

AIR POLLUTION AROUND SCHOOLS

Clean Air Network
CAN
健康空氣行動



**CLEAN AIR NETWORK
"LET OUR CHILDREN BREATHE"
AIR POLLUTION AROUND
SCHOOL AREAS**



**EVERYONE HAS THE
RESPONSIBILITY**

Release date:
March 2020

1. Introduction on Project

From 19/10/2019 to 2/11/2019, the Clean Air Network (CAN) had conducted a 2-week-long community nitrogen dioxide (NO₂) measurement project, putting 80 NO₂ diffusion tubes at 25 locations in several areas with the help from our volunteers. The tubes were then sent to laboratory for analysis, and the results will be applied to find out polluting sources near to schools, or other places children at school age will visit daily. Datas from the diffusion tubes will be visualized into maps and organized into graphs for easier comparison. This measurement project is part of the CAN's latest campaign 'Let Our Children Breathe', and further details regarding the campaign will be discussed. In this report, we will include the analysis on results from the diffusion tubes, so as the possible harms that air pollution may bring to school children, and what other stakeholders in the community should concern about.



Photo 1: NO₂ diffusion tubes installed at Sham Shui Po Park Stage II

1.1 NO2 Diffusion Tubes

CAN has deployed up to 80 NO2 diffusion tubes for the first time to measure NO2 concentration in 25 locations in Sham Shui Po district, including Sham Shui Po, Cheung Sha Wan, So Uk and Shek Kip Mei. Given its smaller size, NO2 diffusion tube can be installed in locations at street level, such as bus stops and parks, providing a more accurate measurement of quality of air we normally breathe in. In fact, NO2 diffusion tubes have been used in London by local government or even concern groups to measure air qualities in communities for decades, providing sufficient data to support implementation of different policies to improve air qualities. Moreover, the tubes are distributed to citizens for encouraging participation in citizen science projects, which allows citizens to set up tubes at desired locations and provide enormous amount of data for visualizing air pollution in forms of interactive maps or figures. NO2 diffusion tubes have been one of the less costly options for passive air quality measuring tool, while being convenient to use and flexible to install, and these tubes can generate valuable data for concern groups to raise public awareness through publication of results or urging local governments to take up a more active role in alleviating air pollution. By engaging the public through citizen science projects, the public will be more active in taking actions to change their lifestyles to reduce emission of air pollutants, or to reduce their exposure to polluted air.



Photo 2: NO2 diffusion tubes installed at Sham Shui Po MTR Station C2 Exit

1.2 'Let Our Children Breathe' Campaign

Starting from summer 2019, CAN has launched 'Let Our Children Breathe' Campaign, which is a community education pilot program aiming to identify the level of air pollution exposed in school area and raise public awareness on the links between exposure to polluted air and its adverse health effects in children. At present, CAN has chosen Sham Shui Po district as the initial focus area of the project, and other than the air quality measurement project, education workshops and training sessions for students and parents are prepared to let them understand how air pollution destroying our health. And as being said, CAN aims to help students, parents and other stakeholders in the community to identify the air pollution harming the school children, and hence it is vital for us to obtain datas from setting up NO₂ diffusion tubes to create an "inter-school air quality monitoring network" in an economically efficient and scientifically reliable way.

The two principles of this campaign are as follow:

1. To raise citizens' awareness on the dangers air pollution may pose on our health, with growing children and students being the most impacted groups.
2. To make parents, children and teachers to identify the serious sources of air pollution near to schools, hence encouraging them to take routes with better ambient air quality. CAN will devote to establish an inter-school air quality monitoring network, with the datas collected, we can help different stakeholders in the community to push forward effective policies for improving air quality, guarding the children and also the public's health.

The goals of this campaign are as follow:

- 1) To push forward citizen science projects to engage the public in combating air pollution
- 2) To cultivate the school children's interest in learning science, and their logical development
- 3) To create a platform to educate the public, enabling the parents, schools and others in the community to realize the harms of air pollution, encouraging them to voice out demands for a cleaner, healthier school environment
- 4) To amass the power of an inter-school air quality monitoring network to tackle the problem of air pollution in Hong Kong

1.3 NO₂ and its harms on Children's health

Nitrogen dioxide (NO₂) is the main air pollutant from motor vehicle exhaust. According to United States Environmental Protection Agency, breathing air with a high concentration of NO₂ can irritate airways in the human respiratory system. Short exposure to NO₂ can intensify respiratory diseases, especially asthma, leading to respiratory symptoms, such as coughing, wheezing or difficulty in breathing. Longer exposure to higher concentrations of NO₂ may accelerate development of asthma and potentially increase one's vulnerability to respiratory infections. People with asthma, as well as children and the elderly are under more risks from the harms of NO₂.

Yet, for school children who are still developing, it should not be ignored that NO₂ may severely affect the development of their organs. Plus, supposingly school children will normally spend most of their times everyday, in places like schools, MTR stations, bus stops or even parks. For example, a whole-day primary school student may already spend at least 8 hours in school. If the aforementioned places are prone to high NO₂ concentrations, it is inevitable for school children to be under the risks of breathing in NO₂ constantly. Moreover, NO₂ is normally being emitted from the exhausts of vehicles, but due to the shorter heights of school children, their exposure to NO₂ may worryingly increase their risks of having respiratory diseases.

Figure 6: NO₂ long term trend

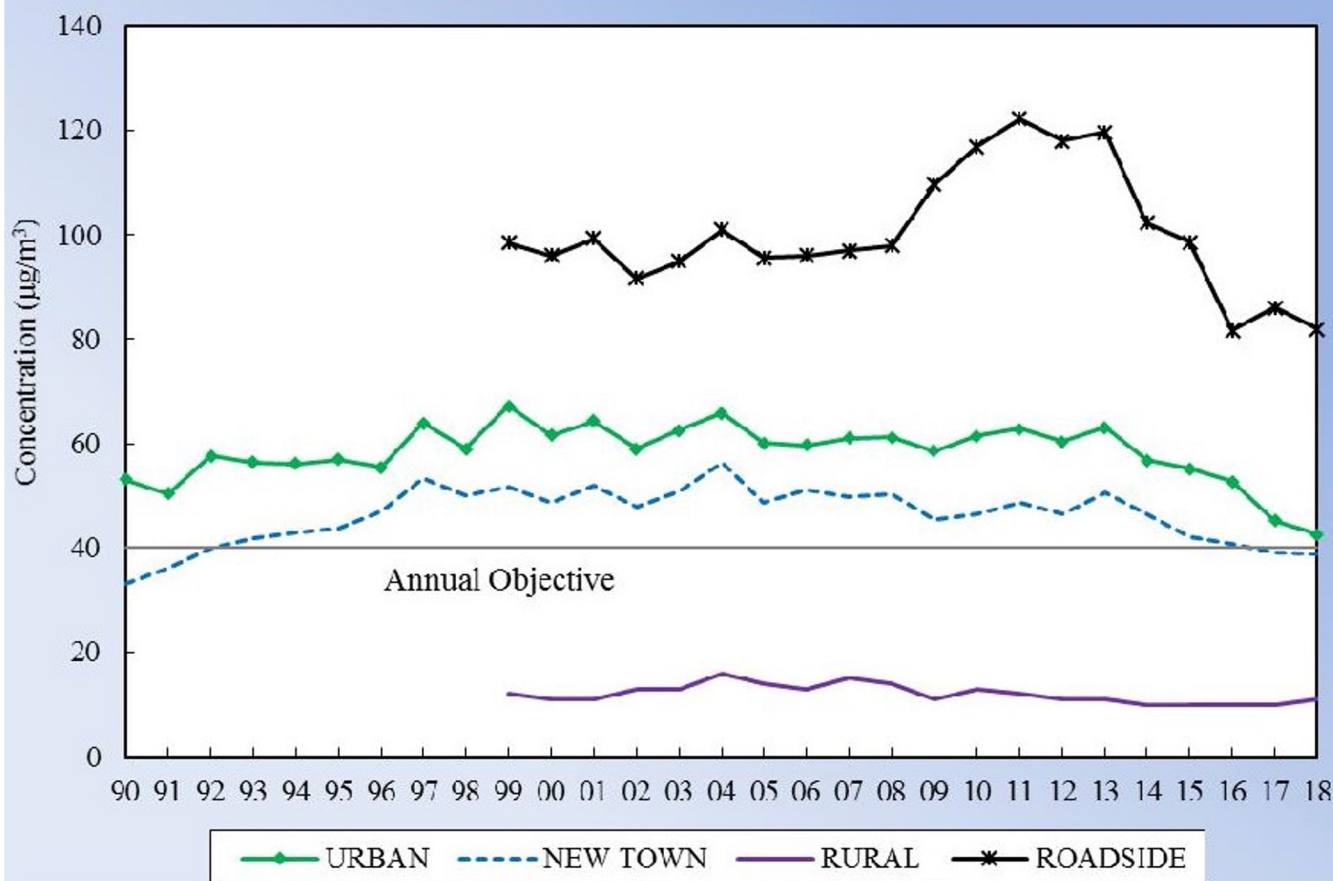


Figure 1: Environmental Protection Department(EPD) 'Pollutants Long-term Trends (1990-2018)'

From the above figure, it is not hard to notice that Hong Kong's NO₂ pollution is still concerning us, as roadside emission has still exceeded annual objective set by the EPD. Without a "down-to-earth" air monitoring, there will never be a clearer picture on the commuting students' exposure towards the health risks of high concentration of NO₂ at roadside, especially for district like Sham Shui Po, where there is high traffic flow during rush hours.

1.4 Sham Shui Po Community Air Measurement Project

Sham Shui Po is a district with high traffic flow as well as high building density · while there is a cluster of schools, ranging from kindergartens to secondary schools. Therefore, CAN picked 25 locations in Sham Shui Po district, including schools, roads, MTR exits and bus stops, in order to reflect the concentration of NO₂ that school children may predictably expose to. CAN has chosen the Sham Shui Po, Cheung Sha Wan, So Uk and Shek Kip Mei as areas for measurement, and with estimation supported by government statistics, the numbers of students in the areas are as follow:

Area	No. of schools	Est. no. of students
Cheung Sha Wan	Kindergarten: 2 Pri. School: 7 Sec. School: 1	6152
Sham Shui Po	Kindergarten: 7 Pri. School: 0 Sec. School: 0	1232
Shek Kip Mei	Kindergarten: 6 Pri. School: 4 Sec. School: 4	5436
So Uk	Kindergarten: 6 Pri. School: 4 Sec. School: 3	6148

Regardless the schools children attending, with a simple estimation based on the hours needed for half-day and full-day programs, students may spend at least 5 hours in possible locations with high NO₂ concentrations, such as studying in schools which locate near to busy roads, or waiting for buses for commuting. Furthermore, students will normally study at the same places for years, meaning that if the locations are with consistently high concentration of NO₂, students will be unavoidably exposed to NO₂ for a long period of time, causing serious damages to their healths. To tackle this problem, we need to identify the sources of pollution, and hence to work out solutions to mitigate the harms brought by NO₂ onto the school children. A easy solution, taking as an example, will be for schools to close all windows that are facing towards the roads with high traffic flows and hence high concentration of NO₂.

However, it is worth noticing that the air quality monitoring station in Sham Shui Po is located 17 meters from the ground level, and its location is far from most schools found in Sham Shui Po district. In order to get more “down-to-earth” and accurate monitoring at aforementioned locations, we must employ the NO₂ diffusion tubes to capture the real pictures of NO₂ pollution, and so we can raise concern from the public on this invisible threat to our children’s health.

2. Data

Cheung Sha Wan

Highest: Cheung Sha Wan
MTR Exit A
(93 $\mu\text{g}/\text{m}^3$)

Lowest: Fortune Street and
Fat Tseung Street Intersection
(47 $\mu\text{g}/\text{m}^3$)

Sham Shui Po

Highest: Sham Shui Po Air
Monitoring Station
(104 $\mu\text{g}/\text{m}^3$)

Lowest: Sham Shui Po Park
Stage II
(40 $\mu\text{g}/\text{m}^3$)

Shek Kip Mei

Highest: Nam Cheong Street
and Pak Tin Street
Intersection
(122 $\mu\text{g}/\text{m}^3$)

Lowest: Shek Kip Mei Estate
Playground
(30 $\mu\text{g}/\text{m}^3$)

So Uk

Highest: So Uk Bus Terminus
(88 $\mu\text{g}/\text{m}^3$)

Lowest: Un Chau Estate
Playground
(37 $\mu\text{g}/\text{m}^3$)

Types of locations	No. of tubes installed (discluding area blanks)	No. of area blanks
School	21	1
MTR Exit	15	2
Bus stop	21	1
Roadside	6	-
Park	12	-
Travel Blank	1	-

Figure 2: No. and Locations of NO2 Diffusion Tubes Installed

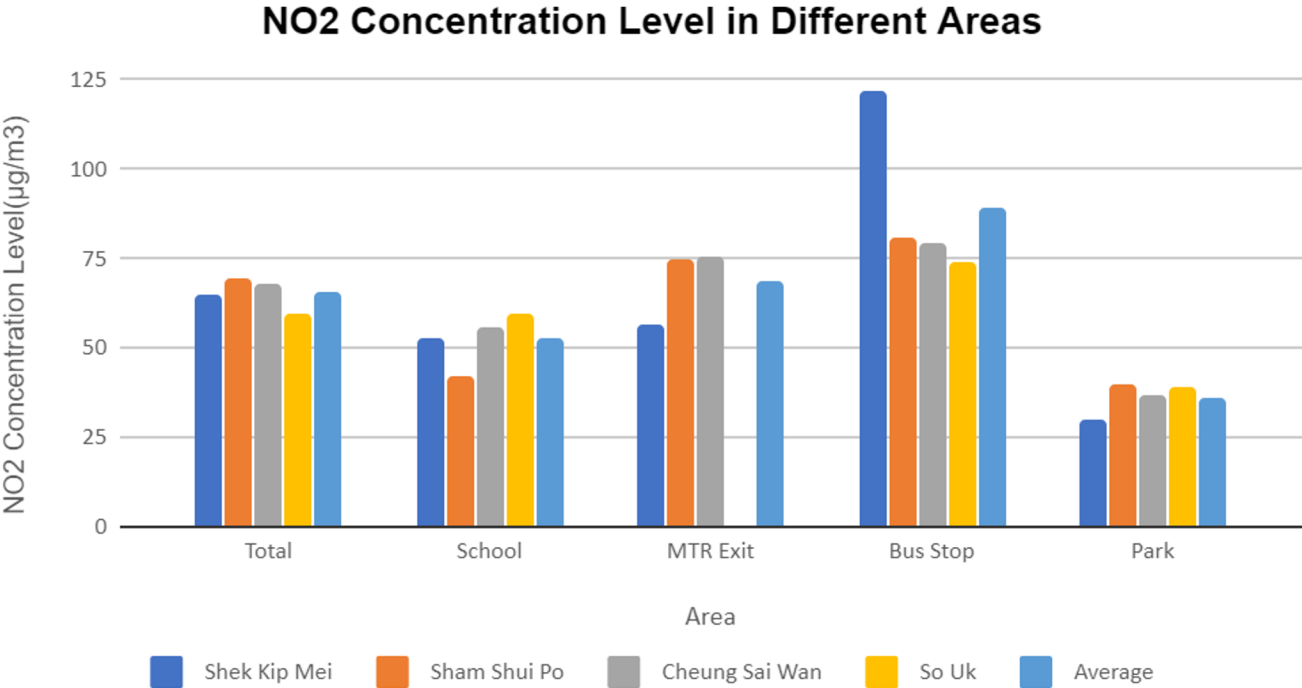


Figure 3: NO2 Concentration Levels in Different Areas

Measurement Location	Type	Area	NO ₂ (µg/m ³)
Fortune Street and Fat Tseung Street Intersection(School Zone)	School	Cheung Sha Wan	47
Fuk Wing Street and Fuk Wa Street Intersection(School Zone)	School	Sham Shui Po	72
Lai Kok Estate Lai Lo House(School Zone)	School	Sham Shui Po	42
Pratas Street(School Zone)	School	Sham Shui Po	49
Wai Chi Street(School Zone)	School	Shek Kip Mei	41
Nam Cheong Street and Wai Chi Street Intersection(School Zone)	School	Shek Kip Mei	65
Kwong Lee Street(School Zone)	School	So Uk	59
Shek Kip Mei MTR Station C Exit	MTR Exit	Shek Kip Mei	57
Sham Shui Po MTR Station C2 Exit	MTR Exit	Sham Shui Po	54
Sham Shui Po MTR Station A1 Exit	MTR Exit	Sham Shui Po	95
Cheung Sha Wan MTR Station B Exit	MTR Exit	Cheung Sha Wan	57
Cheung Sha Wan MTR Station A1 Exit	MTR Exit	Cheung Sha Wan	93

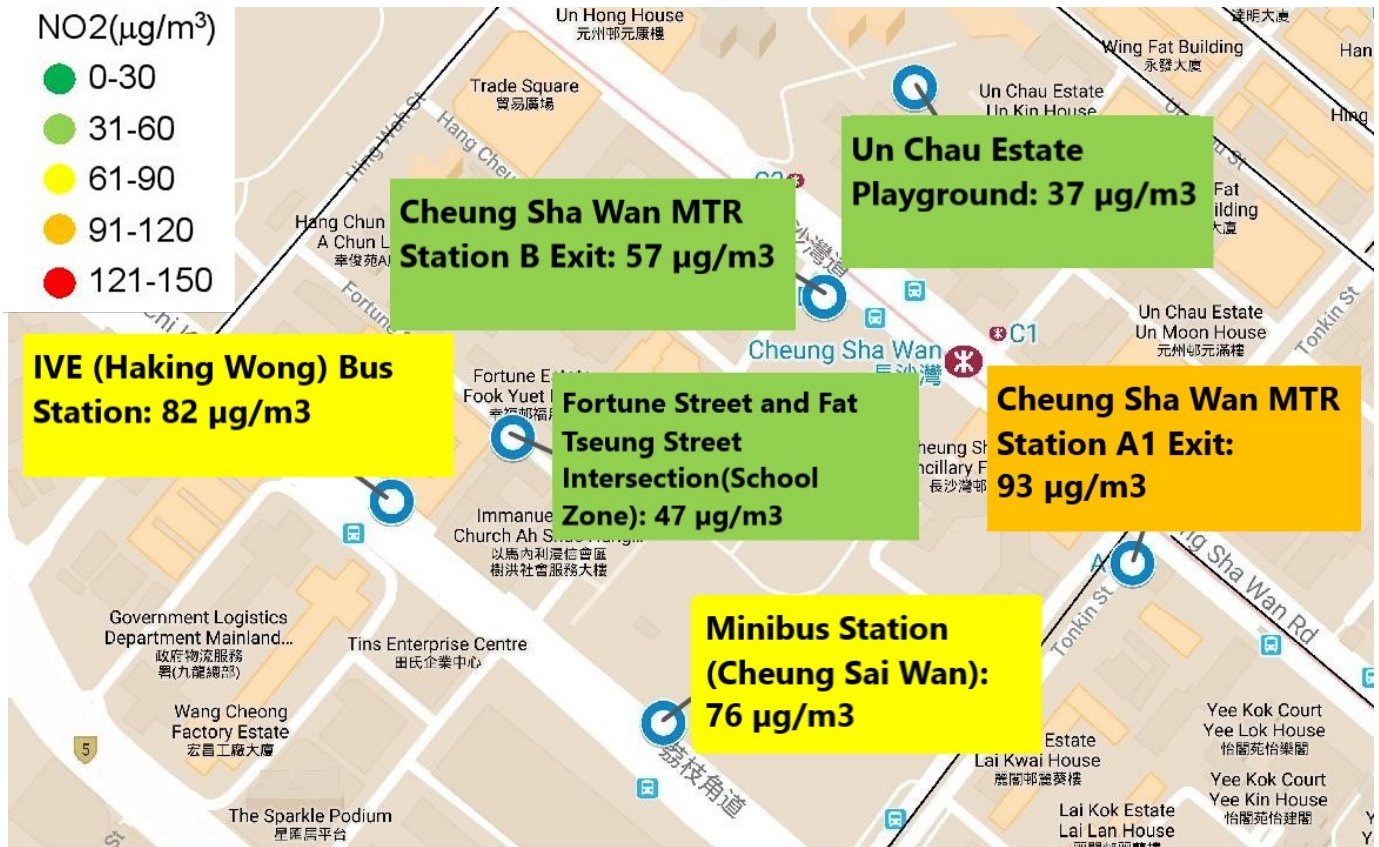
*Names of the schools will be replaced with nearest street names or building names for privacy

Measurement Location	Type	Area	NO ₂ (µg/m ³)
Nam Cheong St. Bus Stop	Bus Stop	Shek Kip Mei	122
Lai Kok Estate Bus Station	Bus Stop	Sham Shui Po	81
Minibus Station (Cheung Sai Wan)	Minibus Stop	Cheung Sha Wan	76
IVE (Haking Wong) Bus Station	Bus Stop	Cheung Sha Wan	82
Minibus Station (So Uk)	Minibus Stop	So Uk	70
So Uk Bus Terminus	Bus Stop	So Uk	88
Tomb Park; Tonkin Street Bus Station	Bus Stop	So Uk	63
Mei Shing House Shek Kip Mei Estate	Roadside	Shek Kip Mei	74
Sham Shui Po Air Quality Monitoring Station	Roadside	Sham Shui Po	104
Shek Kip Mei Estate Playground	Park	Shek Kip Mei	30
Sham Shui Po Park Stage II	Park	Sham Shui Po	40
Un Chau Estate Playground	Park	Cheung Sha Wan	37
Lei Cheng Uk Swimming Pool Rest Garden	Park	So Uk	42

Legend

NO₂($\mu\text{g}/\text{m}^3$)

- 0-30
- 31-60
- 61-90
- 91-120
- 121-150

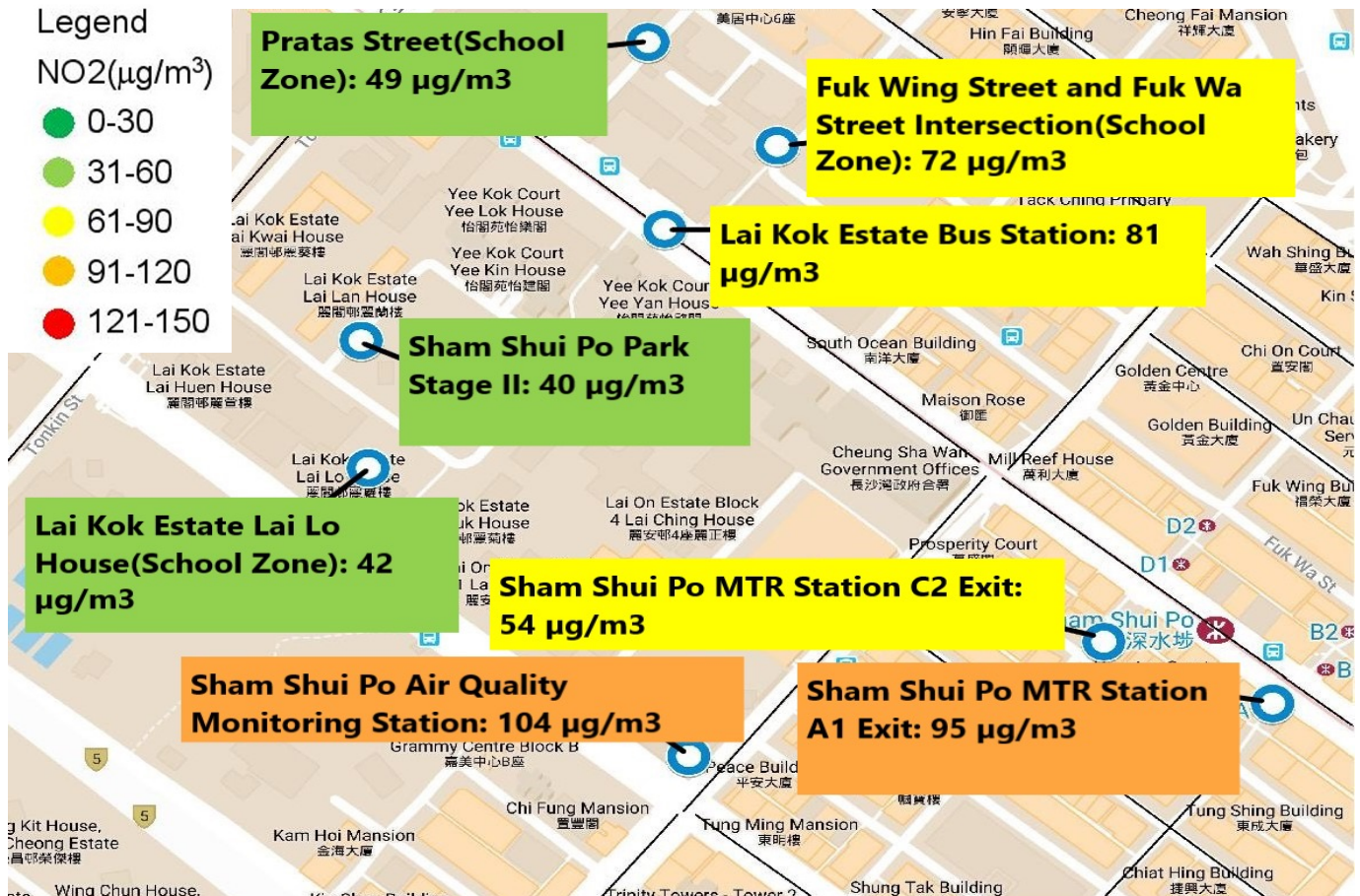


Map 1: Cheung Sha Wan Area

Legend

NO₂($\mu\text{g}/\text{m}^3$)

- 0-30
- 31-60
- 61-90
- 91-120
- 121-150



Map 2: Sham Shui Po Area

Legend

NO₂(μg/m³)

- 0-30
- 31-60
- 61-90
- 91-120
- 121-150



Map 3: Shek Kip Mei Area



Map 4: So Uk Area

3. Analysis

Schools	Cheung Sha Wan Area	Fortune Street and Fat Tseung Street Intersection	47 $\mu\text{g}/\text{m}^3$
	Sham Shui Po Area	Fuk Wing Street and Fuk Wa Street Intersection(School Zone)	72 $\mu\text{g}/\text{m}^3$
		Pratas Street	49 $\mu\text{g}/\text{m}^3$
	Shek Kip Mei	Wai Chi Street	41 $\mu\text{g}/\text{m}^3$
		Nam Cheong Street and Wai Chi Street Intersection	65 $\mu\text{g}/\text{m}^3$
	So Uk	Kwong Lee Street	59 $\mu\text{g}/\text{m}^3$

Table 1: NO2 concentration level measured near to schools

From the NO2 diffusion tubes installed near to the schools, the data obtained can help us to analysis the NO2 pollution near to the schools, so as the underlying causes.

1. High concentrations of NO2 are normally found near to the streets with high traffic flows, which can be measured in terms of Annual Average Daily Traffic (AADT) Data. For example, from the Annual Traffic Census publicated by the Traffic Department in 2018, at Nam Cheong Street (from Pak Tin Street to Woh Chai Street), the AADT was 9780, while at Wai Chi Street (from Woh Chai Street to Pak Tin Street), the AADT was 2600. Hence, even at the same area---Shek Kip Mei, the NO2 concentration level in Nam Cheong Street and Wai Chi Street Intersection, has been higher than the measurement obtained from Wai Chi Street. As shown from the AADT datas in aforementioned streets, the high traffic flows on roads near to schools will eventually lead to higher concentration level of NO2, since vehicles are the main source of NO2 emission.
2. During the on-site observation and installation, several construction sites can be seen near to the schools. For example, at Fortune Street and Fat Tseung Street Intersection, construction sites of housing estates could be found during the installation period, construction vehicles entering, idling in or leaving the construction sites may still lead to the high concentration of NO2.

Parks	Sham Shui Po Area	Sham Shui Po Park Stage II	39.8033 $\mu\text{g}/\text{m}^3$
	Shek Kip Mei	Shek Kip Mei Estate Playground	29.5167 $\mu\text{g}/\text{m}^3$
	So Uk	Un Chau Estate Playground	36.5233 $\mu\text{g}/\text{m}^3$
		Lei Cheng Uk Swimming Pool Rest Garden	41.5967 $\mu\text{g}/\text{m}^3$

Table 2: NO₂ concentration level measured at parks

From the NO₂ diffusion tubes installed at parks, the data obtained gives us insight into the importance of going to parks, from the perspective of improving children's health.

1. Comparing with the measurement of all locations, we have found out that the concentration levels of NO₂ in parks are comparatively lower than most of the locations, especially like roadside and bus stops. For example, the highest concentration level recorded among all locations was Nam Cheong Street and Pak Tin Street Intersection (121.9800 $\mu\text{g}/\text{m}^3$), in Shek Kip Mei. Yet, in the same area, the lowest concentration level recorded was Shek Kip Mei Estate Playground (29.5167 $\mu\text{g}/\text{m}^3$). Direct comparison is to be avoided as both locations show different geographical characteristics and traffic flow, yet it is still worth noticing that parks, or playgrounds are with better air quality, due to the surrounding buildings and distance from roads. As a result, children and parents



Photo 3: Shek Kip Mei Estate Playground

Bus Stops	Cheung Sha Wan Area	IVE (Haking Wong) Bus Station	82 µg/m ³
	Sham Shui Po Area	Lai Kok Estate Bus Station	81 µg/m ³
	Shek Kip Mei	Nam Cheong St bus stop	122 µg/m ³
	So Uk	So Uk Bus Terminus	88 µg/m ³
		Tomb Park; Tonkin Street Bus Station	63 µg/m ³

Table 3: NO₂ concentration level measured at bus stops

MTR Station Exits	Cheung Sha Wan	Cheung Sha Wan MTR Station A1 Exit	93 µg/m ³
		Cheung Sha Wan MTR Station B Exit	57 µg/m ³
	Sham Shui Po	Sham Shui Po MTR Station A1 Exit	95 µg/m ³
		Sham Shui Po MTR Station C2 Exit	54 µg/m ³
	Shek Kip Mei	Shek Kip Mei MTR Station C Exit	57 µg/m ³

Table 4: NO₂ concentration level measured at MTR Station Exits

From the NO₂ diffusion tubes installed at bus stations and MTR station exits, we can see that such locations are prone to the serious risk of NO₂ pollution, harming the health of children who take bus or MTR to schools.

For bus stations,

1. NO₂ is usually emitted from the exhausts of vehicles, due to the operation of engines. Yet, it is more worrying as children, especially those studying at kindergartens and primary schools, are generally shorter in height, hence this may imply that the children will breathe in most of the NO₂ emitted from the exhausts of vehicles when waiting at bus stations. Moreover, commonly speaking children will usually study at the same schools for several years, and waiting at bus stations several times a week. This implies that children will inevitably have a long exposure to NO₂ pollution over time, accumulating the harms brought by NO₂ to their organs, which their functions are still developing.
1. Bus stations for several bus routes, or at busy roads may pose greater threats to children's health, as a bus station for many bus routes mean that it is possible to have several buses idling at bus stations at the same time, emitting a worrying amount of NO₂. Furthermore, bus stations at busy roads may mean that buses being unable to drive away from the stations under traffic congestion, idling for a longer time at the stations. Based on these situations, it can be assumed that children, or even adults waiting at the stations will under exposure of more NO₂, posing more harms to their health.

For MTR station exits,

1. From the data obtained, we can see that there is huge difference in concentration levels of NO₂ measured at MTR station exits facing the roads, and those facing the pedestrian zones. For example, in Sham Shui Po, NO₂ diffusion tubes were installed at both A1 and C2 Exits, and the concentration level at C2 Exit, where is facing towards Apliu Street, is seemingly lower than that of A1 Exit, where is facing towards Cheung Sha Wan Road. As Apliu Street is a part-time pedestrian precinct from 12am to 9pm, and implementation of traffic calming streets, the low traffic passage helps to lower the concentration level of NO₂. Yet for Cheung Sha Wan Road (from Yen Chow Street to Nam Cheong Street), the AADT data from the Transport Department in 2018 was 23950, showing a very high traffic flow.

4. Solutions

From the above analysis on the concentration levels of NO₂ at different locations, where children may go to frequently if they live or study at the aforementioned areas, it shows a dreadful fact that children are prone to an invisible yet deadly threat---NO₂ and its harms on health. Children, with their organs still developing, are inevitably vulnerable under air pollution, and solutions can be advocated to better protect children's health.

For Individuals (children and parents)

1. To enjoy quality air, parents should bring their children to parks to exercise, allowing children to breath in air with lower NO₂ concentration, and to improve lung function.
2. Parents and children can wear masks when waiting for buses at bus stations, or walking to schools during rush hours.
3. Parents and children can choose walking routes with fewer vehicles passing by on the roads, or away from construction sites.

For Schools

1. Windows of schools facing towards roads with high traffic flows should always remained closed.
2. Schools can open school gates earlier to allow students waiting inside the campus, instead of waiting outside the schools, as nearby streets may get congested with students getting off school buses, leading to possible high concentration of NO₂ in the morning, and in the afternoon.
3. Schools can work together to provide programmes on air pollution and its impacts on human health.
4. Schools can set up air monitoring network jointly as citizen science project for students, increasing their interest for STEM subjects and involvement in fighting air pollution.

For Bus Companies

1. More electric buses can enter service, especially running on routes that will drive on roads where many schools are located.