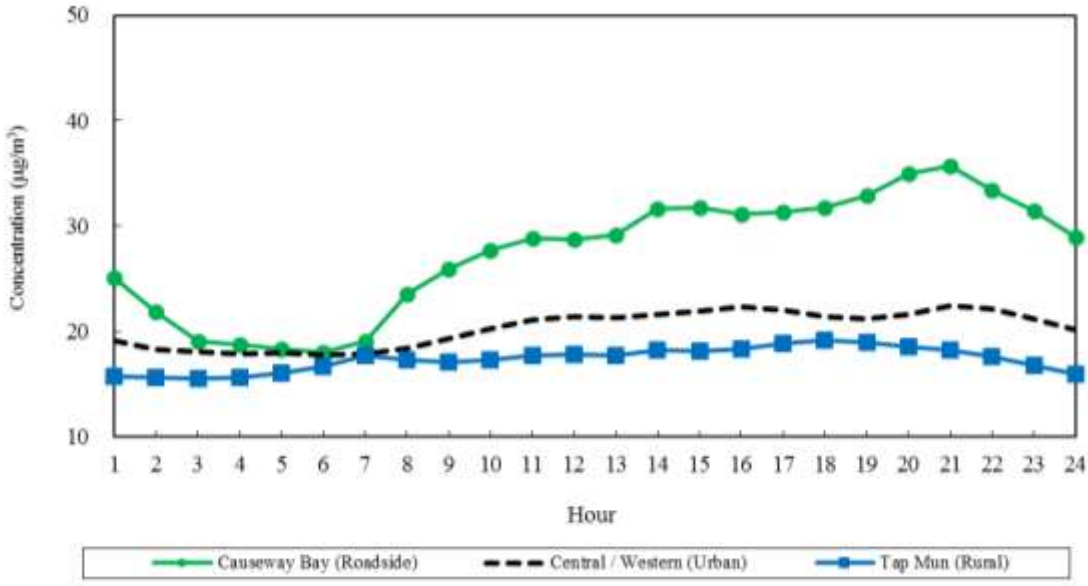
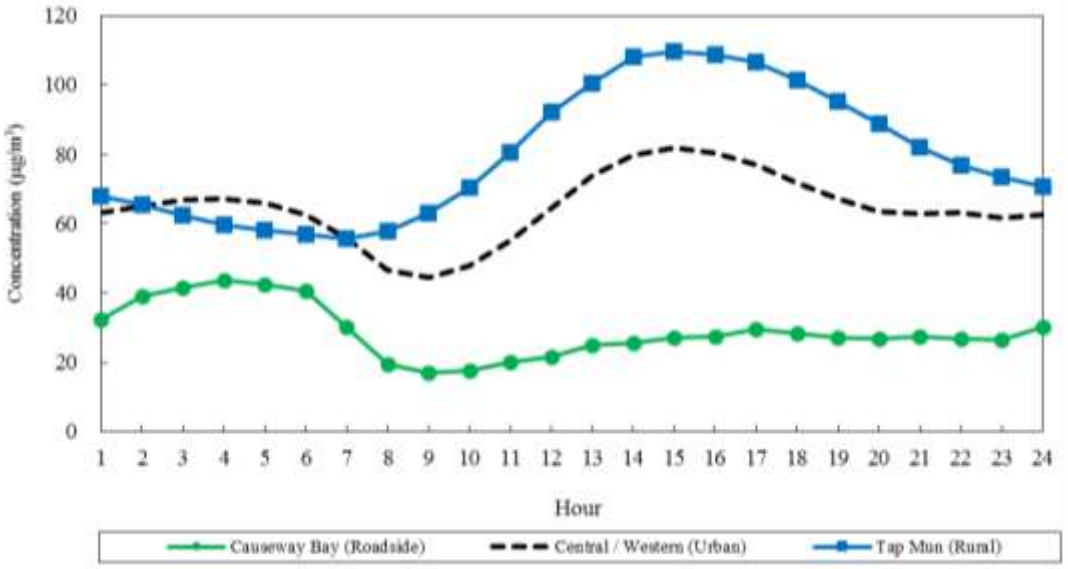


Figure 10: 2019 Diurnal Variations of FSP



The diurnal pattern of O_3 is different from those 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 at the roadside, the lowest O_3 concentrations are often observed during rush hours. This is because a large amount of NO 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 NO from vehicular emissions.

Figure 11: 2019 Diurnal Variations of O_3

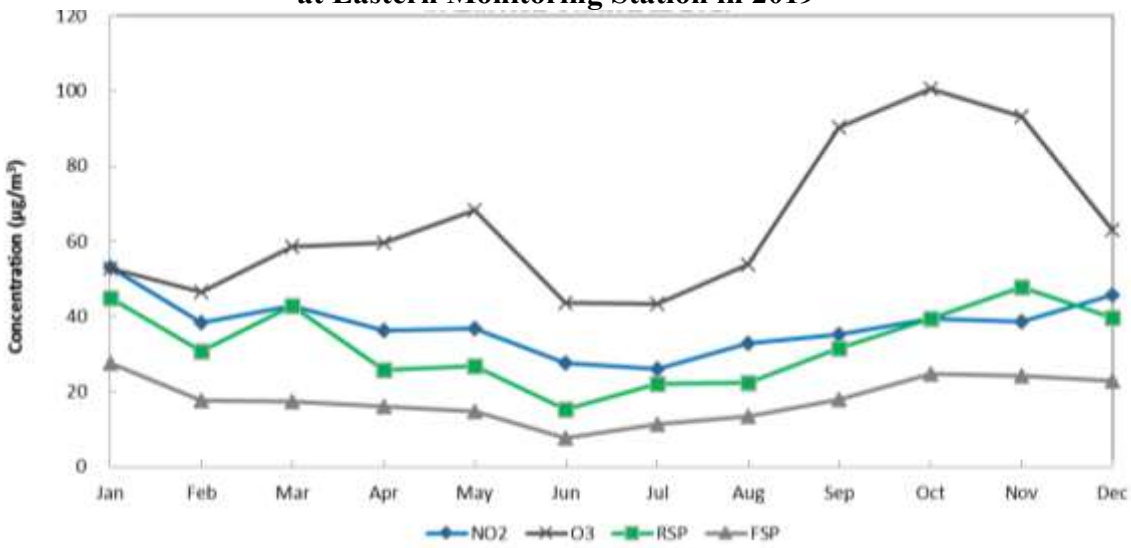


5.2 Over a Year

The concentrations of NO_2, RSP and FSP are in general lower in summer than autumn and winter for 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 O_3, the highest monthly concentrations usually occur in October with more favourable weather conditions (such as strong solar radiation, less clouds, low wind speed, etc.) for O_3 formation via photochemical reactions.

Figure 12: Monthly Variations of NO_2, O_3, RSP and FSP at Eastern Monitoring Station in 2019



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 conditions, such as stronger solar radiation which promotes photochemical smog formation or more rainfall that cleans the pollutants from the air, even if 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 4 groups of land use types, namely Urban, New Town, Rural and Roadside as defined in Table 1.

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

Land Use Type	Land Use Characteristics	Air Quality 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 areas with heavy traffic and surrounded by many tall buildings	Causeway Bay, Central and Mong Kok

5.3.1 Sulphur Dioxide (SO_2)

Since the local implementation of the Air Pollution Control (Fuel Restriction) Regulations in 1990 for restricting sulphur content of industrial fuels, the implementation of the Air Pollution Control (Motor Vehicle Fuel) Regulations in 1995 for controlling motor vehicle fuel quality, the introduction of ultra-low sulphur diesel for vehicle fleet in July 2000 and the subsequent introduction of Euro V motor diesel in December 2007, SO_2 concentrations in Hong Kong have shown a continuous declining trend.

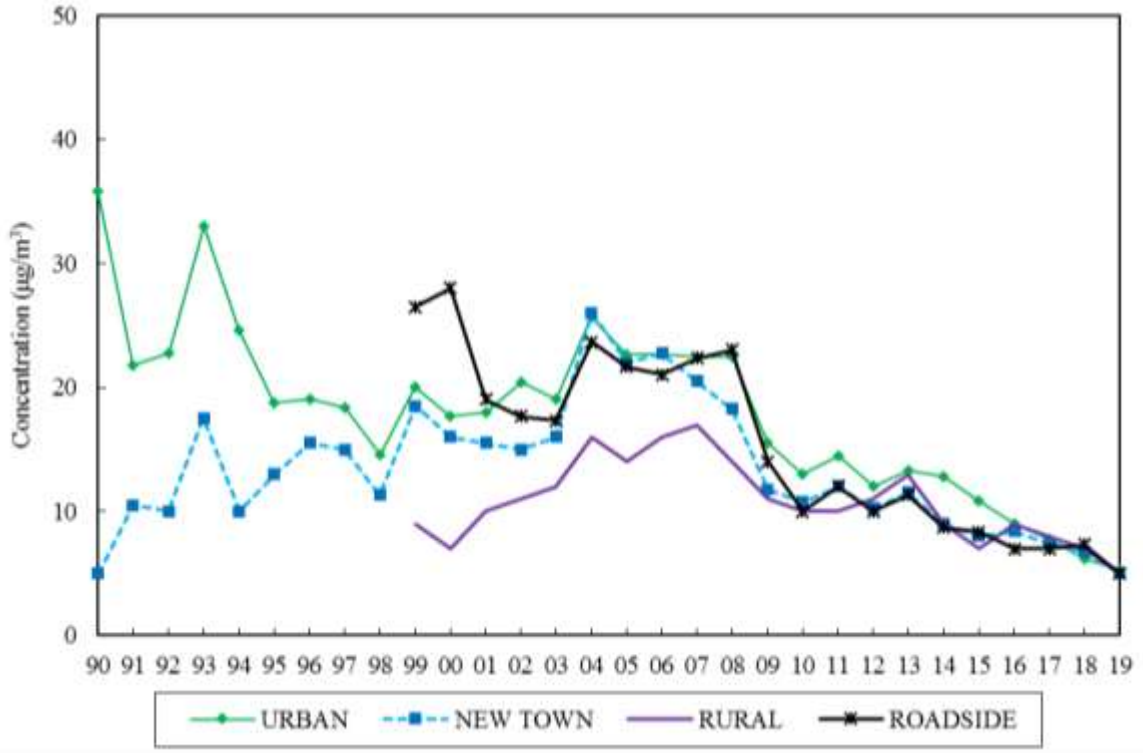
In April 2014 and July 2015, the Air Pollution Control (Marine Light Diesel) Regulation and the Air Pollution Control (Ocean Going Vessels) (Fuel at Berth) Regulation were introduced respectively to further reduce SO_2 emissions from vessels. Starting from 1 January 2019, the Air Pollution Control (Fuel for Vessels) Regulation was in effect, which requires all ocean-going vessels to use compliant fuel within Hong Kong waters irrespective of whether they are sailing or berthing.

On the regional front, the Governments of Guangdong Province and Hong Kong have been working together to introduce a wide range of control measures, such as retrofitting

power plants with flue gas desulphurization devices, phasing out highly polluting industrial plants in the PRD Region, introducing fuels with lower sulphur content, etc., to reduce SO_2 emissions in the Region.

As a result of the implementation of various fuel control measures, both the ambient and roadside SO_2 concentrations in 2019 remained low at 5 μg/m^3.

Figure 13: SO_2 Long Term Trend



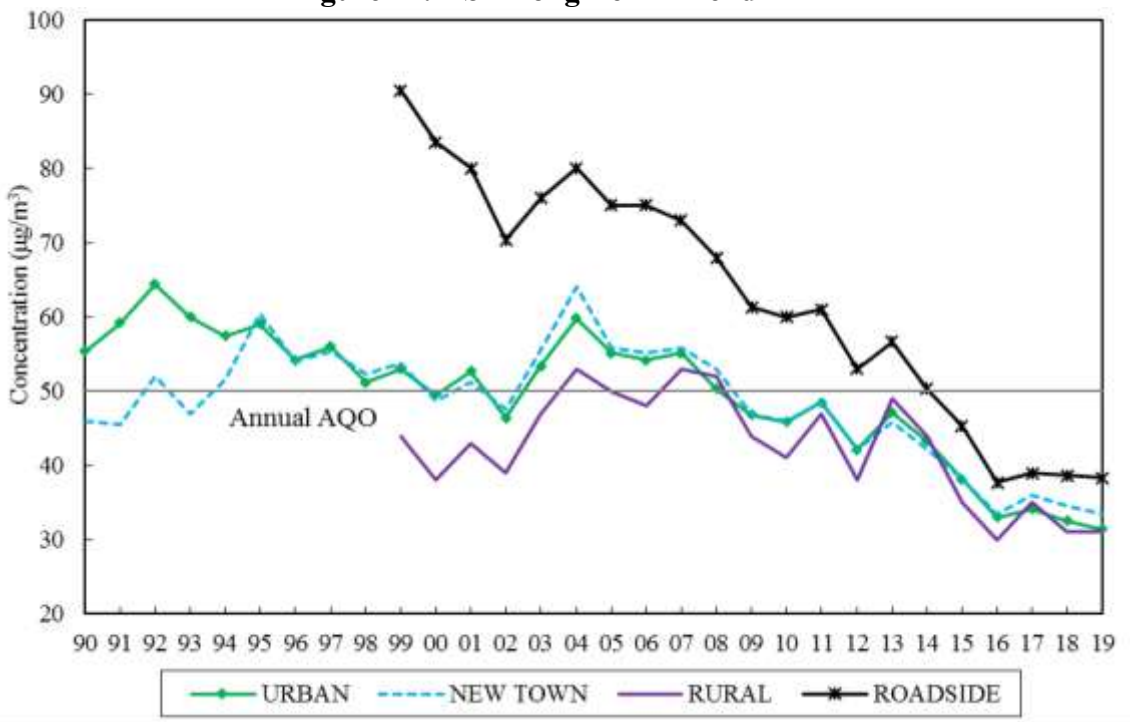
5.3.2 Respirable Suspended Particulates (RSP)

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 ambient RSP concentrations then continuously dropped to a level below the annual AQO limit from 2009 onwards, reflecting a reduction in regional background RSP levels over the last ten years.

As a result of the implementation of various vehicle emission control measures in the last two decades, the annual average of RSP concentration at the roadside in 2019 was significantly reduced by 58% when compared with the 1999[3] level and has remained below the annual AQO limit since 2015.

[3] 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



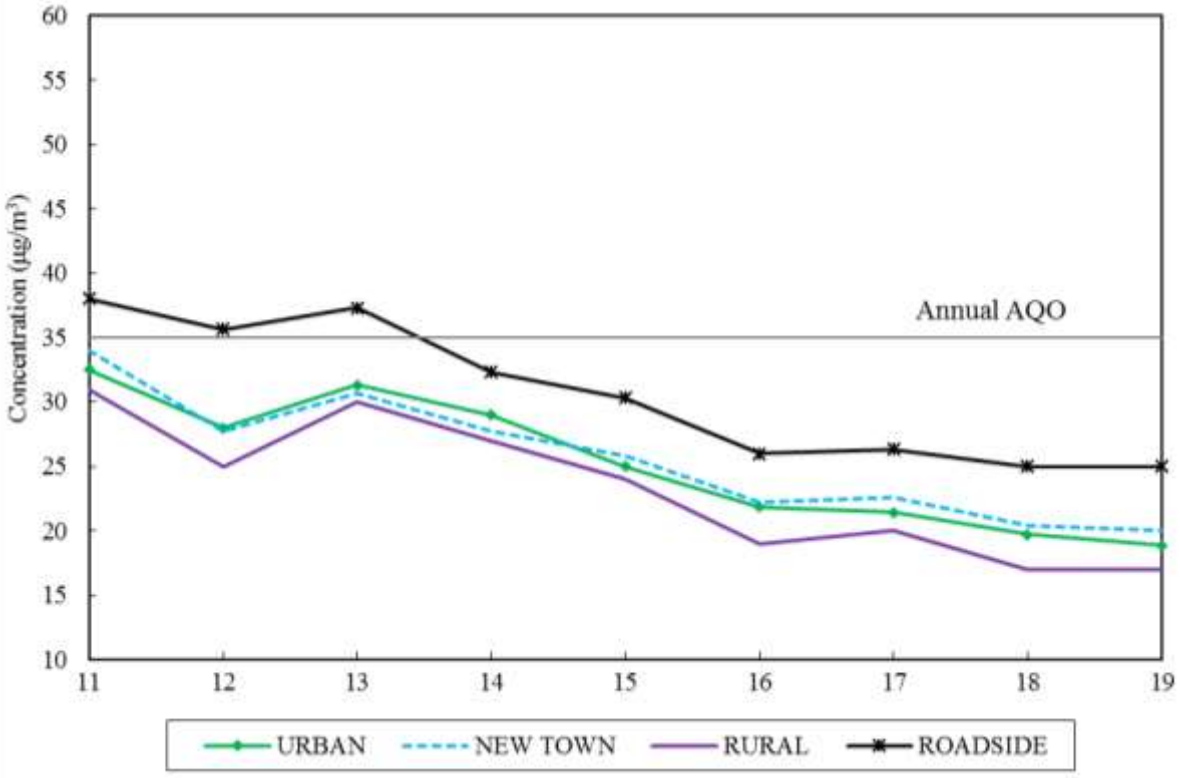
5.3.3 Fine Suspended Particulates (FSP)

We started to monitor FSP at all our monitoring stations in 2011[4]. Same as RSP, the ambient concentrations of FSP in the territory showed an overall downward trend between 2011 and 2019, reflecting a continuous reduction in regional background FSP levels.

The roadside FSP levels also showed a discernible improvement in recent years. In 2019, the annual average of FSP concentration at the roadside reduced by about 34% when compared with the 2011 level and has complied with the annual AQO since 2014.

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

Figure 15: FSP Long Term Trend



5.3.4 Ozone (O_3)

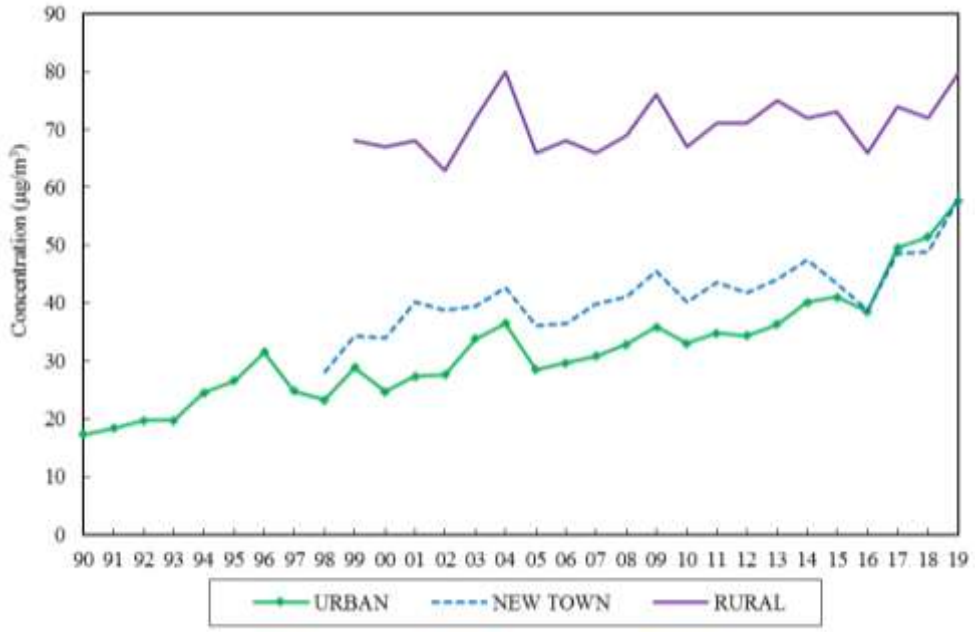
O_3 is a complex regional air pollution issue. It is formed when precusors such as NOx and VOCs undergo complicated photochemical reactions under sunlight. O_3 can travel long distances and affect areas downwind. On the other hand, O_3 can react with some pollutants like NO emitted from combustion sources (such as motor vehicles) and be titrated. Hence the O_3 concentrations measured at a particular location would depend on the regional O_3 background level, its local formation as well as titration effect.

As NO emissions from motor vehicles can react with and remove O_3 in the air, areas with heavy traffic normally have lower O_3 levels than areas with light traffic. Tap Mun station started monitoring O_3 in 1998. As Tap Mun station is located in a remote rural area with virtually no local emission, the O_3 concentrations recorded could represent the regional background levels of O_3. This station has consistently recorded higher O_3 levels than those recorded in urban areas, but the gap has been narrowing steadily from over 100% in the early 2000s to about 40% in recent years.

The rural O_3 concentrations have shown a moderate upward trend since the early 2000s, whereas the O_3 levels in new towns and urban areas have exhibited relatively more distinct rising trends. The rising trend of O_3 levels in Hong Kong, especially those in new towns and urban areas, could be attributed to the moderate increase in regional O_3 background as well as the reduction in local vehicle emissions, the latter leading to less NO in the air for titration with O_3.

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

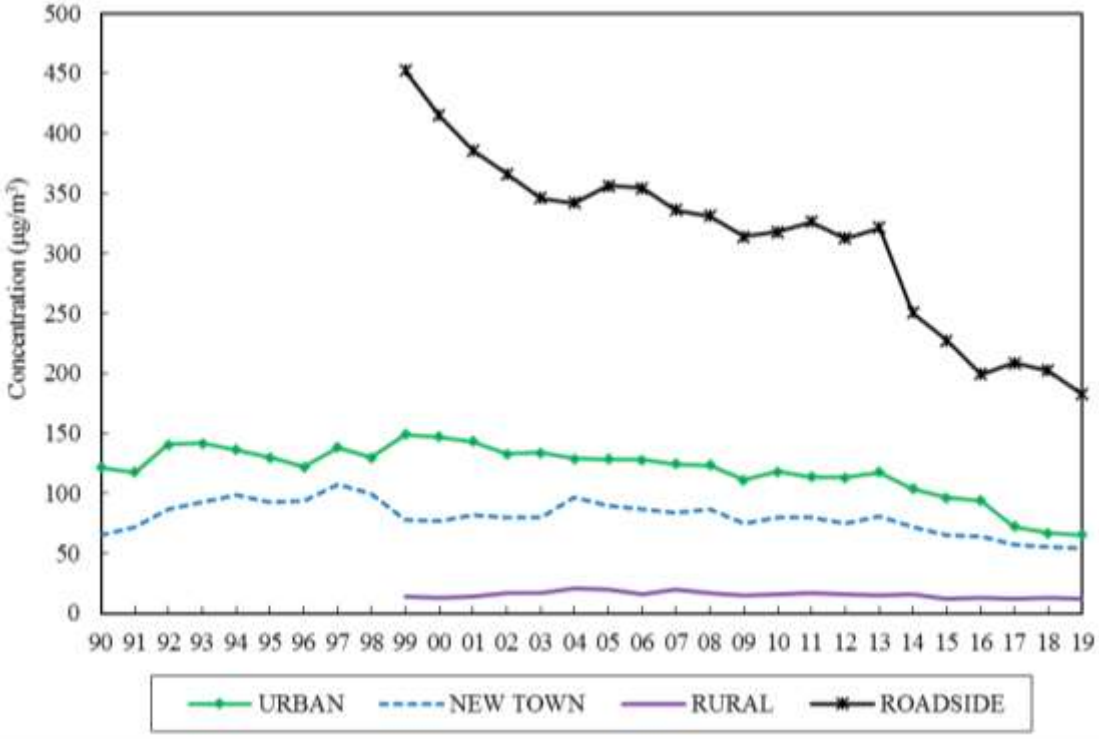
Figure 16: O_3 Long Term Trend



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

While the background NOx concentrations (i.e. rural area in Tap Mun) remained flat, the annual averages of ambient NOx in urban areas and new towns exhibited moderate declining trends between 1999 and 2019. 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 2019 was 60% lower than that in 1999[5].

Figure 17: NOx Long Term Trend



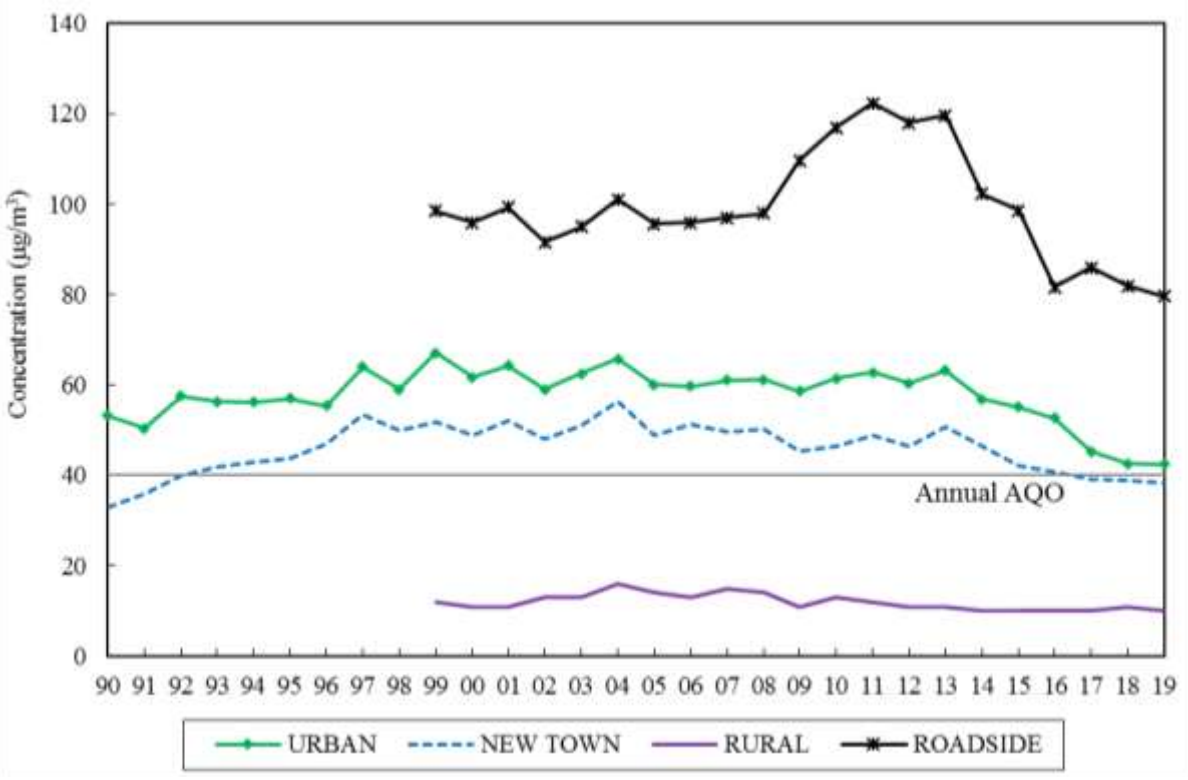
[5] 1999 is selected for comparison as this was the year when the Government started to implement a list of measures to cut vehicular emissions.

NO_2, a major component of NO_x, is mainly formed from the oxidation of NO. The oxidation can be promoted by the presence of a large amount of O_3 and VOCs in the ambient air. The ambient NO_2 levels exhibited a slow ascending trend between 1990 and 2004, but the trend levelled off from 2005 to 2012 and has started to decline progressively since 2013.

Roadside NO_2 levels have been more difficult to reduce. However, the increasing trend of its concentrations once recorded in the past, 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 O_3 concentration promoting the conversion of NO emitted from motor vehicles to NO_2, was reversed and started to drop from its peak in 2011. The annual NO_2 concentration at the roadside recorded in 2019 had reduced by 19% when compared with the 1999 level.

To address the problem of the elevated roadside NO_2 pollution, the Government has put forward enhanced measures including supporting the transport trades to test green vehicles, 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 for newly registered motor vehicles.

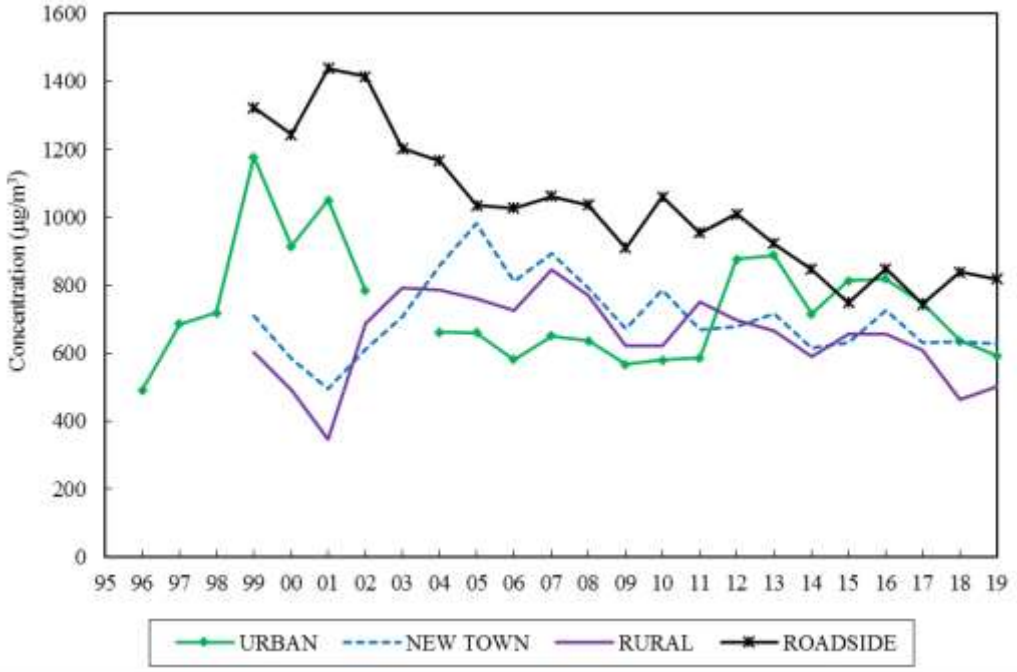
Figure 18: NO_2 Long Term Trend



5.3.6 Carbon Monoxide (CO)

The ambient concentration of CO in the territory remained at a very low level while the CO concentration at the roadside had dropped to a level close to the ambient one in recent years.

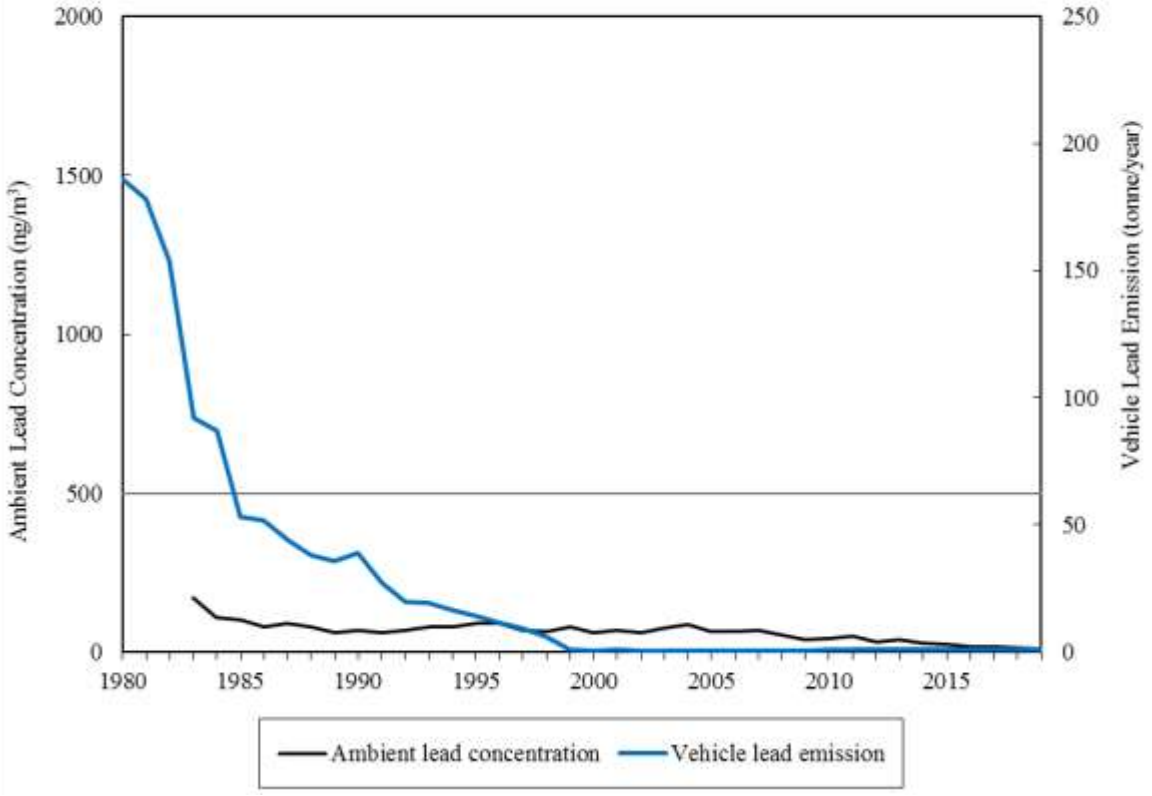
Figure 19: CO Long Term Trend



5.3.7 Lead (Pb)

The Pb concentrations at the roadside and in ambient air have been lingering at very low levels over the years since the oil companies took voluntary action in reducing the Pb content of petrol in the eighties. Pb 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 were banned in April 1999.

Figure 20: Vehicle Lead Emission and Ambient Lead Concentration



Appendix A

Air Quality Objectives and their Compliance Status

Hong Kong Air Quality Objectives (AQOs) for 7 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 of limit 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" means 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 2019. 2 general stations and all 3 roadside stations complied with the 8 hour AQO for O_3 and all general stations complied with the 1-hour AQO for NO_2. For other criteria pollutants including RSP, FSP, SO_2 and CO, all general and roadside stations complied with their respective short-term AQOs.

Table A2: Compliance Status of Short-Term Air Quality Objectives in 2019

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	×	✓	✓	✓	✓	✓	✓	✓
	Yuen Long	×	✓	✓	✓	✓	✓	✓	✓
	Tuen Mun	×	✓	✓	✓	✓	✓	✓	✓
	Tung Chung	×	✓	✓	✓	✓	✓	✓	✓
	Tai Po	×	✓	✓	✓	✓	✓	--	--
	Sha Tin	×	✓	✓	✓	✓	✓	--	--
	Tap Mun	×	✓	✓	✓	✓	✓	✓	✓
Roadside Station	Causeway Bay	✓	×	✓	✓	✓	✓	✓	✓
	Central	✓	×	✓	✓	✓	✓	✓	✓
	Mong Kok	✓	×	✓	✓	✓	✓	✓	✓

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

Compliance with the long-term AQOs

Table A3 shows the compliance status of the long-term (annual) AQOs for all monitoring stations in 2019. All stations complied with the annual AQOs for RSP and FSP whereas 6 general and 3 roadside stations could not comply with the annual AQO for NO_2 in 2019. For lead, all 10 monitoring stations achieved full compliance with the long-term AQO in 2019.

Table A3: Compliance Status of Long-Term (Annual) Air Quality Objectives in 2019

Station		Annual			
		NO_2	**RSP**	**FSP**	**Lead**
General Station	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	✓	✓	✓	--
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 Science Group of the Environmental Protection Department operates the Air Quality Monitoring Network which had 16 monitoring stations in 2019. 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 addition, the measurement of fine suspended particulates (FSP) concentration has been accredited by HOKLAS since August 2016.

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 of 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 measured 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 measured in the subsequent elemental analysis of the RSP samples by Government Laboratory using Inductively Coupled Plasma Optical Emission Spectroscopy. 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 3 stations, namely Central/Western, Kwun Tong and Yuen Long. The parameters measured for all wet and dry samples include: conductivity, 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 broadband 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 (https://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 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 of 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 2019, 359 audit checks were carried out on the stations' analysers and samplers. Based on the 95% probability limits, the accuracy varied from -7.7% to 6.7% for gases, and from -9.2% to 6.6% 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 2019, 3098 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 -5.6% and 5.4%, 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)	Nov 1983[1]
Eastern (Sai Wan Ho Fire Station)	20 Wai Hang Street, Sai Wan Ho	Urban: Residential	28m	15m (4 floors)	Jan 1999
Kwun Tong (Yue Wah Mansion)	407-431 Kwun Tong Road, Kwun Tong	Urban: Mixed residential/ commercial/industrial	37m	25m (7 floors)	Jul 1983[2]
Sham Shui Po (Sham Shui Po Police Station)	37A Yen Chow Street, Sham Shui Po	Urban: Mixed residential/ commercial	21m	17m (4 floors)	Jul 1984
Kwai Chung (Kwai Chung Police Station)	999 Kwai Chung Road, Kwai Chung	Urban: Mixed residential/ commercial/industrial	19m	13m (2 floors)	Jul 1988[3]
Tsuen Wan (Princess Alexandra Community Centre)	60 Tai Ho Road, Tsuen Wan	Urban: Mixed residential/ commercial/industrial	21m	17m (4 floors)	Aug 1988
Tseung Kwan O (Tseung Kwan O Sports Centre)	9 Wan Lung Road, Tseung Kwan O, Sai Kung	Urban: Residential	23m	16m (2 floors)	Mar 2016
Yuen Long (Yuen Long District Office Bldg.)	269 Castle Peak Road, Yuen Long	New Town: Residential	31m	25m (6 floors)	Jul 1995
Tuen Mun (Tuen Mun Public Library)	1 Tuen Hi Road, Tuen Mun	New Town: Residential	31m	27m (4 floors)	Dec 2013
Tung Chung (Tung Chung Health Centre)	6 Fu Tung Street, Tung Chung	New Town: Residential	34.5m	27.5m (4 floors)	Apr 1999
Tai Po (Tai Po Govt. Offices Bldg.)	1 Ting Kok Road, Tai Po	New Town: Residential	31m	28m (6 floors)	Feb 1990[4]
Sha Tin (Sha Tin Govt. Secondary School)	11-17 Man Lai Road, Tai Wai, Sha Tin	New Town: Residential	31m	25m (6 floors)	Jul 1991
Tap Mun	Tap Mun Police Post	Background: Rural	26m	11m (3 floors)	Apr 1998
Causeway Bay	1 Yee Woo Street, Causeway Bay	Urban Roadside: Mixed commercial/ residential area surrounded by tall buildings	6.5m[5] / 7m[6]	3m[5] / 3.5m[6]	Jan 1998

Monitoring Station	Address	Area Type	Sampling Height		Date Start Operation
			Above P.D.H.K.	Above Ground	
Central	Junction of Des Voeux Road Central and Chater Road, Central	Urban Roadside: Busy commercial/ financial area surrounded by tall buildings	8.5m	4.5m	Oct 1998
Mong Kok	Junction of Nathan Road and Lai Chi Kok Road, Mong Kok	Urban Roadside: Mixed commercial/ residential area surrounded by tall buildings	8.5m[5] / 10.9m[6]	3m[5] / 5.4m[6]	Apr 1991[7]

Notes: P.D. = Principal Datum

[1] Central/Western station was relocated to the current address in October 2009.

[2] Kwun Tong station was relocated to the current address in April 2012.

[3] Kwai Chung station was relocated to the current address in January 1999.

[4] Tai Po station was relocated to the current address in February 2006.

[5] Sampling height for gaseous pollutants.

[6] Sampling height for suspended particulates.

[7] Mong Kok station was relocated to the current address in January 2001.

Table B2: Summary of the Parameters Monitored in the Network (2019)

Monitoring Station	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
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	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) Oscillating microbalance b) Beta Attenuation	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 Sep-Pak cartridge	Once per month	24 hours
Benzo(a)pyrene	USEPA Method TO-13	Tisch TE-1000	Quartz fibre filter and polyurethane foam with XAD-2 resin	Once per month	24 hours

Toxic Air Pollutants	Sampling and Analysis method	Sampling Instrument	Sampling Media	Sampling Schedule	Sampling Period
Dioxin	USEPA Method TO-9A	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, 2019

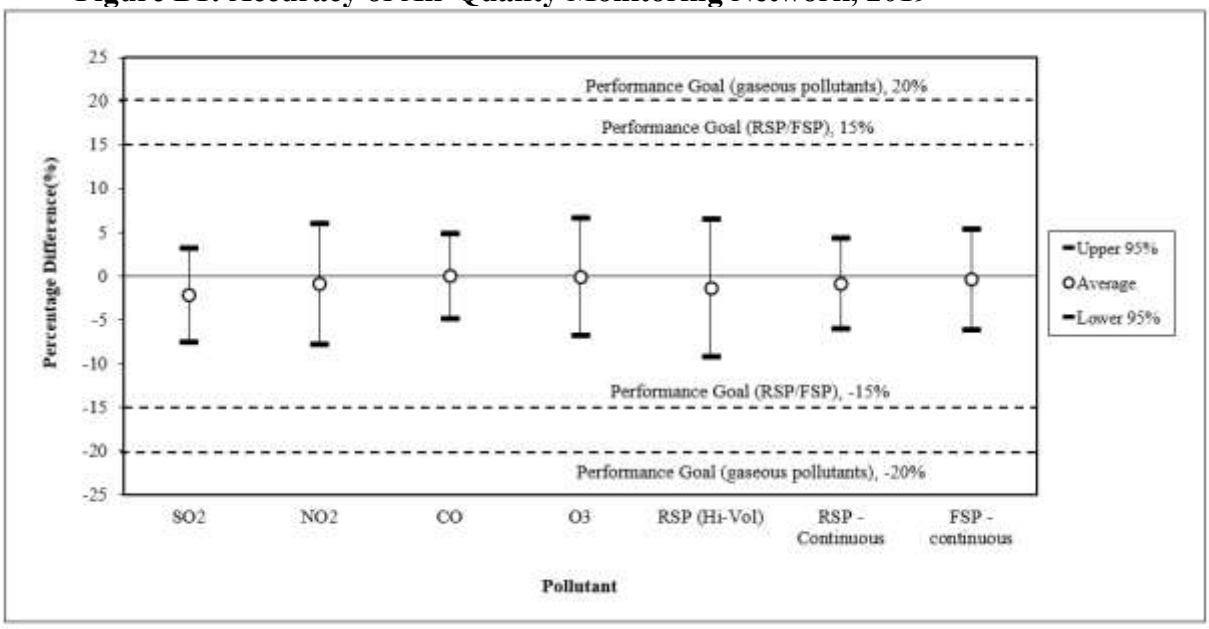
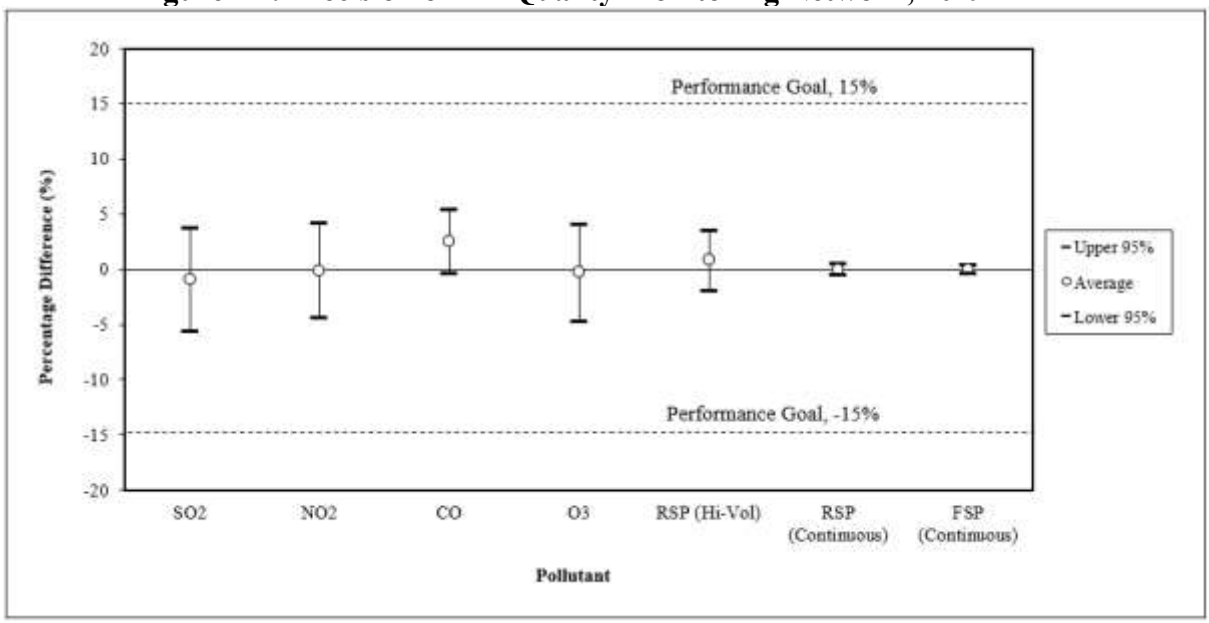


Figure B2: Precision of Air Quality Monitoring Network, 2019



Appendix C

Tables of Air Quality Data

Table C1: 2019 Exceedance of Short-Term Limits of Air Quality Objectives

Pollutant: Sulphur Dioxide

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

Station	No. of exceedance of limit vaue	1st High	2nd High	3rd High	4th High
Central/Western	0	105	76	64	62
Eastern	0	59	44	43	41
Kwun Tong	0	50	44	43	41
Sham Shui Po	0	44	44	43	41
Kwai Chung	0	75	57	56	53
Tsuen Wan	0	48	48	46	45
Tseung Kwan O	0	30	26	26	25
Yuen Long	0	53	50	44	42
Tuen Mun	0	61	57	48	45
Tung Chung	0	86	72	67	57
Tai Po	0	22	20	20	20
Sha Tin	0	35	34	27	27
Tap Mun	0	20	20	20	19
Causeway Bay	0	67	63	55	51
Central	0	55	49	46	42
Mong Kok	0	45	40	40	39

Pollutant: Carbon Monoxide

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

Station	No. of exceedance of limit vaue	1st High
Tsuen Wan	0	1970
Tseung Kwan O	0	2170
Yuen Long	0	2150
Tuen Mun	0	2050
Tung Chung	0	2260
Tap Mun	0	1360
Causeway Bay	0	2620
Central	0	2440
Mong Kok	0	2280

Pollutant: Sulphur Dioxide

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

Station	No. of exceedance of limit vaue	1st High	2nd High	3rd High	4th High
Central/Western	0	14	13	13	12
Eastern	0	10	8	7	7
Kwun Tong	0	14	13	12	11
Sham Shui Po	0	16	15	15	14
Kwai Chung	0	22	21	21	18
Tsuen Wan	0	18	14	14	13
Tseung Kwan O	0	14	14	13	12
Yuen Long	0	12	12	12	11
Tuen Mun	0	13	13	13	12
Tung Chung	0	21	19	19	18
Tai Po	0	12	12	10	10
Sha Tin	0	15	14	13	12
Tap Mun	0	13	13	12	12
Causeway Bay	0	17	14	12	11
Central	0	19	18	16	15
Mong Kok	0	19	15	13	10

Pollutant: Carbon Monoxide

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

Station	No. of exceedance of limit vaue	1st High
Tsuen Wan	0	1835
Tseung Kwan O	0	1935
Yuen Long	0	1903
Tuen Mun	0	1758
Tung Chung	0	1874
Tap Mun	0	1350
Causeway Bay	0	2309
Central	0	2205
Mong Kok	0	2103

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

Station	No. of exceedance of limit vaue	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	3	217	203	202	198	195	194	189	186	184	184	179	174	170	168	166	165	164	161	153
Eastern	4	211	207	205	205	193	184	179	169	157	153	152	150	150	146	145	143	139	136	136
Kwun Tong	10	272	216	213	210	206	205	205	204	203	202	192	192	191	190	190	189	187	187	184
Sham Shui Po	6	227	226	217	212	207	207	199	196	195	189	189	188	183	182	182	179	178	178	176
Kwai Chung	12	221	219	215	213	210	210	209	206	205	204	203	202	196	187	187	186	185	185	184
Tsuen Wan	2	207	203	197	193	192	191	190	190	189	185	183	183	182	182	180	179	179	178	177
Tseung Kwan O	3	218	215	213	198	191	189	183	178	175	169	168	167	164	161	160	160	156	156	155
Yuen Long	0	193	186	183	183	182	181	179	179	177	172	169	166	166	165	164	163	163	162	161
Tuen Mun	2	222	201	196	196	188	186	181	180	179	176	175	174	172	170	167	167	167	166	166
Tung Chung	0	178	176	166	165	165	163	163	160	159	159	159	154	154	152	152	150	149	149	149
Tai Po	0	189	182	180	169	164	161	158	156	156	156	154	150	150	148	147	144	142	142	142
Sha Tin	0	185	181	180	170	169	165	164	162	161	161	160	159	159	159	156	154	153	151	150
Tap Mun	0	132	90	77	76	76	69	67	64	64	60	59	58	58	57	57	56	56	56	56
Causeway Bay	121	366	362	356	354	349	348	345	329	329	327	325	323	317	316	313	311	295	291	287
Central	116	323	308	298	295	290	287	285	283	279	276	274	270	265	261	260	260	259	254	252
Mong Kok	88	317	303	294	291	288	281	278	275	273	272	272	266	266	261	258	252	251	250	248

Table C1 (Cont.): 2019 Exceedance of Short-Term Limits of Air Quality Objectives

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

Station	No. of exceedance of limit value	1st High	2nd High	3rd High	4th High	5th High	6th High	7th High	8th High	9th High	10th High
Central/Western	23	306	304	302	278	229	214	206	205	197	191
Eastern	17	304	270	266	265	219	185	184	180	175	169
Kwun Tong	5	240	228	214	190	172	154	150	150	150	150
Sham Shui Po	11	279	274	231	213	206	186	179	171	168	164
Kwai Chung	6	275	269	239	206	169	165	158	146	146	143
Tsuen Wan	14	296	288	246	238	196	192	190	179	174	171
Tseung Kwan O	33	299	297	253	249	214	205	201	192	186	185
Yuen Long	25	310	286	262	248	242	223	222	220	205	200
Tuen Mun	24	337	302	293	277	252	240	222	210	206	203
Tung Chung	28	325	296	260	256	255	238	236	235	234	208
Tai Po	27	297	269	256	251	227	224	218	216	209	197
Sha Tin	33	289	288	247	237	217	210	207	206	201	199
Tap Mun	51	260	255	254	251	251	231	218	216	215	212
Causeway Bay	3	235	213	168	135	118	117	116	111	109	108
Central	4	233	216	195	168	152	148	145	134	133	133
Mong Kok	1	177	157	137	135	134	133	129	127	126	125

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

Station	No. of exceedance of limit value	1st High	2nd High	3rd High	4th High	5th High	6th High	7th High	8th High	9th High	10th High
Central/Western	2	139	118	98	75	74	73	73	73	70	69
Eastern	0	96	85	74	71	69	69	67	67	66	66
Kwun Tong	0	99	92	78	76	75	74	73	73	73	73
Sham Shui Po	1	120	99	85	73	72	70	69	68	66	65
Kwai Chung	0	97	96	71	69	63	62	60	60	60	59
Tsuen Wan	2	123	111	85	78	76	75	71	71	69	65
Tseung Kwan O	0	79	77	66	65	65	63	63	61	60	60
Yuen Long	2	125	114	94	92	89	88	85	85	85	83
Tuen Mun	4	146	139	106	102	99	98	94	94	92	89
Tung Chung	2	123	120	91	89	85	83	80	77	76	75
Tai Po	2	141	126	85	82	74	70	68	66	66	65
Sha Tin	0	97	93	73	69	67	66	64	63	61	60
Tap Mun	0	74	74	73	68	66	66	66	65	64	64
Causeway Bay	3	151	127	114	94	87	83	83	82	82	80
Central	3	154	128	105	86	84	83	78	76	76	74
Mong Kok	3	130	111	103	80	77	76	75	75	74	74

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

Station	No. of exceedance of limit value	1st High	2nd High	3rd High	4th High	5th High	6th High	7th High	8th High	9th High	10th High
Central/Western	2	101	82	75	57	56	56	53	52	51	49
Eastern	0	64	60	48	45	45	45	43	40	40	40
Kwun Tong	0	69	63	55	55	52	48	45	45	45	44
Sham Shui Po	2	80	77	50	44	44	43	39	38	36	36
Kwai Chung	0	57	57	55	46	44	44	44	40	39	39
Tsuen Wan	1	86	74	63	57	56	56	53	50	48	47
Tseung Kwan O	0	59	53	48	48	42	41	40	39	39	38
Yuen Long	1	81	70	59	54	51	47	46	46	46	45
Tuen Mun	2	92	80	69	69	62	60	56	55	55	53
Tung Chung	1	82	74	64	63	59	55	54	53	52	52
Tai Po	1	98	69	66	63	54	52	51	48	47	47
Sha Tin	0	64	57	54	51	49	46	42	42	40	39
Tap Mun	0	53	51	44	39	38	38	37	36	35	35
Causeway Bay	3	108	86	81	64	63	60	59	58	54	54
Central	3	105	82	80	64	61	56	55	54	53	53
Mong Kok	3	94	78	77	59	58	58	56	56	56	55

Notes:

1. All concentration units are in microgram per cubic metre (μg/m^3).
2. Shaded no. of exceedance of limit value respresents exceedance of the respective air quality objective.
3. Shaded concentration is higher than the limit value of the respective air quality objective.

Table C2: 2019 Monthly and Annual Averages of Air Pollutants Concentrations

Pollutant: Sulphur Dioxide

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	3	2	5	6	4	3	4	4	4	5	5	4	4
Eastern	2	1	1	1	1	1	2	3	3	3	3	3	2
Kwun Tong	5	5	3	5	6	7	7	7	6	6	7	8	6
Sham Shui Po	4	4	4	5	5	5	6	6	7	7	9	7	6
Kwai Chung	8	7	9	12	12	6	6	6	8	8	10	7	8
Tsuen Wan	9	7	7	7	8	8	7	8	8	8	3	4	7
Tseung Kwan O	6	5	6	3	3	3	4	4	5	4	5	4	4
Yuen Long	7	3	3	3	3	5	6	7	5	5	7	7	5
Tuen Mun	5	2	4	8	8	3	3	4	4	4	6	8	5
Tung Chung	13	10	3	3	6	7	9	4	5	4	5	6	6
Tai Po	3	2	2	2	3	4	5	4	7	6	6	6	4
Sha Tin	5	4	3	2	2	5	5	4	5	6	8	8	5
Tap Mun	3	7	5	6	6	5	2	3	5	6	8	8	5
Causeway Bay	6	4	4	4	4	6	6	4	5	5	5	8	5
Central	10	5	6	5	4	6	5	6	5	4	7	9	6
Mong Kok	5	3	3	3	3	4	3	3	3	4	4	6	4

Pollutant: Nitrogen Oxides

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	96	55	55	38	44	40	32	41	42	33	42	56	48
Kwun Tong	92	54	68	85	64	102	85	68	57	61	58	72	72
Sham Shui Po	111	79	70	63	60	58	54	67	60	58	68	84	69
Kwai Chung	123	77	87	95	83	110	101	89	80	73	83	97	92
Tsuen Wan	118	73	72	64	60	59	53	54	45	45	68	88	67
Tseung Kwan O	54	33	39	46	34	54	47	46	36	41	38	43	43
Yuen Long	111	61	66	55	46	47	45	55	57	54	68	91	63
Tuen Mun	121	72	74	58	62	55	49	57	58	54	72	96	69
Tung Chung	107	49	49	32	35	31	25	32	39	38	49	69	46
Tai Po	72	43	48	46	37	47	41	42	48	51	48	58	49
Sha Tin	62	34	37	39	32	43	37	39	39	41	43	52	42
Tap Mun	22	12	13	15	11	11	8	11	7	8	12	16	12
Causeway Bay	277	200	209	209	189	253	230	225	227	205	176	245	221
Central	239	161	174	149	156	186	171	172	172	148	143	187	172
Mong Kok	203	149	154	165	152	172	165	160	145	139	101	145	154

Pollutant: Nitrogen Dioxide (Annual limit value = 40 $\mu g/m^3$)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	60	41	42	32	34	28	24	31	37	30	38	48	37
Eastern	53	38	43	36	37	28	26	33	35	39	38	46	38
Kwun Tong	54	35	42	49	39	50	47	44	43	48	43	50	45
Sham Shui Po	67	49	48	44	42	37	35	43	46	47	54	61	48
Kwai Chung	67	46	52	54	47	51	51	51	55	54	61	62	54
Tsuen Wan	71	50	51	44	41	35	32	37	34	36	58	64	46
Tseung Kwan O	36	21	27	31	22	31	29	31	28	33	29	30	29
Yuen Long	67	40	45	40	33	28	28	38	46	46	54	63	44
Tuen Mun	68	46	48	40	41	34	32	38	46	44	58	69	47
Tung Chung	64	33	32	24	25	20	16	23	32	33	42	51	33
Tai Po	50	30	34	34	28	31	28	31	39	42	39	44	36
Sha Tin	45	24	29	31	24	30	28	30	33	36	37	40	32
Tap Mun	18	10	12	12	9	9	6	9	6	8	11	14	10
Causeway Bay	91	68	77	76	71	68	66	77	98	96	87	93	81
Central	95	69	78	71	71	65	64	74	96	91	89	94	80
Mong Kok	94	70	77	79	77	69	69	77	87	85	71	81	78

Pollutant: Carbon Monoxide

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tsuen Wan	1030	873	815	688	579	422	396	441	423	513	729	849	645
Tseung Kwan O	911	655	749	399	328	314	371	451	462	564	593	651	538
Yuen Long	1054	745	576	429	397	481	607	514	529	676	704	836	629
Tuen Mun	975	802	807	702	561	600	522	580	679	786	669	646	693
Tung Chung	992	491	537	508	540	455	346	419	490	671	657	616	561
Tap Mun	680	602	569	414	410	205	285	402	479	630	634	704	501
Causeway Bay	1005	810	691	648	709	779	779	774	772	937	750	906	797
Central	1092	1042	799	312	849	888	780	934	836	907	816	865	845
Mong Kok	1030	899	897	724	905	852	700	739	810	741	730	725	813

Table C2 (Cont.): 2019 Monthly and Annual Averages of Air Pollutants Concentrations

Pollutant: Ozone

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	48	44	57	60	65	43	45	56	93	105	96	62	65
Eastern	53	46	58	60	68	44	43	54	90	101	93	63	65
Kwun Tong	49	48	58	51	64	28	26	42	81	90	89	59	57
Sham Shui Po	40	36	46	46	53	31	29	40	78	84	79	52	51
Kwai Chung	40	39	47	41	49	20	17	32	65	79	75	49	46
Tsuen Wan	39	38	47	44	51	27	28	43	76	83	65	42	49
Tseung Kwan O	69	64	73	64	78	38	38	56	94	104	103	79	72
Yuen Long	37	41	49	53	57	38	39	53	75	81	73	44	53
Tuen Mun	24	33	43	49	48	34	36	49	84	90	78	44	51
Tung Chung	35	42	55	61	63	46	48	60	81	93	83	48	60
Tai Po	51	51	60	58	63	37	39	55	82	89	86	60	61
Sha Tin	56	55	65	60	69	38	38	54	85	93	91	63	64
Tap Mun	71	65	75	73	84	51	50	67	105	119	113	82	80
Causeway Bay	22	22	30	27	33	16	17	21	35	47	49	26	29
Central	25	26	33	31	41	21	20	28	47	62	62	35	36
Mong Kok	24	22	29	25	31	15	13	21	49	55	63	33	32

Pollutant: Respirable Suspended Particulates (PM_{10}) (Annual limit value = 50 $\mu g/m^3$)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	51	31	29	23	25	13	19	21	31	38	43	39	30
Eastern	45	31	30	26	27	15	22	22	31	39	48	40	31
Kwun Tong	51	32	33	30	30	22	31	29	38	53	57	49	38
Sham Shui Po	48	31	30	26	27	18	24	25	34	40	48	43	33
Kwai Chung	41	26	27	23	23	16	21	21	29	36	42	37	29
Tsuen Wan	47	24	26	23	22	15	22	23	31	38	45	38	30
Tseung Kwan O	40	28	27	25	25	16	22	22	29	38	43	36	29
Yuen Long	52	28	33	25	26	15	23	26	39	53	65	58	37
Tuen Mun	67	35	37	29	29	18	26	29	44	50	64	60	41
Tung Chung	61	27	29	24	21	13	21	23	28	33	41	42	30
Tai Po	51	29	28	25	23	14	20	22	32	39	45	40	31
Sha Tin	44	26	27	24	23	16	22	20	26	32	38	37	28
Tap Mun	38	26	27	25	27	17	24	26	34	44	49	39	31
Causeway Bay	63	47	39	39	37	27	32	31	46	52	53	55	43
Central	58	36	34	30	29	21	26	26	37	44	51	45	37
Mong Kok	53	36	35	30	30	18	24	26	36	44	48	45	35

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

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Central/Western	36	21	20	17	16	8	12	15	21	26	26	26	20
Eastern	27	18	17	16	15	8	11	14	18	25	24	23	18
Kwun Tong	29	19	19	19	17	12	15	16	20	30	25	24	21
Sham Shui Po	31	18	18	16	15	9	12	14	19	23	24	22	18
Kwai Chung	26	16	18	16	14	10	13	14	19	25	24	22	18
Tsuen Wan	34	18	18	16	14	9	13	15	20	25	27	26	20
Tseung Kwan O	25	16	16	15	13	7	11	13	17	24	23	20	17
Yuen Long	31	13	17	16	15	10	14	16	23	28	28	25	20
Tuen Mun	41	23	24	19	17	10	14	17	26	32	35	34	24
Tung Chung	39	15	19	16	12	8	12	15	21	23	25	26	19
Tai Po	32	19	19	18	15	9	12	15	22	28	28	27	20
Sha Tin	27	15	15	16	13	10	12	12	17	21	21	22	17
Tap Mun	22	15	16	16	15	9	12	15	18	25	24	22	17
Causeway Bay	42	29	25	26	24	17	20	21	28	33	30	34	27
Central	38	22	22	21	19	14	16	18	24	30	30	29	24
Mong Kok	37	24	24	22	20	12	16	18	24	29	28	30	24

Notes:

1. All concentration units are in microgram per cubic metre ($\mu g/m^3$).
2. Shaded annual average represents exceedance of the respective air quality objective.

Table C3: 2019 Hourly Statistics of Air Pollutants Concentrations

Pollutant: Sulphur Dioxide

Station	No. of hourly data	Data capture rate (%)	<----------Percentiles----------> 10	25	50	75	90	95	97.5	99	99.8	Arithmetic mean	Highest 1-hour
Central/Western	8544	97.5	2	2	4	5	7	9	11	14	21	4	43
Eastern	8616	98.4	0	1	2	3	4	6	7	9	14	2	31
Kwun Tong	8672	99.0	3	5	6	7	9	10	11	13	19	6	36
Sham Shui Po	8569	97.8	3	4	5	7	9	12	14	16	20	6	34
Kwai Chung	8656	98.8	5	6	8	10	13	15	18	21	26	8	51
Tsuen Wan	8412	96.0	3	6	7	8	9	11	12	15	22	7	41
Tseung Kwan O	8549	97.6	2	3	4	5	7	8	9	13	16	4	21
Yuen Long	8459	96.6	2	3	5	6	8	10	12	14	18	5	42
Tuen Mun	8632	98.5	2	3	4	7	9	10	12	15	21	5	37
Tung Chung	8388	95.8	2	3	6	9	10	12	15	19	25	6	37
Tai Po	8685	99.1	2	2	4	6	7	9	10	11	15	4	19
Sha Tin	8644	98.7	2	3	5	6	8	10	12	14	17	5	28
Tap Mun	8407	96.0	2	4	5	6	8	10	11	13	16	5	19
Causeway Bay	8528	97.4	2	3	4	7	9	11	13	16	23	5	43
Central	8695	99.3	3	4	5	7	10	12	14	18	25	6	38
Mong Kok	8597	98.1	1	2	3	5	7	8	10	14	23	4	31

Pollutant: Nitrogen Oxides

Station	No. of hourly data	Data capture rate (%)	<----------Percentiles----------> 10	25	50	75	90	95	97.5	99	99.8	Arithmetic mean	Highest 1-hour
Central/Western	8639	98.6	13	20	36	59	92	127	169	234	391	48	535
Kwun Tong	8670	99.0	18	31	54	96	147	185	221	279	421	72	576
Sham Shui Po	8580	97.9	23	36	59	87	119	152	194	266	458	69	615
Kwai Chung	8650	98.7	29	50	80	118	164	199	244	320	436	92	602
Tsuen Wan	8340	95.2	19	35	56	81	116	156	218	307	400	67	509
Tseung Kwan O	8624	98.4	15	20	28	50	90	121	154	197	347	43	599
Yuen Long	8373	95.6	24	36	52	76	111	146	190	254	341	63	507
Tuen Mun	8638	98.6	25	38	57	86	126	159	205	260	324	69	463
Tung Chung	8408	96.0	11	18	32	59	97	127	165	230	313	46	389
Tai Po	8624	98.4	19	28	42	60	85	104	125	162	243	49	412
Sha Tin	8496	97.0	13	19	31	52	83	109	135	171	263	42	395
Tap Mun	8373	95.6	4	7	10	15	22	29	33	41	76	12	154
Causeway Bay	8629	98.5	60	108	190	298	421	503	584	682	877	221	1163
Central	8688	99.2	49	86	148	229	324	385	457	573	732	172	872
Mong Kok	8516	97.2	47	84	145	202	266	311	362	454	697	154	864

Pollutant: Nitrogen Dioxide (1-hour limit value = 200 μg/m^3; allowable no. of exceedance of limit value = 18. Annual limit value = 40 μg/m^3)

Station	No. of hourly data	Data capture rate (%)	<----------Percentiles----------> 10	25	50	75	90	95	97.5	99	99.8	Arithmetic mean	Highest 1-hour	No. of exceedance of limit value
Central/Western	8639	98.6	12	18	32	50	69	84	101	120	159	37	217	3
Eastern	8619	98.4	13	22	36	50	63	72	83	99	136	38	211	4
Kwun Tong	8670	99.0	15	25	40	60	79	95	116	144	186	45	272	10
Sham Shui Po	8580	97.9	19	28	44	62	81	94	110	131	178	48	227	6
Kwai Chung	8650	98.7	22	35	50	67	90	111	129	150	185	54	221	12
Tsuen Wan	8340	95.2	16	27	42	59	81	101	118	141	178	46	207	2
Tseung Kwan O	8624	98.4	10	15	21	36	60	77	95	120	156	29	218	3
Yuen Long	8373	95.6	18	27	39	55	75	91	109	129	162	44	193	0
Tuen Mun	8638	98.6	18	27	42	61	83	100	115	132	166	47	222	2
Tung Chung	8408	96.0	8	14	26	45	67	82	99	117	149	33	178	0
Tai Po	8624	98.4	15	22	32	46	61	72	85	104	142	36	189	0
Sha Tin	8496	97.0	11	16	27	42	61	77	94	114	151	32	185	0
Tap Mun	8373	95.6	3	6	9	13	19	24	28	35	56	10	132	0
Causeway Bay	8629	98.5	35	52	76	101	128	153	181	213	290	81	366	121
Central	8688	99.2	32	51	74	102	132	154	178	214	253	80	323	116
Mong Kok	8516	97.2	34	52	75	97	123	141	164	202	250	78	317	88

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

Station	No. of hourly data	Data capture rate (%)	<----------Percentiles----------> 10	25	50	75	90	95	97.5	99	99.8	Arithmetic mean	Highest 1-hour	No. of exceedance of limit value
Tsuen Wan	8409	96.0	340	430	610	810	982	1120	1230	1380	1720	645	1970	0
Tseung Kwan O	8605	98.2	270	360	490	670	870	980	1099	1270	1544	538	2170	0
Yuen Long	8460	96.6	340	430	590	770	1000	1140	1250	1404	1690	629	2150	0
Tuen Mun	8669	99.0	458	540	660	810	980	1100	1190	1310	1587	693	2050	0
Tung Chung	8411	96.0	310	370	500	680	900	1050	1300	1520	1770	561	2260	0
Tap Mun	8401	95.9	260	350	480	620	770	900	980	1080	1282	501	1360	0
Causeway Bay	8607	98.3	530	630	750	920	1110	1260	1390	1610	2030	797	2620	0
Central	8667	98.9	540	700	840	1000	1170	1290	1420	1570	1900	845	2440	0
Mong Kok	8598	98.2	550	660	800	950	1090	1180	1260	1400	1758	813	2280	0

Table C3 (Cont.): 2019 Hourly Statistics of Air Pollutants Concentrations

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	8628	98.5	16	34	56	89	121	140	158	195	307	65	391
Eastern	8623	98.4	22	36	55	89	119	135	149	178	269	65	380
Kwun Tong	8614	98.3	10	23	52	85	112	126	137	154	210	57	317
Sham Shui Po	8485	96.9	10	22	43	73	101	118	133	170	253	51	361
Kwai Chung	8604	98.2	3	13	38	71	100	115	129	147	239	46	348
Tsuen Wan	8403	95.9	7	19	40	71	98	116	134	179	259	49	414
Tseung Kwan O	8603	98.2	17	34	66	104	133	152	166	188	266	72	387
Yuen Long	8430	96.2	10	22	44	74	105	129	157	209	281	53	415
Tuen Mun	8557	97.7	7	18	40	71	107	130	162	217	315	51	422
Tung Chung	8398	95.9	10	29	52	82	113	135	165	218	310	60	412
Tai Po	8686	99.2	10	27	53	88	118	140	164	201	274	61	374
Sha Tin	8569	97.8	11	27	55	94	125	146	168	199	263	64	349
Tap Mun	8398	95.9	26	44	73	109	141	161	176	203	264	80	319
Causeway Bay	8613	98.3	5	10	21	41	65	81	95	108	148	29	288
Central	8709	99.4	5	12	27	53	80	95	110	129	194	36	293
Mong Kok	8515	97.2	3	9	23	47	75	89	104	119	158	32	237

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	8592	98.1	10	15	26	40	54	66	77	103	153	30	200
Eastern	8491	96.9	12	17	27	42	56	66	73	86	115	31	179
Kwun Tong	8333	95.1	13	22	35	51	65	74	81	90	139	38	171
Sham Shui Po	8452	96.5	14	19	29	42	57	67	75	92	139	33	187
Kwai Chung	8528	97.4	11	17	25	37	49	60	69	86	115	29	136
Tsuen Wan	8565	97.8	11	16	25	38	55	66	79	106	144	30	166
Tseung Kwan O	8579	97.9	12	17	26	38	52	59	68	77	112	29	185
Yuen Long	8558	97.7	12	19	31	50	71	85	97	112	142	37	186
Tuen Mun	8572	97.9	15	22	34	54	75	90	105	128	164	41	204
Tung Chung	8588	98.0	10	16	25	38	57	71	88	119	147	30	203
Tai Po	8650	98.7	10	16	26	40	55	66	78	94	172	31	241
Sha Tin	8123	92.7	11	17	25	36	50	59	68	79	137	28	173
Tap Mun	8503	97.1	13	19	27	41	55	62	69	77	89	31	126
Causeway Bay	8419	96.1	19	28	40	55	70	81	91	110	173	43	233
Central	8478	96.8	15	22	32	46	62	74	85	112	168	37	235
Mong Kok	8685	99.1	14	20	31	45	62	72	84	108	155	35	202

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	8592	98.1	7	10	18	26	35	45	54	75	110	20	145
Eastern	8510	97.1	5	10	16	24	32	39	45	55	76	18	117
Kwun Tong	8553	97.6	7	12	19	27	35	42	49	61	80	21	102
Sham Shui Po	8306	94.8	7	10	16	23	31	37	44	57	96	18	129
Kwai Chung	8518	97.2	7	11	16	23	31	37	44	57	71	18	90
Tsuen Wan	8565	97.8	6	10	17	25	36	45	55	72	103	20	126
Tseung Kwan O	8574	97.9	5	9	15	22	30	38	44	52	72	17	118
Yuen Long	8577	97.9	7	11	17	25	36	43	52	63	88	20	115
Tuen Mun	8573	97.9	9	13	22	32	44	52	64	76	101	24	124
Tung Chung	8588	98.0	6	9	15	25	36	47	60	78	101	19	124
Tai Po	8650	98.7	7	11	18	26	37	44	54	68	102	20	164
Sha Tin	8156	93.1	5	9	15	22	30	36	45	56	87	17	129
Tap Mun	8557	97.7	7	10	16	23	30	36	41	47	57	17	68
Causeway Bay	8419	96.1	12	18	25	34	44	53	61	76	120	27	167
Central	8478	96.8	9	14	21	30	39	49	59	79	115	24	152
Mong Kok	8685	99.1	10	14	21	30	40	48	58	78	109	24	143

Notes:

1. All concentration units are in microgram per cubic metre ($\mu g/m^3$).
2. Shaded arithmetic mean represents exceedance of the respective air quality objective.
3. Shaded no. of exceedance of limit value represents exceedance of the respective air quality objective.

Table C4: 2019 Diurnal Variations of Air Pollutants Concentrations

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	4	4	4	4	4	4	4	4	4	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4
Eastern	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Kwun Tong	6	6	6	7	6	6	6	6	6	7	7	6	6	7	7	6	6	6	6	6	6	6	6	6
Sham Shui Po	5	5	5	7	6	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5
Kwai Chung	8	7	7	7	7	7	8	8	9	9	9	9	9	9	9	9	9	9	9	9	8	8	8	8
Tsuen Wan	7	7	7	6	6	6	6	7	7	7	7	7	7	8	8	8	8	7	7	7	7	7	7	7
Tseung Kwan O	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4
Yuen Long	5	5	5	5	4	5	5	5	5	5	6	6	5	5	5	5	5	6	5	5	5	5	5	5
Tuen Mun	4	4	4	4	4	4	4	5	5	5	5	6	5	5	5	5	5	5	5	5	5	5	5	4
Tung Chung	6	5	6	5	5	5	5	6	6	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6
Tai Po	4	4	4	4	4	4	4	4	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4
Sha Tin	5	4	4	6	5	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Tap Mun	5	6	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	5	5	5	5	5	5	5
Causeway Bay	4	3	3	3	3	3	4	5	6	7	6	6	6	7	6	6	6	6	6	6	5	5	5	4
Central	5	5	4	4	4	4	5	6	7	7	7	7	7	6	6	7	6	7	7	7	6	6	5	5
Mong Kok	3	2	2	2	2	2	3	4	4	4	4	4	4	4	5	5	5	5	5	4	4	4	4	3

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	38	33	28	25	24	26	34	51	64	68	63	59	54	51	51	56	54	56	57	58	56	52	48	43
Kwun Tong	50	35	30	26	26	37	67	94	101	99	90	83	78	78	84	89	93	99	103	94	79	69	67	61
Sham Shui Po	53	42	36	34	35	39	56	77	89	89	79	77	75	78	80	85	90	93	94	86	76	70	66	61
Kwai Chung	71	53	47	42	41	49	77	113	130	123	107	100	96	99	106	110	117	122	127	113	99	89	85	80
Tsuen Wan	51	36	28	26	27	31	53	73	86	84	80	77	73	76	78	81	84	88	92	88	78	69	67	64
Tseung Kwan O	49	41	32	30	35	43	67	67	45	36	33	33	32	33	33	35	39	45	49	50	52	47	50	49
Yuen Long	56	49	41	37	38	45	73	96	81	65	58	53	50	53	55	61	68	73	79	83	79	75	73	67
Tuen Mun	61	52	46	41	40	51	68	90	91	82	75	70	64	64	66	68	73	83	89	87	83	77	72	65
Tung Chung	42	34	30	27	27	32	41	53	56	57	57	55	51	52	53	52	52	51	54	50	48	47	46	43
Tai Po	42	35	30	27	29	33	54	83	76	58	49	45	41	42	44	46	51	56	59	59	56	52	50	47
Sha Tin	42	36	30	27	26	29	46	62	60	47	38	33	30	29	31	36	41	45	50	54	54	52	51	48
Tap Mun	11	11	11	11	11	11	12	13	15	16	15	13	12	11	11	11	12	12	13	13	12	12	12	11
Causeway Bay	151	103	89	80	79	82	144	243	288	287	276	291	294	305	293	279	281	286	290	276	232	234	233	190
Central	114	93	81	73	70	74	111	174	258	249	241	230	205	187	205	212	209	233	262	220	177	159	147	139
Mong Kok	109	73	62	59	59	63	105	148	184	187	189	190	190	201	201	209	218	220	221	193	163	162	159	143

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	31	27	23	21	20	21	27	39	44	45	43	41	39	38	40	44	45	47	49	49	46	42	39	35
Eastern	31	25	21	19	19	21	32	44	48	46	43	41	38	40	43	46	50	51	49	46	43	40	37	35
Kwun Tong	36	26	22	20	20	25	40	52	53	52	50	48	47	49	53	57	60	63	66	61	53	47	46	42
Sham Shui Po	39	31	27	25	25	28	39	49	53	52	49	49	49	52	55	59	64	67	69	64	57	51	48	45
Kwai Chung	44	34	30	27	27	31	43	55	61	61	57	57	58	61	67	70	75	77	77	70	61	56	53	50
Tsuen Wan	37	26	21	19	20	23	38	47	50	49	48	48	49	52	55	58	62	66	68	65	57	51	49	46
Tseung Kwan O	34	29	23	22	24	27	36	36	28	23	22	21	21	23	23	25	28	34	37	38	38	36	36	36
Yuen Long	41	37	32	29	29	33	42	49	46	41	38	37	36	39	41	46	52	57	61	61	57	53	51	48
Tuen Mun	42	37	33	30	30	35	43	50	50	48	46	45	43	44	46	49	54	63	67	64	60	55	50	46
Tung Chung	30	25	22	20	20	23	27	32	34	35	35	35	35	37	39	39	40	40	42	40	38	36	34	32
Tai Po	34	28	24	22	23	26	36	46	45	37	33	31	30	31	33	35	40	45	49	49	45	42	40	37
Sha Tin	34	29	24	22	22	24	33	39	38	32	27	25	23	23	25	29	34	38	43	46	45	42	41	38
Tap Mun	10	10	9	10	10	10	10	10	11	12	12	11	10	9	9	10	10	11	12	11	11	11	10	10
Causeway Bay	64	50	45	41	41	42	58	79	85	88	91	98	102	106	107	106	103	103	102	97	90	87	84	73
Central	59	51	46	42	40	42	55	75	95	95	95	96	93	92	98	102	102	106	112	102	88	80	74	70
Mong Kok	62	46	41	39	38	40	57	71	81	83	85	88	92	98	100	105	107	108	107	98	87	84	80	75

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	609	572	548	539	548	563	627	685	704	683	668	647	638	646	645	648	652	675	705	722	713	697	685	653
Tseung Kwan O	560	533	520	497	505	510	560	572	550	527	520	509	505	503	501	501	509	533	557	579	586	588	596	587
Yuen Long	639	622	600	585	578	584	637	676	651	617	602	590	586	586	584	587	600	625	670	701	712	700	688	670
Tuen Mun	683	665	656	638	667	681	686	738	719	701	697	683	678	678	674	675	681	696	725	736	743	733	712	695
Tung Chung	547	540	528	529	529	540	559	567	566	564	570	569	569	575	578	563	562	561	575	574	577	575	574	564
Tap Mun	482	491	491	495	498	503	517	526	530	524	518	516	506	503	496	494	495	492	490	491	492	492	492	490
Causeway Bay	762	746	718	691	689	663	688	758	788	843	864	840	839	835	823	837	821	829	866	901	904	864	798	762
Central	779	757	731	727	714	729	755	810	856	900	905	880	882	896	884	884	877	912	950	957	960	905	831	808
Mong Kok	799	786	767	730	762	737	734	778	814	823	819	802	800	802	815	820	831	861	901	910	891	863	832	828

Table C4 (Cont.): 2019 Diurnal Variations of Air Pollutants Concentrations

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	63	65	67	67	66	63	56	47	44	48	55	64	74	80	82	80	77	72	67	64	63	63	62	62
Eastern	64	66	68	68	66	62	52	43	44	49	57	67	76	78	79	78	74	70	69	67	65	64	63	62
Kwun Tong	57	63	63	63	62	56	45	39	40	45	51	59	66	70	69	68	65	60	55	54	56	57	55	55
Sham Shui Po	52	56	58	57	56	51	41	34	34	40	47	55	61	64	64	63	57	49	45	45	48	50	49	49
Kwai Chung	45	51	52	52	51	46	37	29	30	35	44	51	58	60	59	57	51	45	41	41	43	44	43	43
Tsuen Wan	45	50	53	53	51	46	36	31	34	41	49	56	62	66	68	67	61	53	44	39	41	41	40	41
Tseung Kwan O	59	62	63	62	59	55	48	51	59	68	76	85	91	96	99	98	95	88	81	74	69	67	62	60
Yuen Long	43	42	44	44	41	37	29	27	36	48	60	71	82	88	90	85	77	66	55	47	44	43	41	40
Tuen Mun	46	46	47	47	45	39	32	28	33	41	50	60	71	79	83	81	73	60	49	44	43	43	44	45
Tung Chung	51	52	53	53	52	47	42	39	44	50	57	65	76	83	88	89	83	75	63	57	55	54	53	53
Tai Po	51	51	52	50	47	43	35	31	40	54	66	78	88	92	93	91	85	76	66	60	57	55	53	52
Sha Tin	52	53	56	55	53	50	41	39	47	59	71	81	89	95	97	93	86	79	69	61	56	53	52	50
Tap Mun	68	65	62	60	58	57	56	58	63	70	81	92	101	108	110	109	107	101	95	89	82	77	73	71
Causeway Bay	32	39	42	44	42	40	30	19	17	17	20	22	25	25	27	27	30	28	27	27	27	27	27	30
Central	41	45	48	49	49	46	36	26	20	22	25	29	36	41	40	38	37	33	28	30	33	36	37	37
Mong Kok	35	43	46	46	44	42	29	21	19	22	25	30	33	34	35	33	30	27	25	26	30	30	29	29

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	28	27	27	27	27	26	26	27	29	30	32	33	32	32	33	34	34	33	32	32	33	32	31	30
Eastern	32	31	30	30	29	28	28	28	29	30	31	32	33	32	33	34	34	33	33	33	34	33	32	32
Kwun Tong	34	32	33	32	32	32	31	33	35	39	42	43	43	39	42	44	43	43	41	40	40	39	38	37
Sham Shui Po	32	30	29	28	27	27	27	28	29	31	32	33	33	33	35	37	39	39	38	38	38	37	35	33
Kwai Chung	27	26	25	24	24	24	24	25	26	28	29	29	29	30	31	33	34	33	33	33	31	30	30	28
Tsuen Wan	28	26	25	24	24	24	24	25	26	28	30	31	31	33	35	35	35	34	34	34	34	32	30	29
Tseung Kwan O	29	28	27	27	26	25	25	26	26	27	28	29	29	29	31	32	33	33	33	33	32	31	30	30
Yuen Long	35	33	33	32	31	31	31	33	35	37	39	41	41	41	42	41	42	41	42	41	41	39	37	36
Tuen Mun	39	38	36	35	35	34	34	36	38	41	42	43	43	43	45	46	46	46	45	45	44	44	42	40
Tung Chung	28	27	26	26	25	25	25	26	27	29	31	33	34	35	37	38	37	35	33	32	31	31	30	29
Tai Po	30	29	28	27	27	27	27	28	30	31	31	31	31	31	31	32	32	32	33	33	33	33	32	32
Sha Tin	29	27	27	26	25	25	25	26	26	27	28	29	28	28	28	29	30	31	32	31	31	31	31	30
Tap Mun	29	28	28	28	28	29	30	30	31	31	33	33	33	34	34	34	34	34	34	33	32	31	30	29
Causeway Bay	39	35	30	29	29	28	31	37	41	45	48	48	47	49	51	50	50	51	51	53	53	49	47	44
Central	35	31	31	30	29	29	30	33	35	38	39	40	40	39	41	41	41	40	39	40	40	40	38	37
Mong Kok	33	30	28	27	27	27	28	31	33	35	37	37	38	39	41	41	40	39	40	42	42	40	37	34

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	19	18	18	18	18	18	18	18	19	20	21	21	21	22	22	22	22	21	21	22	22	22	21	20
Eastern	18	17	17	17	17	17	16	17	17	17	18	18	18	18	18	19	19	18	18	19	20	19	18	18
Kwun Tong	19	18	17	18	17	17	17	18	19	21	22	22	22	21	22	23	23	23	22	23	23	23	21	20
Sham Shui Po	18	17	16	16	15	15	16	17	17	17	18	18	18	19	20	20	21	21	20	20	21	21	20	19
Kwai Chung	17	17	16	16	16	16	16	17	17	18	18	18	18	19	19	20	20	20	20	20	20	20	19	18
Tsuen Wan	19	17	17	16	16	16	17	17	18	19	19	20	20	22	23	23	23	22	22	23	23	22	21	20
Tseung Kwan O	17	17	16	16	16	15	15	15	15	16	16	17	17	17	17	17	17	18	18	18	18	18	18	17
Yuen Long	18	18	17	17	17	18	18	19	19	19	19	19	19	20	21	21	22	23	23	23	23	22	20	19
Tuen Mun	24	23	22	22	21	21	22	23	23	24	24	24	24	25	26	26	27	26	27	27	28	27	26	25
Tung Chung	18	18	17	16	16	16	17	17	18	18	19	20	21	22	23	23	23	22	21	21	20	20	19	19
Tai Po	20	19	19	18	18	18	18	19	20	21	20	20	20	21	21	21	21	21	22	22	22	22	21	21
Sha Tin	17	17	16	16	15	15	15	16	17	17	17	17	17	17	17	17	17	18	18	18	19	19	19	18
Tap Mun	16	16	16	16	16	17	18	17	17	17	18	18	18	18	18	18	19	19	19	19	18	18	17	16
Causeway Bay	25	22	19	19	18	18	19	24	26	28	29	29	29	32	32	31	31	32	33	35	36	33	31	29
Central	22	20	20	20	19	19	20	21	22	24	25	25	25	26	26	26	26	25	25	26	27	26	25	24
Mong Kok	22	20	19	18	18	19	19	21	22	24	24	24	25	27	27	27	26	26	27	29	30	28	25	23

Note:

1. All concentration units are in microgram per cubic metre ($\mu g/m^3$).

Table C5: 2019 Total Wet and Dry Deposition

(a) Wet Deposition

	Monitoring Station	Central/Western	Kwun Tong	Yuen Long
	Wet Deposition (tonne/ha)	26166	15562	18289
	Weighted Mean pH (based on volume-weighted mean hydrogen ion concentrations ($[H^+]$)	4.74	4.94	4.81
	Weighted Mean pH (based on volume-weighted mean pH)	4.98	5.22	5.05
	Number of Samples	118	78	91
Filtrate (kg/Ha)	**NH_4^+**	8.84	7.13	7.38
	NO_3^-	45.37	27.38	33.33
	SO_4^{2-}	32.85	19.67	22.03
	Cl^-	30.49	18.63	15.50
	F^-	0.67	0.42	0.51
	Na^+	18.89	10.59	9.50
	K^+	6.55	3.87	4.63
	Formate	7.51	5.46	6.37
	Acetate	5.53	3.49	4.84
	Ca^{2+}	4.36	4.52	3.06
	Mg^{2+}	2.30	1.29	0.89

** 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	25	15	24
Filtrate (kg/Ha)	**NH_4^+**	0.56	0.82	0.11
	NO_3^-	9.73	7.54	8.39
	SO_4^{2-}	4.57	5.13	2.97
	Cl^-	9.06	10.39	3.93
	F^-	0.037	0.026	0.054
	Na^+	6.83	5.25	2.68
	K^+	0.47	0.39	0.31
	Formate	0.19	0.12	0.22
	Acetate	0.15	0.13	0.15
	Ca^{2+}	4.39	4.39	5.42
	Mg^{2+}	0.90	0.84	0.45

Table C6: 2019 Ambient levels of Toxic Air Pollutants (TAPs)

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	11	10
Organic Substances			
Benzene [2]	$\mu g/m^3$	1.03	1.08
Benzo[a]pyrene	ng/m^3	0.02	0.03
1,3-Butadiene	$\mu g/m^3$	0.06	0.04
Formaldehyde	$\mu g/m^3$	3.83	1.51
Perchloroethylene	$\mu g/m^3$	0.37	0.40
Dioxins [4]	$pgI\text{-}TEQ/m^3$	0.018	0.018

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 have been temporarily relocated to Kwai Chung Station since January 2015.

[3] For lead, the reported figures are the respective 2019 annual average concentrations in the elemental analysis of respirable suspended particulates.

[4] 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).