

Press Release
25th March 2021

Clean Air Network ‘Let Our Children Breathe’ Air Monitoring Report of Tuen Mun

BACKGROUND

Clean Air Network launched ‘Let Our Children Breathe’ Campaign to conduct a series of air monitoring activities in the Tuen Mun District. This report reflects the result of monitoring conducted during 18th January to 31st January 2021.

One surrogate air pollutant (nitrogen dioxide, NO₂) is used to reflect the level of street level air quality. Concentrations of the pollutant were measured at 50 monitoring spots located in Tuen Mun to understand the roadside air pollution the community is exposed to.

Summary

1. Among the 50 monitoring spots, the 10 most polluted spots with the highest concentrations of NO₂ include bus stops, light rail stops and school zones which are near busy roads.
2. The 3 most polluted bus stops are also the first, second and fourth spots recorded the highest concentrations of NO₂ in Tuen Mun. These bus stops are with cover or semi-confined so pollutants are difficult to be dispersed, threatening the health of the citizens.
3. The 3 most polluted school zones are close to busy roads, one of the school entrances is less than 10 meters away from the traffic. There is an urgent need for the government to install air filters and screen for schools exposed to serious air pollution.

Note

Due to limitations of the equipment, in this report we will focus on the relative comparison of pollution level among all monitoring spots. The absolute level of the monitoring result of this study is for reference.

Monitoring Locations

Image 1 : 50 monitoring locations

Link: <https://cutt.ly/Bxc837c>



Image 2: Categories of 50 monitoring spots

Category	Quantity
School zone	15
Bus stop	12
Park/Playground	12
Light rail stop	10
EPD Tuen Mun Air Quality Monitoring Station	1

ANALYSIS

Methodology of Analysis

1. Average concentration level is be used to describe and compare the air pollutant levels among the selected locations.
2. Observation on surrounding environment was conducted to identify possible factors of influence of the level of pollution at all spots.

Result of Analysis

1. The 10 most polluted spots are mainly close to Tuen Mun Road

Image 3: 10 monitoring spots with the highest NO₂ concentrations

Spots	Type of spots	Distance from main road	NO ₂ concentration (µg/m ³)
San Hui Market	Bus Stop	0.02 km	175.39
Tuen Mun Station Public Transport Interchange	Bus Stop	0.35 km	151.82
On Ting Stop	Light Rail Station	0.35 km	142.22
Tuen Mun Central Bus Terminus	Bus Stop	0.15 km	141.91
Hung Kiu and San Wo Ln intersection	School Zone	0.05 km	137.32
San Hui Playground	Park	0.08 km	128.68
Tuen Mun Air Monitoring Station	Air Monitoring Station	0.1 km	126.83
Tuen Mun Heung Sze Wui Rd and Pui To Rd intersection	School Zone	0.16 km	126.67
Yau Oi Stop	Light Rail Station	0.54 km	120.77
Waldorf Garden (Castle Peak Rd)	Bus Stop	0.01 km	111.34

From the above table, we can observe that most of the spots are located quite close to main road (Tuen Mun Road), which is the most congested road in Tuen Mun. The air pollutants from the traffic road directly affect the air quality and worsen the air pollution problem in the spots. When

compared with spots which are far away from the main road, we can observe that the NO₂ concentration exceed a lot. It proves that the distance from the main road will directly affect the NO₂ concentration in the spots.

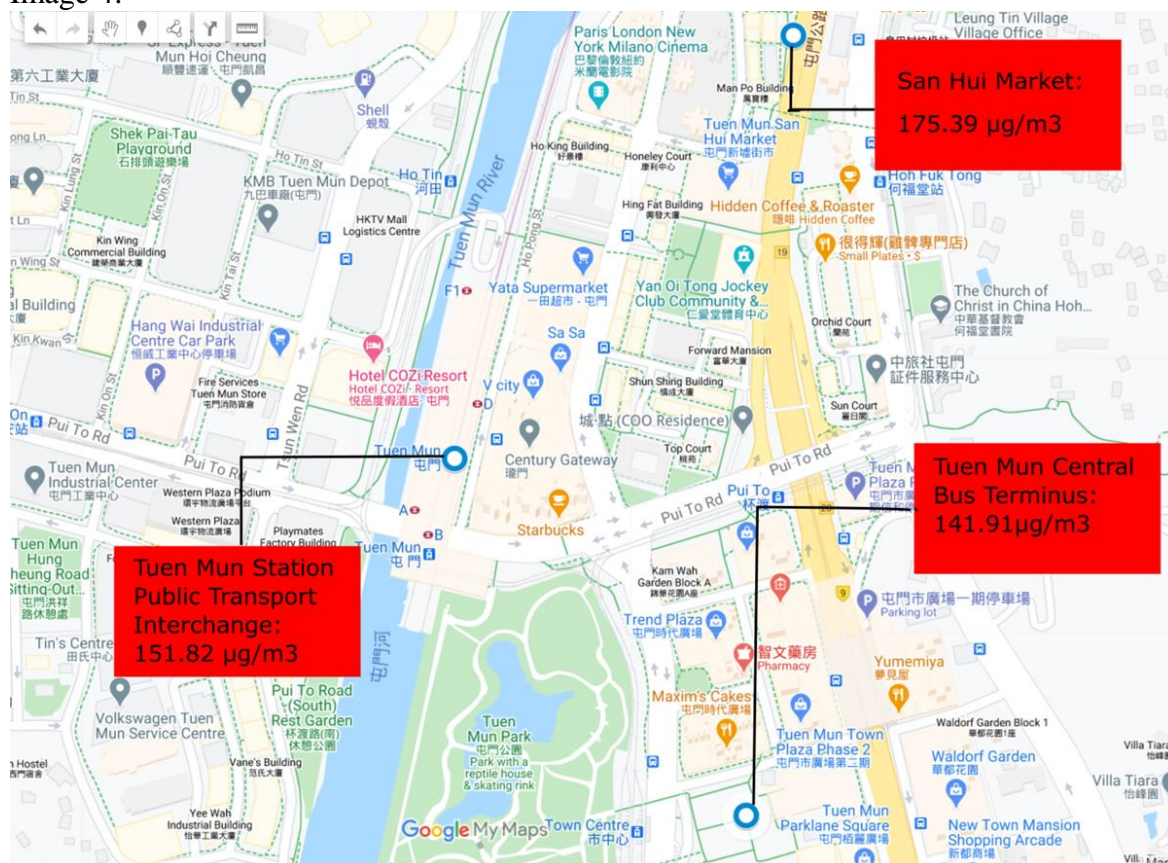
According to Environmental Protection Department (EPD), the past 24 hours pollutants concentration of NO₂ is around 60 µg/m³, which is far less than our measurement. This is because the air monitoring station is built 27 meters above ground, while our NO₂ tubes are installed nearby the bus stop. Thus, the data from the Air Monitoring Station hardly reflects the NO₂ exposure of the pedestrians.

2. The 3 most polluted bus stops are all covered or semi-confined

Among the 12 bus stops we monitored, the 3 stops with the highest NO₂ concentrations are below:

Image 4 & 5: 3 bus stops with the highest NO₂ concentrations

Image 4:



上環永和街 23-29 號俊和商業中心 23 樓

23/F, Chun Wo Commercial Centre, 23-29 Wing Wo Street, Sheung Wan, Hong Kong

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CLEAN AIR NETWORK is a company limited by guarantee and a charitable institution

Image 5:

Spots	Distance from main road	NO ₂ concentration (µg/m ³)
San Hui Market bus stop	0.02 km	175.39
Tuen Mun Station Public Transport Interchange	0.35 km	151.82
Tuen Mun Central Bus Terminus	0.15 km	141.91

The 3 most polluted bus stops are also the first, second and fourth spots recorded the highest concentrations of NO₂ in Tuen Mun. They are with cover or semi-enclosed so pollutants are difficult to be dispersed, threatening the health of the citizens.

San Hui Market bus stop is located in Tuen Mun Road, with a daily traffic of 127,870. Tuen Mun Road is a traffic highway, with the design of noise barrier to mitigate the noise pollution.

However, the noise barrier will trap the air pollutants, so the NO₂ pollution remains high in the bus stop. This will seriously affect the health of the passengers, as passengers are constantly breathing in air pollutants while waiting for bus.

Image 6: San Hui Market bus stop



Tuen Mun Station Public Transport Interchange and Tuen Mun Central Bus Terminus are covered bus terminus with superstructure. Bus terminus should strictly follow the emission stated in the "Control of Air Pollution in Semi-confined Public Transport Interchanges". However, since it has no legal validity, bus companies have no responsibility to follow the practice note.

On the other hand, covered bus terminus are usually designed without ventilated corridor, which traps the air pollutants and increase the NO₂ concentration.

Furthermore, buses may be unable to drive away in busy hours, idling for a longer time in the terminus. Therefore, children, or even adults waiting at the terminus waiting for bus will expose to more NO₂, posing to more harms to health.

3. The 3 most polluted school zones

Among the 15 school zones we monitored, the 3 stops with the highest NO₂ concentrations are below:

Image 7 & 8: 3 school zones with the highest NO₂ concentrations

Image 7:

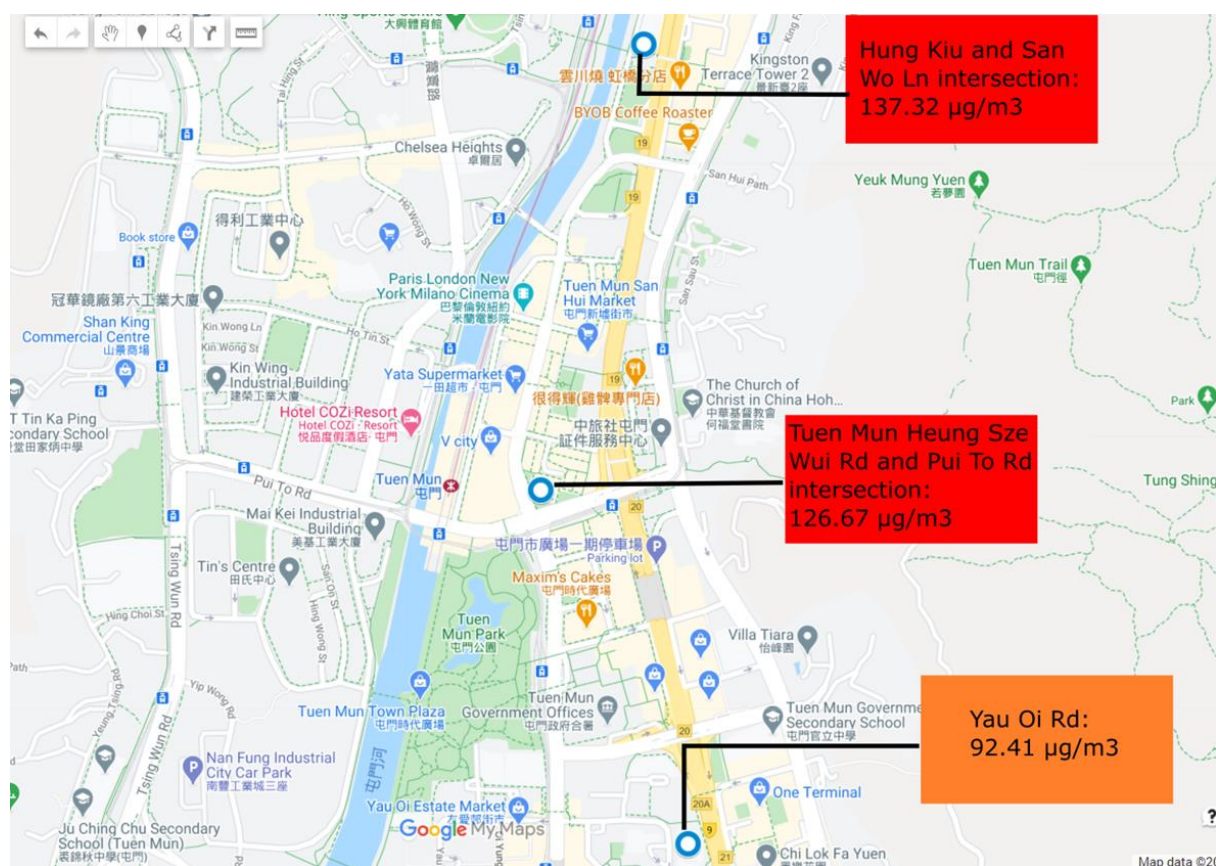


Image 8:

Spots	Distance from main road	NO ₂ concentration (µg/m ³)
Hung Kiu and San Wo Ln intersection	0.05 km	137.32
Tuen Mun Heung Sze Wui Rd and Pui To Rd intersection	0.16 km	126.67
Yau Oi Road	0.06 km	92.41

High concentration of NO₂ are normally found near to street with high traffic flow, which can be measured in terms of Annual Average Daily Traffic (AADT) data.

For instance, the school zones in Hung Kiu and San Wo Ln intersection, and Tuen Mun Heung Sze Wui Road and Pui To Road intersection are located near Tuen Mun Road, the most congested road in Tuen Mun.

According to AADT 2019, Tuen Mun Road (from Pui To Road to Tsing Chui Path) resulted in a daily traffic of 127,870, while Tuen Mun Road (from Wong Chu Road to Tuen Hing Road) resulted in a daily traffic of 102,060, far more than the traffic in other roads in Tuen Mun.

This explains why the NO₂ pollution in these two schools are serious.

Since children's organ are still developing, they are under higher risk of having respiratory diseases. Thus, we suggest children to choose a route with better air quality, to reduce the exposure to NO₂ pollution.

Image 9: the junction of Tuen Mun Heung Sze Wui Rd and Pui To Rd



Although the daily traffic of the school zone in the junction of Tuen Mun Heung Sze Wui Rd and Pui To Rd are far less than the Tuen Mun Rd, the school is next to Tuen Mun Station Public Transport Interchange, one of the most polluted spots in this 6-weeks measurement period. On the other hand, the main entrance of the school is facing the road, less than 10 meters away from the traffic, contributing to the high NO₂ concentration and increases the health risk of children.

4. The 3 most polluted light rail stops

Among the 10 light rail stops we monitored, the 3 stops with the highest NO₂ concentrations are below:

Image 10 & 11: 3 light rail stops with the highest NO₂ concentrations

Image 10:

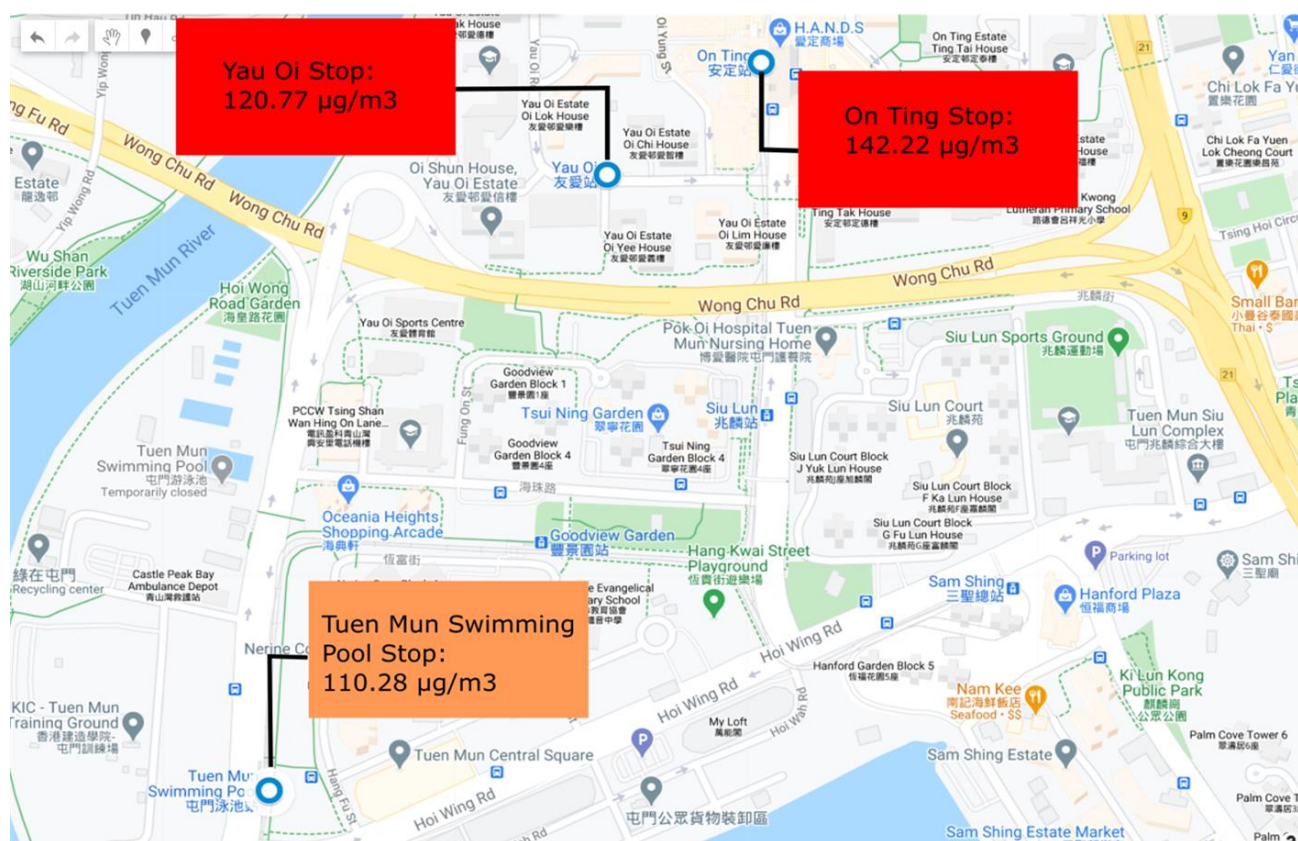
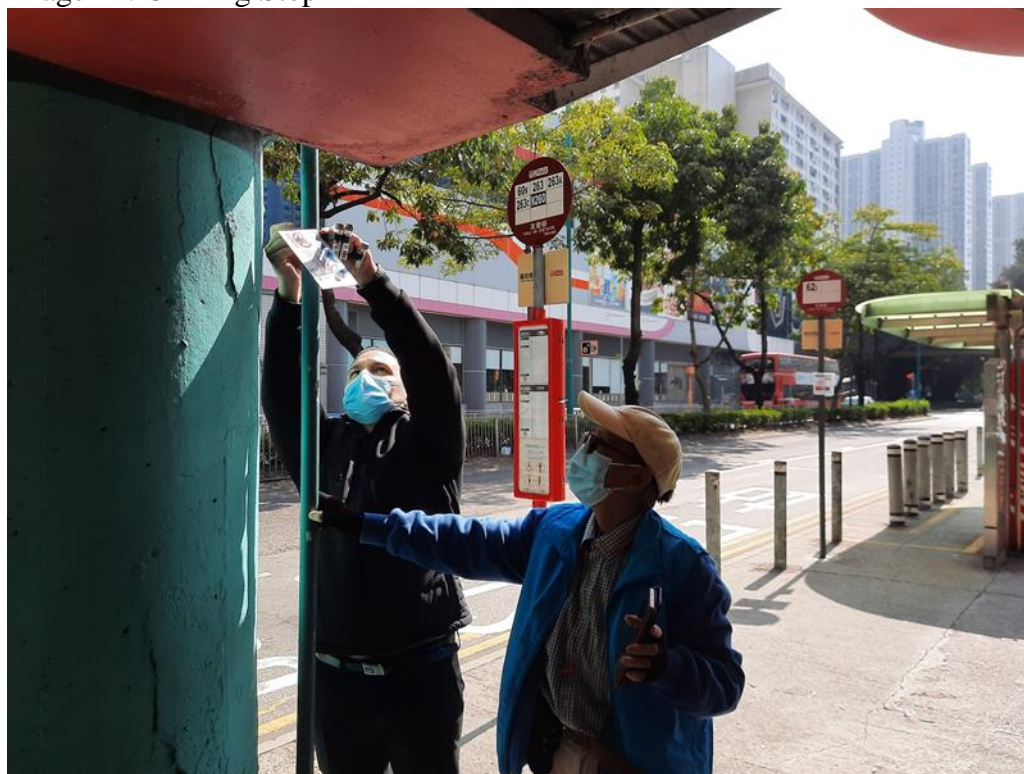


Image 11:

Spots	Distance from main road	NO ₂ concentration (µg/m ³)
On Ting Stop	0.35 km	142.22
Yau Oi Stop	0.54 km	120.77
Tuen Mun Swimming Pool Stop	0.82 km	110.28

Image 12: On Ting Stop



Although the most polluted light rail stops are located far away from Tuen Mun Road, they still result in a high NO₂ concentration.

On Ting Stop is located beside the bus stop. The bus idling directly affects the air quality in the light rail station. Furthermore, the light rail station and bus stops are covered by the bridges of the nearby shopping mall, and the air pollutants hardly disperse. This contributes to the high NO₂ concentration in the light rail station.

For Yau Oi Stop, it is surrounded by the traffic highway Wong Chu Road, and Tuen Mun Heung Sze Wui Road. According to AADT 2019, Wong Chu Road (from Tuen Mun Road to Hoi Wong Road) has a daily traffic of 53,510, half of that of Tuen Mun Road. The heavy traffic increases vehicular emission and degrades air quality.

With the KMB and Citybus depot surrounded, the NO₂ concentration in Tuen Mun Swimming Pool stop is quite high. Buses entering and leaving the depot will continuously emit air pollutants

and pollute the surrounding environment. Therefore, the NO₂ concentration in morning and night times are extremely high.

5. The 3 most polluted parks/playgrounds

Among the 12 parks/playgrounds we monitored, the 3 spots with the highest NO₂ concentrations are below:

Image 13 & 14: 3 light rail stops with the highest NO₂ concentrations

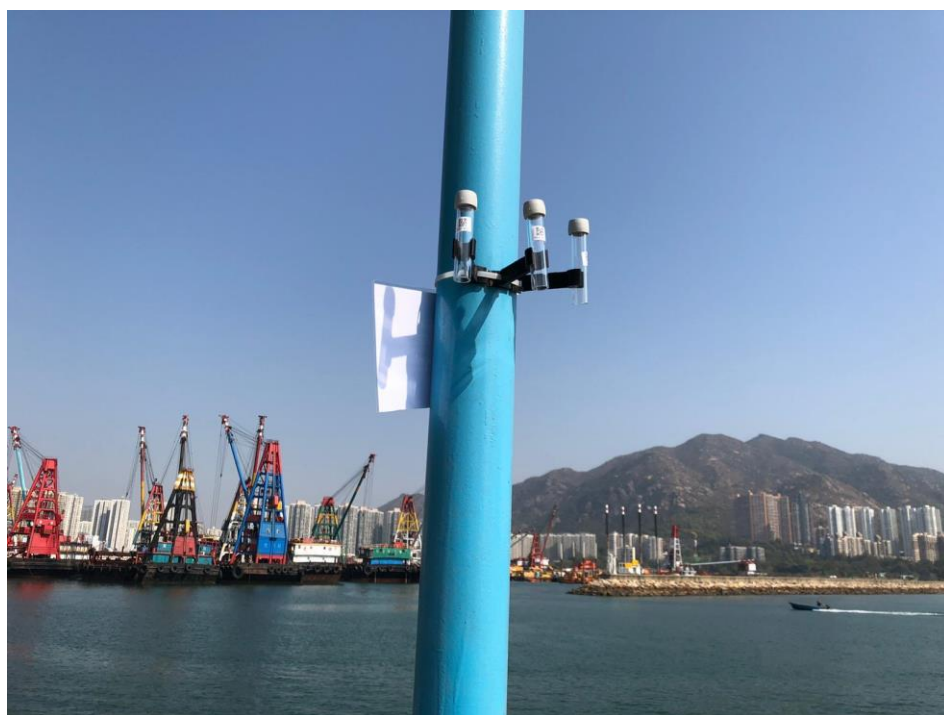
Image 13:



Image 14:

Spots	Distance from main road	NO ₂ concentration (µg/m ³)
San Hui Playground	0.08 km	128.68
Hoi Chu Road Playground	0.42 km	86.52
Tuen Mun Castle Peak Bay	1.49 km	86.12

Image 15: Tuen Mun Castle Peak Bay



Comparing with the measurement of other locations, we have found that parks generally have lower NO₂ concentration. Yet, when compared with the previous NO₂ measurement in Sham Shui Po, the NO₂ concentration in Tuen Mun parks are still exceeding a lot.

With the short distance from Tuen Mun Road, San Hui Playground have an extremely high NO₂ concentration. At the same time, San Hui Playground lacks ventilation system and noise barrier to blow away air pollutants. Staying in the park for a long period of time will pose serious health impacts to children, such as worsening their respiratory diseases. Therefore, children are not advised to stay in this park.

On the other hand, Hoi Chu Road Playground is located near Yau Oi (South) bus terminus, one of the most polluted bus stops in this measurement. Buses idling in the bus terminus constantly emit NO₂, and directly affect the air quality in the playground.

With Tuen Mun Pier nearby, the NO₂ pollution in Castle Peak Bay mainly comes from ship emission. Shipping industry accounts to 37% of NO₂ concentration in Hong Kong, according to the Environmental Protection Department. This emphasises that ship emission greatly affects the air quality in the Castle Peak Bay.

Policy Recommendations

1. Source control: accelerate transition to zero emission vehicles

Exhaust from commercial vehicles (CV) and public transport (PT) account for over 90% of roadside air pollution. Transformation of CV and PT to zero emission mode will minimize the road transport emission, reduce the level of roadside air pollution and thus reduce the overall public health costs.

It is recommended for the Government to strategize to accelerate transformation of CV and PT to zero emission mode. Specifically, the Government should establish an infrastructure development goal, develop funding model to narrow the gap on purchasing newer energy vehicles, and to re-energize the Steering Committee on the Promotion of Electric Vehicles to provide high-level coordination among Government bureaus and departments.

2. Regular monitoring and reporting to inform decision making: expand the scope of Green Schools initiative

Enhanced monitoring and reporting mechanism will help to inform decision makers of the school bodies and Government to introduce appropriate measures.

CAN recommends the Government to expand the scope of Green Schools initiative to subsidize schools to conduct air pollution audits and implement regular monitoring and reporting system.

An expanded Green Schools initiative will also close the financial gaps for schools to implement measures, such as to enhance ventilation system, install barriers, filters and purifiers.

3. Focus to protect schools and elderly homes: assess health risk exposed by the children and elderly across the territory

According to Hong Kong Planning Standards and Guidelines of the Planning Department, there are some recommended buffer distances for trunk roads, primary distributors and other road networks. However, there is no recommended buffer distances between any road networks and school, kindergarten and elderly home while children and the elderly are the most sensitive and vulnerable groups among us.

The Government should review the planning guidelines and examine the number of facilities of vulnerable groups are located near busy roads. The Government should also enable the construction of barriers between main traffic road and schools and elderly homes.

4. Tighten standard and control of semi-confined bus stops air quality control of semi-confined bus stops

The Practice Note on Control of Air Pollution in Semi-confined Public Transport Interchanges issued by the Environmental Protection Department (EPD) in 1998, provides guidelines on the air quality of semi-confined public transport interchanges (PTIs). However the Practice Note is not legally binding. Bus operators do not have any incentives to improve the air quality of the bus stops. Even for those PTIs managed by Transport Department (TD), the air quality is not constantly monitored. TD commissions the Electrical and Mechanical Services Department (EMSD) to conduct air quality measurements in the covered PTIs only every two years.

We urge the government to tighten the standard and control of air quality of semi-confined PTIs; and enhance monitoring and report mechanism to inform citizens on the real-time air pollution level in PTIs; tighten standards of ventilation systems of all PTIs to reduce level of pollution exposed by commuters.

About ‘Let Our Children Breathe’

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. Sponsored by Tuen Mun District Council, ‘Let Our Children Breathe’ Campaign conducted an air monitoring project in Tuen Mun this year to measure the air pollution in the community.

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Appendix 1: Methodology

Measurement

The data of NO₂ were collected by diffusion tubes which contain a chemical reagent Triethanolamine (TEA). Since TEA can absorb NO₂ so the concentration of NO₂ can be calculated by laboratories.

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.

Limitations

The NO₂ diffusion tubes used in this air measurement activity do not need calibration, and reflects the air quality in 50 spots in Tuen Mun. They do not reflect the air quality and air pollution problem in the whole Tuen Mun District.

Spot selection

Tuen Mun Road, as a major expressway connecting Tuen Mun and Tsuen Wan, is known for its frequent traffic jams and road accidents. According to the Annual Average Daily Traffic (AADT) by the Transport Department, most of the road segments of Tuen Mun Road have a daily traffic of more than 100,000 in 2019. Moreover, many schools are built near Tuen Mun Road, reflecting that the air pollution is seriously affecting students' health. Therefore, we installed NO₂ tubes in school zones near Tuen Mun Road, to measure the NO₂ concentration and visualize the seriousness of air pollution. On the other hand, some of the schools are located far away from the main roads and MTR station. These schools should have a lower NO₂ concentration, and hence create less impacts to children's health. Therefore, we also installed NO₂ tubes in school zones such as Leung King, to compare the air pollution level. In this project, we have chosen 15 school zones as our scope, reflecting the air pollution of more than 30 schools, since many schools are located nearby and have similar air pollution levels.

Parks are usually filled with greenings, should have lower NO₂ concentration and impose less impact on children's health. Moreover, most of the parks in Tuen Mun District are located far away from main roads. This further improves the air quality of parks and protects children's

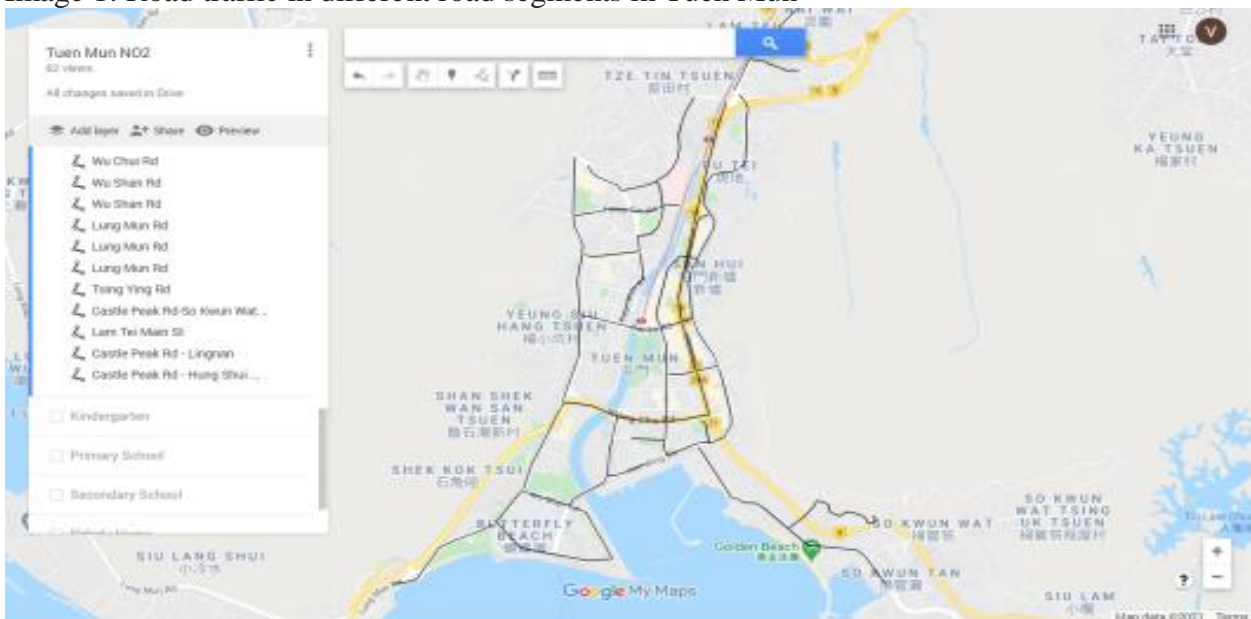
health. On the other hand, children spent more time on physical activities than adults. Therefore, by measuring the NO₂ concentration of parks, we hope to showcase that parks are cleaner and healthier for children to stay, and advise children to spend more time in parks.

A bus station for many bus routes may 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 are unable to drive away from the stations under traffic congestion, idling for a longer time at the stations. Since children's airways are still developing, they are more vulnerable to breathing in polluted air than adults. They breathe more rapidly than adults, and thus car exhaust will impose a higher risk to health. In this campaign, we installed NO₂ tubes on bus terminus and bus stops with many bus routes, to showcase that these bus stops have serious air pollution and advise students to wear masks when waiting for a bus at bus stations or choose bus stops with better air quality.

1. Annual Average Daily Traffic (AADT)

During the spot selection, we chose some spots with high traffic and compare the NO₂ concentration with spots with low traffic. By the data provided by AADT, we are able to compare the traffic in different years (2018 and 2019) and understand the road traffic of different road segments for spot selection.

Image 1: Road traffic in different road segments in Tuen Mun

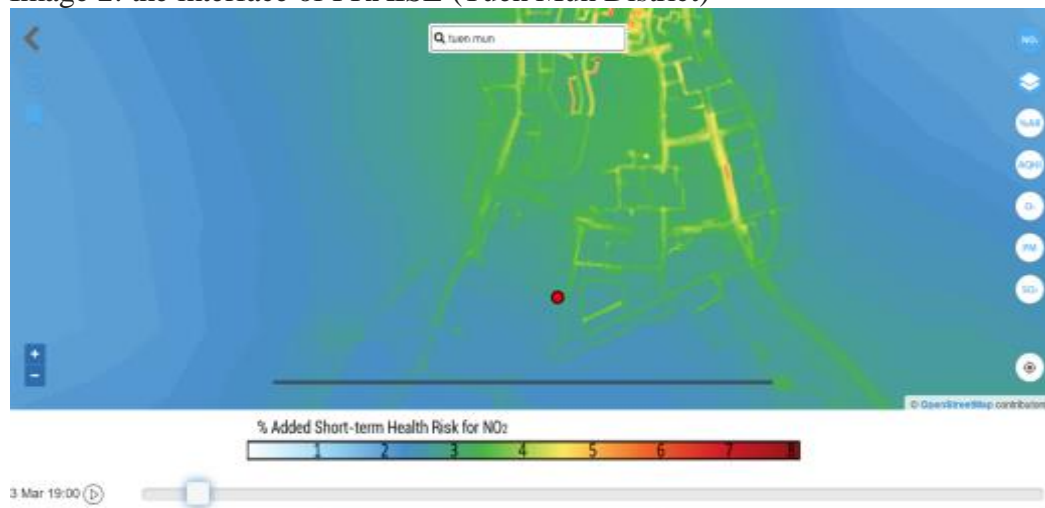


2. PRAISE

PRAISE, a mobile application developed by HKUST, can predict and analyze the air pollution level in different spots, and show the concentration of air pollutants such as NO₂ and PM_{2.5}. From the image below, we can observe that the NO₂ concentration in the afternoon remains high,

especially in Tuen Mun Town. By the mobile application PRAISE, we are able to know the air pollution level of every spot, to help us in selecting appropriate spots for installing NO₂ tubes.

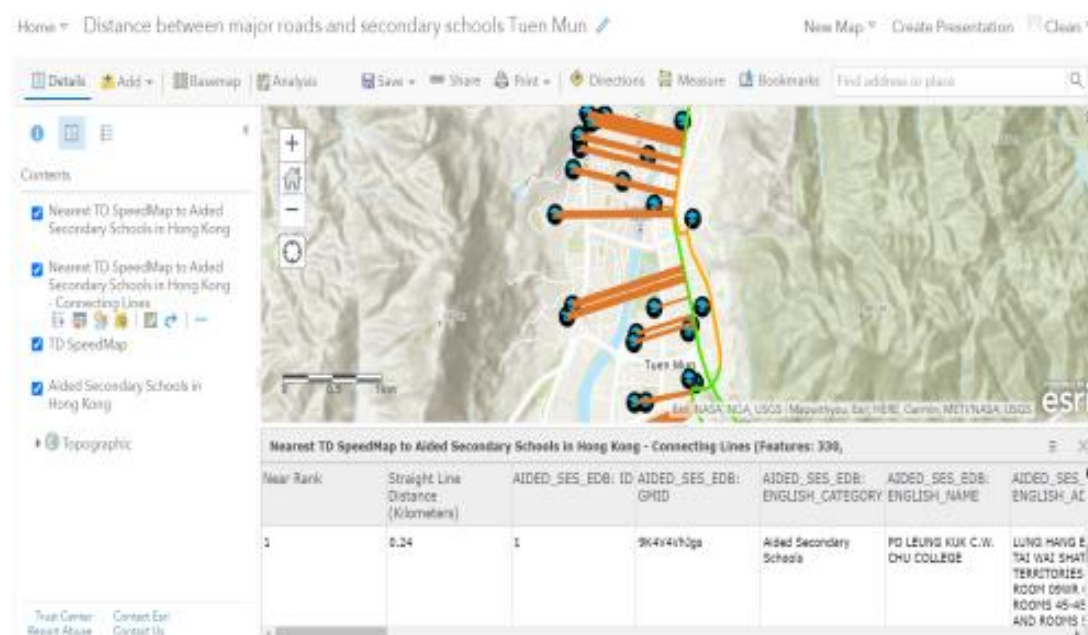
Image 2: the interface of PRAISE (Tuen Mun District)



3. ArcGIS

After selecting the spots, by the GIS system, the road distance between main road (Tuen Mun road) and the selected spots can be calculated. We can analyze the relationship between road distance and NO₂ concentration and provide us more evidence in advising schools to move main entrances away from main roads.

Image 3: ArcGIS system



Appendix 2: NO₂ and its harms on children’s health

Source of NO₂ and related health risks

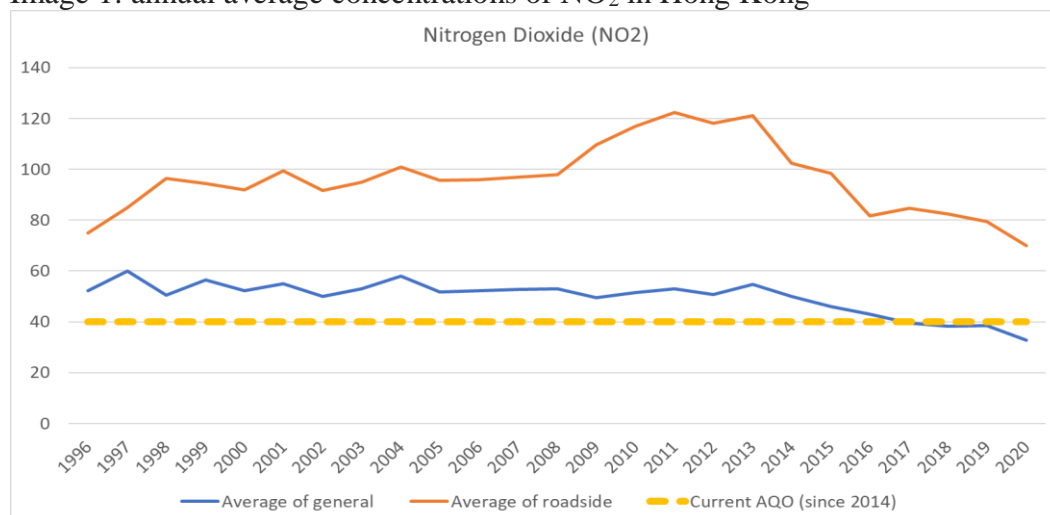
Nitrogen dioxide (NO₂) is the main air pollutant from motor vehicle exhaust. According to the United States Environmental Protection Agency, breathing air with a high concentration of NO₂ can irritate airways in the human respiratory system. Short exposure to NO₂ can intensify respiratory diseases, especially 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.

NO₂ and its harms on children’s health

For school children who are still developing, it should not be ignored that NO₂ may severely affect the development of their organs. Plus, school children will normally spend most of their time every day, 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.

Trend of NO₂ in recent years

Image 1: annual average concentrations of NO₂ in Hong Kong



Although annual average concentration of roadside NO₂ in 2020 declined 13% compared to 2019, it was still at a high level, which was 70 µg/m³, exceeding the World Health Organization (WHO) guidelines and Hong Kong's Air Quality Objectives (AQO) limit (40 µg/m³) by 75%. Annual concentrations of NO₂ of all roadside stations exceeded the WHO and AQO limit. Mong Kok roadside station recorded the highest level (74 µg/m³), exceeding the limit by 85%. Causeway Bay and Central recorded 68 µg/m³, exceeding the limit by 70%.

Appendix 3: Bus route and type of the 12 bus stops monitored

<u>Location</u>	<u>NO₂ concentration (µg/m³)</u>	<u>Number of bus routes</u>	<u>Type of bus stop</u>
Waldorf Garden	111.34	10	On-Street bus stop
Tuen Mun Central Bus Terminus	141.91	28	Covered bus terminus
Tuen Mun Park Bus Station	95.24	16	Open-air bus stop/terminus
Po Tin Bus Terminus	80.57	5	Covered bus terminus
Sam Shing Estate Bus Terminus	102.78	9	Covered bus terminus
Yau Oi (South) Bus Terminus	105.95	3	Open-air bus terminus
On Ting Estate (Bus Stop)	142.22	21	On-street bus stop
Tuen Mun Pier Transport Interchange	104.57	6	Covered bus terminus
San Hui Market Bus Stop	175.39	15	On-street bus terminus
Fu Tai Bus Terminus	116.99	7	Covered bus terminus
Siu Hong Station South Public Transport Interchange	96.53	6	Open-air bus terminus
Siu Hong Court Bus Terminus	82.43	5	On-street bus terminus
Tuen Mun Station Public Transport Interchange	151.82	13	Covered bus terminus