state of the air 2021

BC LUNG ASSOCIATION
CELEBRATING THE CLEAN AIR MONTH OF JUNE

Forget-Me-Not: Illustration by Natalia Lopes

COVID-19's economic consequences are apparent everywhere. Yet the impact of COVID-19 restrictions on air quality and health are less obvious – as are the effects of poor air quality on COVID-19 transmission and illness severity.

Accordingly, we begin this year's State of the Air Report with key findings on the subject, which a panel of international experts presented at the 18th Annual Air Quality & Health Workshop.

We also provide an update on small air sensors' reliability in measuring local air quality. Despite issues with certain models, Metro Vancouver and Environment and Climate Change Canada have recognized the potential of sensors in supplementing their air monitoring and forecasting efforts.

In 2018, after the Air Quality Health Index (AQHI) periodically under-reported health risks from wildfire smoke in our province, the AQHI-Plus was developed. We feature this novel tool that has been recently adopted as a complementary model to AQHI.

Speaking of wildfire smoke, B.C.'s wildfire season is constantly setting new records in both duration and severity. As another wildfire season becomes imminent, we offer 10 best practices to limit our exposure, protect our health, and better prepare us this year.

Another innovation we're featuring is UBC's SmellVan, a web-based app that collects odour information from user-submitted reports to paint a "smellscape" (smell landscape). The SmellVan app does not replace Metro Vancouver's odour complaint process, but it offers information useful to the agency's air quality work.

We also examine Metro Vancouver's efforts to curb traffic-related air pollution – in particular, (i) the findings of a vehicle air emission study it undertook with various federal agencies, and (ii) data from its near-road air quality monitoring station on Clark Drive in Vancouver. This information is vital in developing air quality management plans and transportation policies.

In closing, I'd like to thank once again all those who were involved in this year's Report. And I wish everyone continued good health, safety, and faith during this pandemic.

CHRISTOPHER LAM
President and CEO, BC Lung Association

Air Quality and COVID-19 Pandemic

COVID-19 was first identified in late 2019 and quickly spread worldwide in early 2020. It was declared a global pandemic in March 2020. People infected with COVID-19 can experience a range of symptoms and severity of illness. The risk of negative outcomes-including death—is higher with COVID-19 than with other common respiratory viruses. The virus has the potential to overwhelm public health care systems.

The first COVID-19 vaccines became available in December 2020 and a mass worldwide vaccination roll out is ongoing. To limit the spread of the disease, interactions between people have been restricted in 2020 during the earlier stages of the pandemic. In some regions, these restrictions resulted in a substantial but temporary reduction in vehicle traffic. Researchers worldwide have taken advantage of this phenomenon to study the

impacts of COVID-19 restrictions on air quality and health.

Researchers are also evaluating the effect of air pollution on COVID-19 transmission and illness severity. Historically, evidence has demonstrated that air pollution exposure increases susceptibility to, and severity of, respiratory viral infections and pneumonia. People exposed to higher levels of air pollution may be at greater risk of becoming ill with COVID-19. They may also experience the most severe outcomes.

The 18th annual BC Lung Air Quality and Health Workshop was held virtually on March 3, 2021 with the theme “Air Quality and the COVID-19 Pandemic”. The goal of the 2021 Workshop was to explore the latest research on:

- The impact of restrictions on air quality and health.
- The role of poor air quality in COVID-19 transmission and illness severity.

Kristin Aunan from the Centre for International Climate and Environmental Research in Oslo (CICERO) started the day off speaking about the effect of decreased traffic during COVID-19 lockdowns on air quality across the globe. She described widespread reductions in nitrogen oxide (NO_2) and particulate matter ($PM_{2.5}$) as well as slight increases in surface ozone in some regions. Overall, the results provide evidence to support policies aimed at reducing traffic-related emissions.

David Rich from the University of Rochester spoke about epidemiological studies of air pollution and respiratory infection. This presentation covered the current understanding of links between air pollution and respiratory infections other than COVID-19. Overall, evidence indicates relationships with illness occurrence and severity.

Researchers are also evaluating the effect of air pollution on COVID-19 transmission and illness severity.

Lisa Miyashita from Queen Mary University of London then gave an overview of the mechanisms of air pollution-associated respiratory infection. She included a summary of a study from London showing evidence for a biological mechanism by which particulate matter pollution may facilitate COVID-19 infection. Data from the study showed that respiratory cells exposed to traffic-related particulate matter pollution had increased levels of the ACE2 cell receptor COVID-19 uses to infect cells.

Eric Lavigne from Health Canada summarized recent studies on air pollution and COVID-19 incidence and outcomes from around the world, including studies in Canada. He described the existing epidemiological evidence for air pollution and COVID-19. He highlighted the limitations of existing research from a policy perspective. He concluded that, while recent studies provide evidence for a link between air pollution and COVID-19 incidence and outcomes, further careful research is needed.

Paul Villeneuve from Carleton University spoke about methodological considerations for studying an association between air pollution

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Monitoring Air Quality with Small Sensors

and COVID-19. He described the challenges in conducting epidemiological studies of air pollution and COVID-19. He provided examples of problematic designs and conclusions, and gave recommendations for future studies.

Shelly Miller of the University of Colorado Boulder finished the day with a presentation on policy and interventions for COVID-19, air quality, and health. She provided a model of infection risk, including the importance of aerosol transmission and the role of superspreading. She described the efficacy of a variety of interventions and concluded with strategies for reducing COVID-19 risk. These included recommendations regarding ventilation rates and the use of HEPA air cleaners for smaller rooms and germicidal UV light for larger rooms. She also gave recommendations for improving community respiratory health after COVID-19, including:

- mandating cooking exhaust hoods in all residences
- electrifying homes to reduce reliance on biomass burning
- addressing traffic related air pollution exposures.

The workshop was attended by 396 participants; most of them joining from Canada but also including participants from the US, Europe, the Middle East, South Africa, and South America. The speakers' slides are available online https://bc.lung.ca/health-professionals/air-quality-health-workshop

Photo credits Charlotte May, Tim Mossholder from Pexels

Air quality monitoring stations operated by federal, provincial or regional governments use sophisticated instruments. These "reference monitors" meet strict performance and operating standards. The high quality data they produce is used for decisions about regulations and policies and for reports on the state of the air. Recently, there has been a proliferation of small, low-cost air sensors that are easy to buy, set up, and operate. These small sensors are increasingly popular among residents and "citizen scientists" for measuring local air quality. But, limited certification and guidance for selection, set up, and use can result in misleading collection or interpretation of data.

Here's an update on what's happening with small sensors:

Pilot Project to Make Particulate Matter (PM) Data Available

Environment and Climate Change Canada (ECCC) is working on a pilot project, in collaboration with partners, to enhance real-time air quality data and forecasting during high-impact events such as wildfires. The pilot project is assessing the potential for using small, low-cost sensor technology for a collaborative crowdsourcing approach in regions that do not have real-time particulate matter (PM) data. Evaluations have shown that the sensors reliably capture elevated PM concentrations during smoke events. They are typically accurate to plus or minus one Air Quality Health Index unit (AQHI-Plus formulation for biomass smoke). Sensor information can supplement information provided by ECCC's air quality forecast models and help people make informed health decisions.

A mapping tool, developed in collaboration with Dr. Peter Jackson at the University of Northern BC, shows near real-time data from the sensors. It also shows traditional air quality data from the National Air Pollution Surveillance Program network. Colour coded concentration icons on the map will inform users at a glance where PM is elevated. By clicking on the icon, users can view the change in PM concentra-

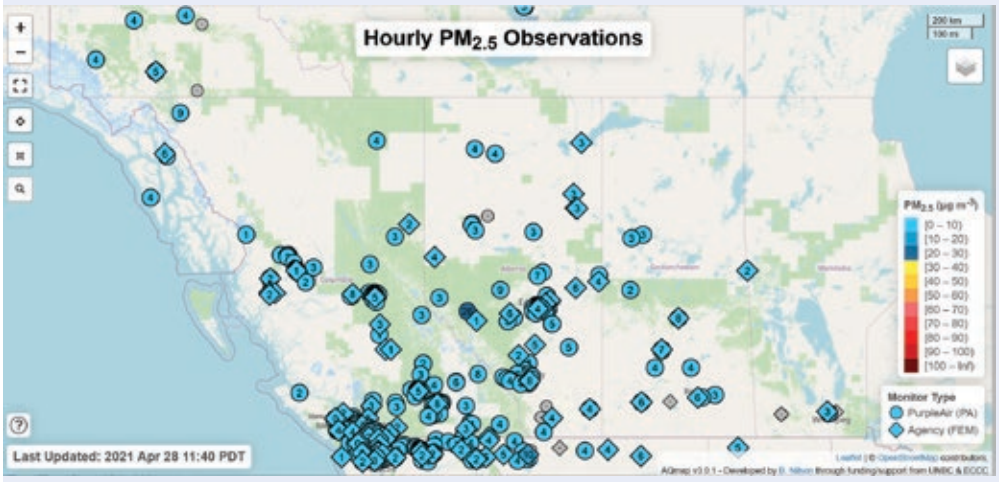

Image from: https://cyclone.unbc.ca/aqmap

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tion over time and associated health messaging. The mapping tool has other advanced features such as the ability to overlay PM concentrations from ECCC's FireWork forecast. The pilot project will continue through the coming wildfire season. There are plans to expand sensor use through collaborations with partners, to test data integration with forecast tools and products, and get feedback from users. More information can be obtained from Corinne.Schiller@Canada.ca or Matthew.Parsons@Canada.ca.

Metro Vancouver's Air Aware Project

The Air Aware project studied the strengths and limitations of small, low-cost air quality monitoring sensors, how they might play a role in Metro Vancouver's air monitoring network, why the public are using them, and how Metro Vancouver can support sensor users.

Early conversations with residents suggested that a major driver for their use was the link between air quality and health. As such, Air Aware was carried out in partnership with Vancouver Coastal Health. Volunteers measured outdoor air quality at their homes with small sensors provided by Metro Vancouver and gave feedback about their experience. The project found that small sensors can be easy to buy, set up, and operate, and can help users understand how activities affect local air quality. However, there is limited guidance on small sensor performance and use, which can result in misleading air quality data.

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To further support users, a website (www.metrovancouver.org/services/air-quality/action/air-aware) was created to help guide the public in the use and interpretation of small sensor data. The website also includes information on the differences between small air sensors and reference monitors, how to choose and use a small air sensor, and examples of how other individuals or organizations are using small sensors.

Air quality agencies like Metro Vancouver and Environment and Climate Change Canada see potential in these sensors to enhance current air monitoring capabilities and continue to support small sensor initiatives. Although data quality issues remain, small sensors have advantages such as the ability to be deployed quickly, and to be set up in a dense network to collect high-resolution spatial data at relatively low cost. Possible future uses that could be explored include:

- short-term air monitoring for community assessment studies;
- air monitoring during emergency situations, such as during wildfire smoke events;
- identification of hot spots or to help understand the impacts of industrial emissions;
- educational and engagement tools for residents or students;
- air monitoring at sensitive receptors such as daycares and health care facilities.

Photo credits: Metro Vancouver

The Air Quality Health Index in BC (AQHI-Plus)

Most communities in B.C. are fortunate to enjoy relatively good air quality throughout most of the year. However, at times, communities may experience episodes of poor air quality that can be harmful to health. These episodes of poor air quality are often due to elevated fine particulate matter ($PM_{2.5}$) from residential wood burning in the winter, ozone formation on hot summer days, or the gases and fine particles that make up smoke from wildfires. Communities in proximity to specific industrial sectors, such as upstream oil and gas, metal smelting, and pulp and paper, may also experience episodes of poor air quality due to elevated levels of sulphur dioxide (SO_2).

The Air Quality Health Index (AQHI) is a tool designed to inform Canadians about air quality conditions in their community and how these conditions may affect their health. This information allows people to take steps to reduce their exposure to ambient air pollution and protect their health and the health of others in their care.

The AQHI reports air quality on a scale from 1 to 10+, the higher the number, the higher the health risk.

The index scale is divided into four health-based risk categories, each with information on actions to reduce exposure to air pollution. The current AQHI is updated each hour and a forecast is provided for the following 72 hours.

The AQHI was developed based on the relative risks of a combination of common air pollutants that are known to harm human health: NO_2, O_3 and $PM_{2.5}$.

With the increasing intensity and duration of wildfires in western Canada in recent years, it became apparent that the AQHI was at times not sufficiently responsive to wildfire smoke. In response, the B.C. Centre for Disease Control, in collaboration with Ministry of Environment and Climate Change Strategy, Health Canada, B.C. Ministry of Health and Metro Vancouver, developed a complementary model, the AQHI-Plus, based solely on $PM_{2.5}$ levels. The AQHI-Plus was developed based on respiratory health effects observed in B.C. during smoky conditions.

The BCCDC also provides additional actions people can take to reduce exposure to wildfire smoke.

In B.C., both the AQHI and the AQHI-Plus are calculated hourly and the highest of the two values is reported. To check the AQHI for communities across Canada, visit the Government of Canada (https://weather.gc.ca/airquality/pages/index_e.html). The Province of British Columbia also reports current and forecast conditions, including an interactive air quality data map for all communities in BC with an air quality monitoring station (https://www.env.gov.bc.ca/epd/bcairquality/data/aqhi-table.html).

One of the best ways to stay informed is to download the AQHI Canada app and set up notifications for alerts when the AQHI in your community reaches the level at which you wish to be notified. People who are more sensitive to air pollution may choose to be notified when the AQHI reaches 4, while the general population may choose to be notified when the AQHI reaches 7. Those who are considered more sensitive to air pollution include people with heart or lung conditions, the elderly, children, and pregnant women.

For more information about how to reduce your exposure to wildfire smoke, visit:

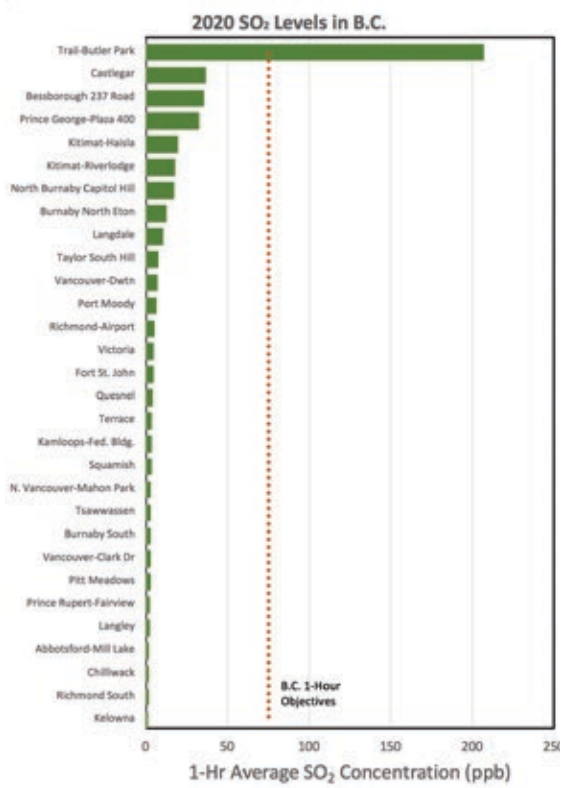
- The Government of Canada wildfire smoke web pages: https://www.canada.ca/en/environment-climate-change/services/air-quality-health-index/wildfire-smoke.html
- The BCCDC wildfire smoke online resources: http://www.bccdc.ca/health-info/prevention-public-health/wildfire-smoke

1-HOUR $PM_{2.5}$ ($\mu g/m^3$)	PROVINCIAL AQHI	AQHI RISK CATEGORY	HEALTH MESSAGE FOR PEOPLE AT HIGHER RISK	HEALTH MESSAGE FOR GENERAL POPULATION	ACTIONS TO REDUCE WILDFIRE SMOKE EXPOSURE
0 – 10	1	LOW	**Enjoy** your usual outdoor activities.	**Ideal air quality** for outdoor activities.	**Normal air quality** in British Columbia
11 – 20	2				
21 – 30	3				
31 – 40	4	MODERATE	**Consider reducing** or rescheduling strenuous activities outdoors if you experience symptoms.	**No need to modify** your usual outdoor activities unless you experience symptoms.	• Use a portable air cleaner to reduce smoke in your home • Stay inside with doors and windows closed, but keep cool – being too hot is more risky than breathing smoke for most people • Visit places with cleaner and cooler air, such as libraries, community centres, and shopping malls • If you cannot access cleaner air, consider using a well-fitted N95 respirator or relocating to an area with less smoke
41 – 50	5				
51 – 60	6				
61 – 70	7	HIGH	**Reduce or reschedule** strenuous activity outdoors.	**Consider reducing** or rescheduling strenuous activities outdoors if you experience symptoms.	
71 – 80	8				
81 – 90	9				
91 – 100	10				
101+	10+	VERY HIGH	**Avoid** strenuous activity outdoors.	**Reduce or reschedule** strenuous activity outdoors, especially if you experience symptoms.	

Pollution Levels How Does B.C. Measure Up?

A record-breaking wildfire season[1] in western United States caused severe impact on B.C.'s air quality levels in 2020. Long range transport of dense smoke from massive wildfires in California, Oregon, and Washington caused days of elevated $PM_{2.5}$ levels across most of the southern half of B.C. in September. As a result, the province issued 36 Smoky Skies Bulletins and Metro Vancouver issued nine smoke-related air quality advisories. More than half of all reporting stations exceeded the 24-hour provincial air quality objective for $PM_{2.5}$.

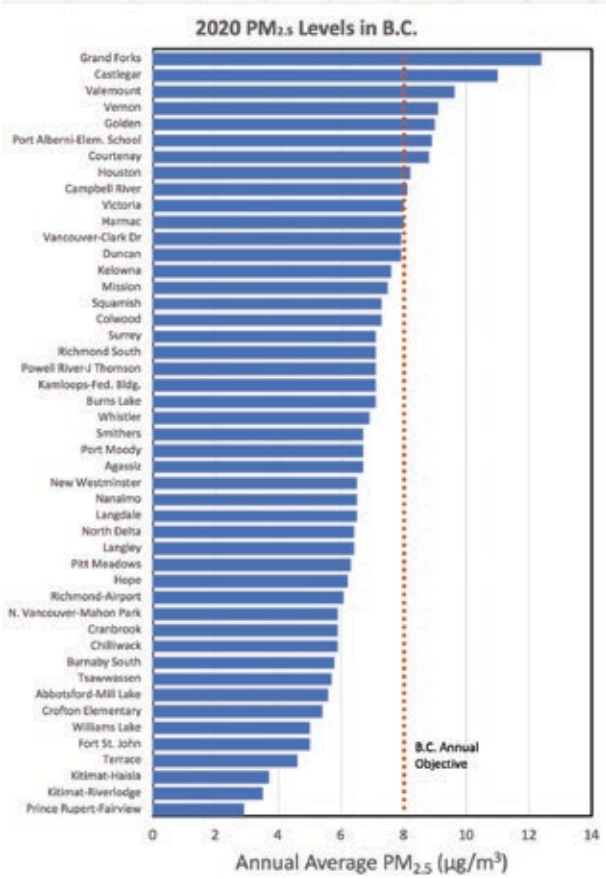
In the following sections, air quality data collected in 2020 are summarized and compared against provincial or national objectives. Data from all available monitoring sites, except temporary mobile sites and industrial fenceline sites, are summarized in the Technical Appendix.



PM2.5 Fine Particulate Matter

Fine particulate matter ($PM_{2.5}$) refers to microscopic particles that are 2.5 micrometres or smaller in diameter. Major sources in B.C. include seasonal wildfires, residential wood combustion, prescribed burning, marine vessels, heavy-duty diesel vehicles, the pulp and paper sector, and the mining sector. Travelling deep into the lungs, inhaled $PM_{2.5}$ can cause short term health effects such as irritation and inflammation and can aggravate health conditions such as asthma and heart disease. There is strong evidence that prolonged exposure to $PM_{2.5}$ increases the risk of chronic disease, such as bronchitis and heart disease[2].

In 2020, $PM_{2.5}$ was monitored in 63 sites across the province for at least a portion of the year. Annual average concentrations ranged from 2.9 µg/m^3 in Prince Rupert-Fairview to 12.4 ug/m3 in Grand Forks. A total of nine sites exceeded the provincial annual objective[3] of 8 µg/m^3 and 29 of 47 sites exceeded the provincial 24-hour objective[4] of 25 µg/m^3. Exceedances are significantly higher this year than in 2019 when only six and three of the sites exceeded the annual and 24-hour objectives, respectively. Long range transport of wildfire smoke from the western United States dominates $PM_{2.5}$ exceedances in 2020.



1 See US National Oceanic and Atmospheric Administration site: https://www.ncdc.noaa.gov/billions/events

2 Gan, W.Q.; Koehoorn, M.; Davies, H.W.; Demers, P.A.; Tamburic, L.;Brauer,M. 2011, "Long-Term Exposure to Traffic-Related Air Pollution and the Risk of Coronary Heart Disease Hospitalization and Mortality", Environmental Health Perspectives,vol.119, no.4, pp. 501-507.

3 Based on the mean of daily average over one year

4 Based on the annual 98th percentile of daily average over three years

SO_2 Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless, highly reactive gas with a pungent odour. Major sources of SO_2 include the upstream oil and gas sector, metal smelting facilities, the pulp and paper sector and marine vessels. Short-term exposures to SO_2 can aggravate asthma and increase respiratory symptoms.

In 2020, SO_2 was monitored at 32 sites, excluding mobile and industrial fenceline sites. One-hour SO_2 levels ranged from 1.5 ppb in Kelowna to 206.8 ppb at Trail-Butler Park.[5] The majority of monitoring sites recorded 1-hour levels less than 10 ppb. Trail-area sites were the only locations to observe exceedances of the provincial objective of 75 ppb and the national objective of 70 ppb.

O_3 Ground-level Ozone

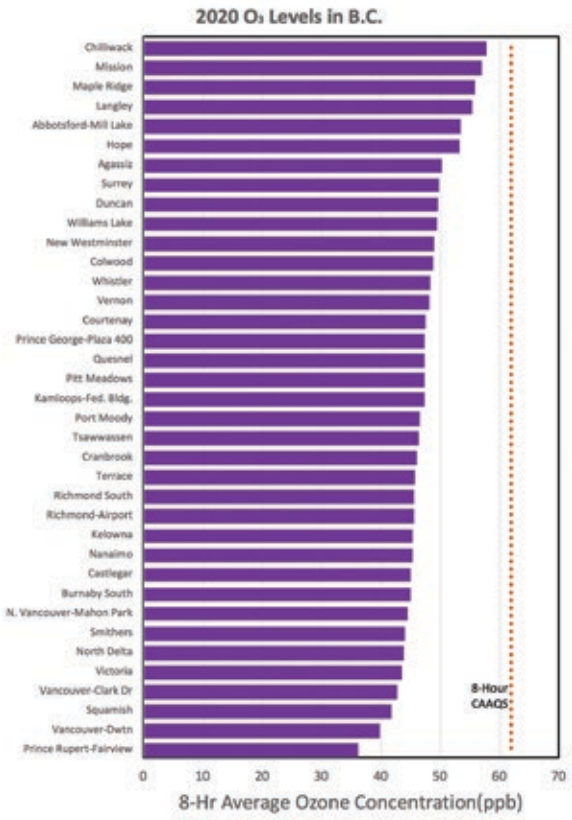
Ground-level ozone (O_3) is a reactive gas that forms in the atmosphere from reactions involving nitrogen oxides (NOx) and volatile hydrocarbons in the presence of sunlight. A major source of both NOx and hydrocarbons in B.C. is the transportation sector, including motor vehicles. Short-term exposures to ozone can cause breathing difficulties, an aggravation of asthma symptoms and other lung diseases, and premature death. There is growing evidence that long-term exposures may be associated with the development of respiratory effects, especially in the young and the elderly.

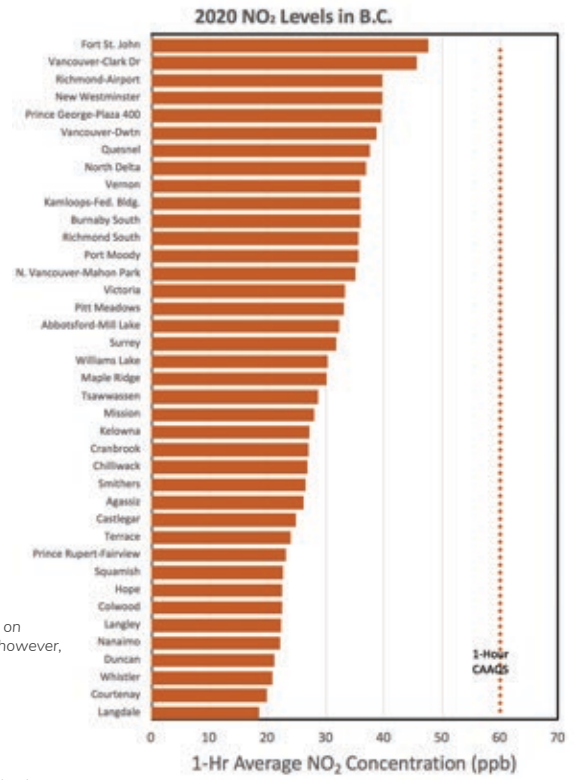
In 2020, ozone was monitored at 46 monitoring sites. Eight-hour concentrations ranged from 36 ppb in Prince Rupert to 58 ppb in Chilliwack[6]. All sites achieved the national standard of 62 ppb[7] but there were five days across ten sites when 62 ppb was exceeded. Metro Vancouver issued two ozone-related air quality advisories in 2020 due to hot, sunny days in July and August.

NO_2 Nitrogen Dioxide

Nitrogen Dioxide (NO_2) is a reddish-brown gas that is associated with emissions from high-temperature combustion. NO_2 is mostly formed in the atmosphere from reactions involving nitrogen oxides (NOx) and ground-level ozone. The largest sources of NOx in B.C. include transportation and industry. Short-term exposures to NO_2 are linked to respiratory illness, and there is growing evidence of effects from long-term exposure, including cardiovascular mortality, cancer, and reproductive effects.

In 2020, NO_2 levels were monitored at 39 sites. One-hour concentrations ranged from 19 ppb in Langdale to 48 ppb in Fort St. John.[8] All sites were well below the interim Provincial Air Quality Objectives for NO_2 of 100 ppb and the national standard of 60 ppb.[9] The Ministry of Environment and Climate Change Strategy recently released an intentions paper[10] for a proposal to adopt more stringent objectives for NO_2.





5 *Based on the annual 99th percentile of daily one-hour maximum concentrations. The provincial objective of 75 ppb is based on similar statistical form as presented, but averaged over three years. Elevated SO2 levels were also recorded at Trail-Warfield; however, this data is under review and not included in this report.*

6 *Based on the annual 4th highest daily 8-hour maximum concentration over one year.*

7 *Achievement of the national standard is based on a similar statistical form as presented, averaged over three years.*

8 *Based on annual 98th percentile of daily one-hour maximum concentration.*

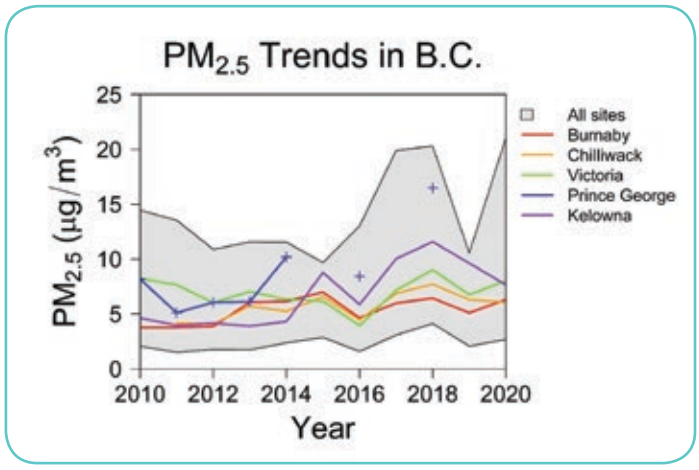
9 *The Canadian Ambient Air Quality Standard (CAAQS) of 60 ppb is based on a three-year average.*

10 *See: https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-quality-management/regulatory-framework/objectives-standards/objectivesforno2*

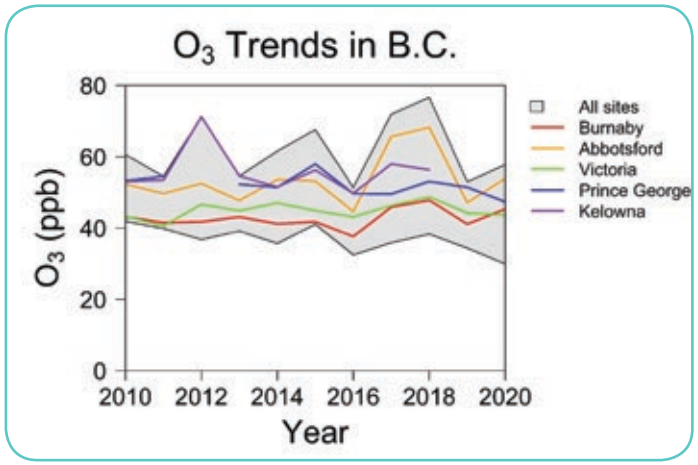
TRENDS Air Pollution Through the Years

We look at trends in air pollution to assess the effectiveness of actions to improve air quality and to determine the need for additional work. The following figures provide 10-year trends in annual concentrations in the most heavily populated areas of the province, and the minimum and maximum concentrations across all B.C. sites.

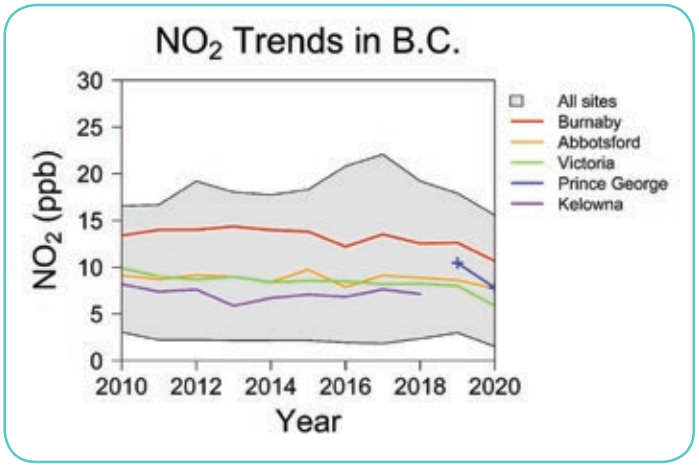
Fine Particulate Matter ($PM_{2.5}$) levels (shown as annual average) have been increasingly influenced by wildfire smoke over the past decade. In 2014 and 2015, wildfire impacts on $PM_{2.5}$ levels were observed in parts of the province (e.g. Prince George and Kelowna). In 2017 and 2018 especially, wildfire smoke was widespread and several sites, including Prince George, Kelowna, Chilliwack and Victoria, observed their highest average concentrations over the past decade. The mild 2019 wildfire season brought $PM_{2.5}$ below 2017 levels for most sites including Burnaby, Chilliwack, and Victoria. Transport of wildfire smoke from the western United States in 2020 caused an increase in $PM_{2.5}$ levels.



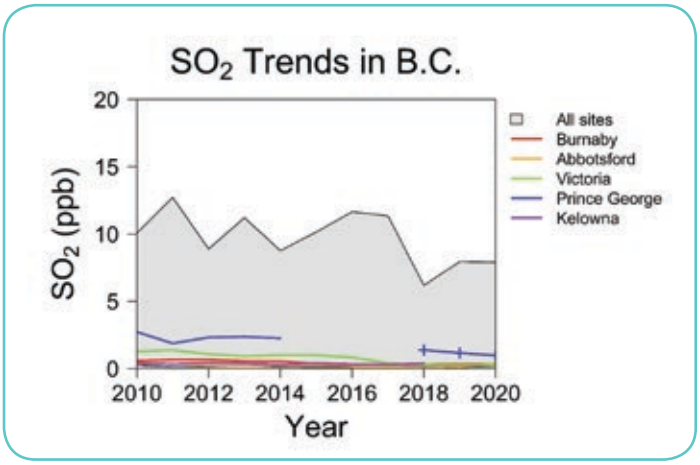
Ozone levels (shown as 4th highest daily 8-hour maxima) are also known to be influenced by wildfire smoke. Siberian wildfire smoke in 2012 and B.C. wildfires in 2015, 2017 and 2018 are believed to have contributed to higher ozone levels in these years.[11,12]



NO_2 levels (shown as annual average) have generally declined in urban areas over the past decade, largely due to more stringent vehicle emission standards and other local actions. The trends have started to plateau from 2010 onwards but aggressive initiatives towards lower emission and zero emission vehicles are expected to improve air quality over the next decade. Reduced traffic in 2020 due to the COVID-19 pandemic resulted in significantly lower NO_2 levels.



SO_2 levels (shown as annual average) in urban areas remain low – less than 3 ppb throughout the last decade. This reflects efforts to reduce sulphur content in motor vehicle and marine fuels and a reduction of emissions from the petroleum refining and cement industries.



11 Teakles, A.D., So, R., Ainslie, B. et al. (2017) Impacts of the July 2012 Siberian fire plume on air quality in the Pacific Northwest. Atmos. Chem. Phys. 17, pp. 2593-2611.

12 Influence of 2015 and 2017 wildfire smoke on ozone levels in the Lower Fraser Valley are discussed further in: Lower Fraser Valley Air Zone Report (2015-2017) at: https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/reports/latest-air-zone-reports.

Prepare for the Worst: Get Ready for Wildfire Smoke

Wildfire seasons in B.C. keep setting new records, and it's impossible to predict what 2021 will bring. Over the past five years we had prolonged periods when most of B.C. population was breathing unhealthy air due to smoke pollution. Exposure to wildfire smoke is associated with a range of acute effects, particularly for those with respiratory diseases. Evidence of longer-term health effects is also starting to emerge.

Outdoor air pollution from vehicles and industry can be reduced though new laws and technologies, but that's not true for wildfire smoke. Furthermore, we can't stop breathing when it's smoky and it's not practical to relocate to less smoky locations. Wildfire smoke is both inevitable and largely unpredictable, so we need to become resilient to smoke by changing our activities and behaviours to limit exposure and protect health.

Being prepared for smoke episodes before they occur can reduce fear and uncertainty when air quality starts to deteriorate. ***Here are 10 steps to help you develop a plan for the wildfire smoke season ahead.***

1 ***Understand the susceptibilities in your household.*** Some people are at higher risk of experiencing health effects from smoke, especially those who have asthma, COPD, heart disease, diabetes, other chronic conditions or acute infections such as COVID-19. Pregnant women, infants, young children, older adults, and people who work or live outdoors are also more susceptible.

2 ***Identify others you want to support.*** There may be people outside your household you want to help during a smoke episode, particularly older adults in your family or community. Keep them in mind as you develop your plans.

3 ***Review medical management plans.*** Anyone who has a chronic disease with a management plan should consult with their doctor about adapting it for smoky conditions. For example, people with asthma and COPD are particularly sensitive to smoke, and those with diabetes may face additional challenges managing their insulin.

Being prepared for smoke episodes before they occur can reduce fear and uncertainty when air quality starts to deteriorate.

4 ***Stock up on rescue medications.*** There can be high demand for medications such as inhalers when it gets smoky, and highly sensitive people may be less mobile. It is best to stock up on these medications before the season begins, so they are readily available when needed. Always travel with your rescue medications during wildfire season.

5 ***Consider purchasing a portable air cleaner.*** Most people spend more than 90% of their time inside. Portable air cleaners with HEPA filters can significantly reduce indoor $PM_{2.5}$ concentrations when sized and used properly. There are many options on the market, so some research is needed to find the best option for your space. A high-quality furnace filter taped to a box fan can also be effective in a small room.

6 ***Get ready to shelter in place.*** Think about how to keep the air in your home (or areas of your home, especially bedrooms) cleaner by closing windows, running your forced air system on recirculate, and using portable air cleaners. Beware of getting too hot, though – overheating is a bigger health risk than breathing smoke for most people.

7 ***Find good masks for time outdoors.*** A well-fitted N95 respirator provides the best protection from wildfire smoke, but it can be hard to get a good fit and they aren't made for children. We've learned during COVID-19 that a well-fitted multi-layer cloth mask can also do a pretty good job. People who work outdoors should consult their occupational health and safety professionals before the seasons begins.

8 ***Use technology to your advantage.*** Smartphone applications such as WeatherCAN and AQHI Canada can help you keep track of current conditions and air quality forecasts. The B.C. Government and Metro Vancouver both provide subscription services to get air quality alerts by text or email.

9 ***Bookmark important information.*** When there are fires burning around B.C. you can start the day by checking the FireWork and BlueSky smoke forecasts. These can help you to understand where fires are currently burning, and where the smoke is likely to travel.

10 ***Connect with others about smoke.*** Talk to your family and community about your planning process and help others to think through their own preparations. The more we get ready for smoke before the wildfire season starts, the more resilient we will be when the smoke arrives.

It is impossible to predict when and where extreme wildfire smoke will occur, but we know that our seasons are getting longer and more severe. If the best offense is a good defense, we must head into every new wildfire season by preparing for the worst. It's not optimistic and it's not pessimistic – it's just realistic based on trends over the past decade.

Mapping the Metro Vancouver Smellscape

Figure 1: The odour description wheel used by Metro Vancouver in the formal odour complaint process.

Odours from a wide range of sources can affect local air quality at different times and with different intensities. Unlike air pollutants such as fine particulate matter ($PM_{2.5}$) and ground-level ozone (O_3), there is no strong scientific evidence linking exposure to odours with specific health effects. Odours can definitely have an impact on how people feel and behave, and can affect their overall quality of life. While single contaminants like $PM_{2.5}$ and O_3 can be measured, odours can be much more difficult to quantify because there can be hundreds of different compounds that can contribute to a particular odour. Qualitative descriptors such as those found in odour wheels (Figure 1) are generally used to classify them. The SmellVan project is a UBC initiative to collect information about the odours people encounter and how they react. Anyone can use the web-based application (https://smell-vancouver.ca/) to submit odour reports that describe the smell, the location and their personal experience. Mapping these reports over space and time provides a "smellscape" that the research team can use to study odours and their sources in the Metro Vancouver region. The SmellVan app does not replace the formal Metro Vancouver odour complaint process, but it does provide useful information for air quality work done by Metro Vancouver and other project partners. Hundreds of reports have been collected since the project started (Figure 2), and they describe many different types of odours across the region (Figure 3). The UBC team has just begun to use back-trajectory modeling, which will help to better understand the odour sources, and will soon deploy the Portable Laboratory for Understanding human-Made Emissions (PLUME) van to measure odour-causing compounds in the air around some locations. Smell something fishy (or skunky or...) in the Metro Vancouver area? If so, let us know!

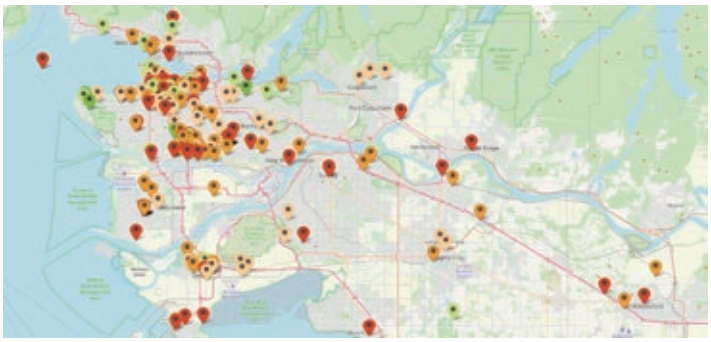


Figure 2: Map of odour reports submitted through the SmellVan web application. Colours indicate the offensiveness of the odour from green (mildly) to red (extremely).

Figure 3: Word cloud created from free text submitted to describe odours reported through the SmellVan web application.

Reducing Exposure To Traffic Emissions

Most of the time, B.C. residents enjoy good, and steadily improving, air quality. Even so, vehicle emissions are still a significant source of air contaminants in our province, especially in densely populated areas. While vehicle emissions have improved, Canada's urban areas, population and vehicle use continue to grow. Around 10 million Canadians, or 32% of the total population live within 250 metres of a major roadway and the vehicle emissions from it. In Metro Vancouver, this percentage is higher, where over one million people – nearly half the population – live within 250 metres of a major road.

To better understand the impacts of traffic-related air pollution near major roads, Metro Vancouver collaborated with Environment and Climate Change Canada, the Ontario Ministry of the Environment, Conservation and Parks, and the University of Toronto on a two-year monitoring study from 2015 to 2017. This national study included new monitoring in both Vancouver and Toronto.

Vehicle Emissions Have Health Impacts

Vehicles emit air contaminants from the combustion of fuel (mainly gasoline and diesel), and brake and tire wear. This traffic-related air pollution, while highest at its source, can have impacts up to 250 metres from a major road. Living or spending time near a major roadway is a known risk factor for a number of respiratory symptoms and cardiovascular problems. A 2019 study estimated that air emissions from transportation in Canada are associated with 1,400 deaths and 12 billion (USD) dollars of health damages.[13]

Diesel-exhaust particles are harmful vehicle-related air contaminants and a known carcinogen. Although diesel engines are more fuel-efficient than gasoline engines, they emit significantly more particulate matter.

The Metro Vancouver Near-Road Air Quality Monitoring Study

You may have driven past the near-road air quality monitoring station at Clark Drive and 11th Avenue in Vancouver without realizing. In fact, the station may have measured emissions from your vehicle. Metro Vancouver operates the station on Clark Drive, a busy roadway and truck route in a densely populated neighbourhood. The station measures near-road traffic-related air pollutants that impact health.

Air quality monitoring at the Clark Drive site in Vancouver showed that air contaminant concentrations are considerably higher near major roadways. Analysis revealed that these elevated concentrations are a direct result of the volume and type of vehicles on Clark Drive, and diesel emissions in particular.

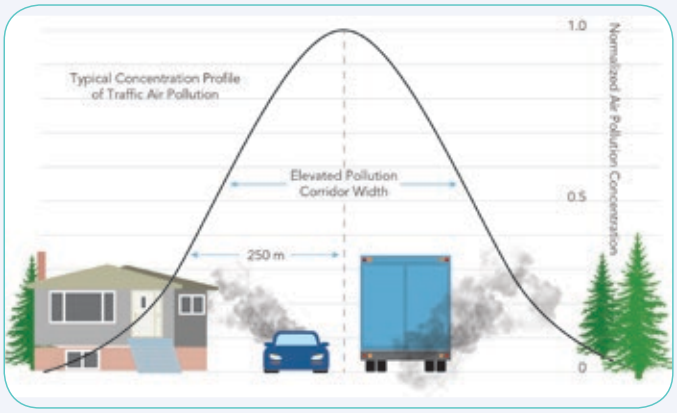


Image courtesy Metro Vancouver

Emissions from different types of vehicles vary significantly. While most passenger vehicles on the road are fuelled by gasoline, the majority of large trucks (i.e., semi-trailer trucks) consume diesel fuel.

Large trucks make up only 6% of the total traffic measured at the Clark Drive monitoring station, but they contribute a disproportionate amount of vehicle-related emissions. The elevated air contaminant concentrations at the Clark Drive site, including nitrogen oxides, black carbon and ultrafine particles, are due more to the large trucks travelling this road, rather than total volumes of traffic. There was a clear correlation between elevated air contaminant levels and the hours and days when large trucks are typically on the roads.

Next Steps for Reducing Exposure

Vehicle emissions have significantly improved over the last several decades, contributing to overall improvements in air quality in B.C. and Metro Vancouver. These trends are expected to continue, as newer and cleaner vehicles, including electric vehicles, replace existing cars and trucks while use of public transit and active transportation increases.

Nonetheless, the results of the near-road monitoring study show that traffic-related air pollution near major roads continues to be significant. Metro Vancouver is committed to continue monitoring the near-road environment at Clark Drive, to further understand the impacts of traffic-related air pollutants and track changes. Real-time data from the Clark Drive station can now be viewed online at www.AirMap.ca.

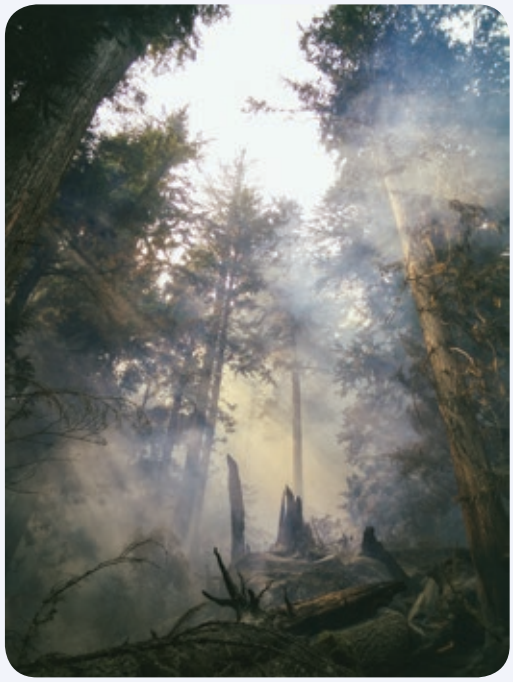
Information from the study will help determine public exposure to air contaminants and will inform a national near-road monitoring strategy for urban areas in Canada. Summaries of the Vancouver and Toronto study findings are available at www.metrovancouver.org and www.socaar.ca. Key recommendations of the Metro Vancouver study are to develop a program to reduce emissions and exposure to traffic-related air pollutants, and increase education about the health impacts of traffic-related air pollution and transportation decisions. Drawing from a range of strategies, including land use policy, infrastructure design, and transportation management, these recommendations will require support from multiple levels of government, from individual municipalities to the province.

Metro Vancouver is developing an updated air quality management plan for the region, the Clean Air Plan. A draft of the Plan identifies opportunities to accelerate emissions reductions in the region, including near major roadways, which will help to protect human health and the environment, through incentives, education and regulation.

13 Anenberg, S.; Miller, J.; Henze D.; Minjares, R.; and Achakulwisut, P., 2019. The global burden of transportation tailpipe emissions on air pollution- related mortality in 2010 and 2015.

Airway health through knowledge creation, dissemination and application

Asthma and Chronic Obstructive Pulmonary Disease (COPD) are the two most common chronic respiratory conditions worldwide. People with asthma or COPD have difficulty breathing, which can limit their activities leading to reduced quality of life, mental health concerns, and financial challenges. Researchers are always learning more about how to prevent and treat these diseases but making the leap from research to effective change in patient care or reduced risk in real life takes a long time and sometimes happens inefficiently or not at all. There is a need to find ways to work better and more closely with stakeholders within the communities of researchers, governments, industry, health administration, and of course with individuals, groups, or populations already with or at-risk of airways disease. Working together will help ask the right questions, get the most helpful answers, and start using new knowledge effectively and as quickly as possible.



At Legacy for Airway Health (LAH), we want to improve quality of life for people who have asthma or COPD and reduce the number of people who develop these diseases in the future. To do this, we need to learn more about the links between what we breathe and airways disease. We can use models to better use the information we already have. We can learn from the experiences of patients and the public to understand how culture, social life, and where people live affect those experiences. We need to continue to seek promising new ways to improve screening, prevention, and treatment based on individual needs. To achieve these goals, LAH works closely with stakeholders to find effective and cost-effective solutions that help prevent and treat airway disease. We help build partnerships that allow us to perform high quality research that connects academic disciplines to generate new evidence and transform it into action.

Evaluation of public advisories during wildfires in B.C.

Wildfires in B.C. have become more frequent and more severe during the past 10 years. People in B.C. have experienced poor air quality because of wildfire smoke and things are expected to get worse in the future. Wildfire smoke is particularly concerning for people with lung/cardiovascular disease, pregnant women, children and infants, and the elderly.

In B.C., government and health agencies issue air quality advisories and public health messages during times of poor air quality. We wanted to find out whether people heard and understood these messages, so we worked with the BC Centre for Disease Control (BCCDC), researchers, patients, and community groups to develop an online survey. The survey was available between September and December 2020 and received over 900 responses.

We found from the survey that people in B.C. receive wildfire smoke messages in different ways. The most common sources of information were websites, followed by social media, radio, and television. Radio was identified as an important source of information for people who identified as Indigenous, those who work in the trades, as well as those living in rural areas. We think this may be because of poor internet and cellular connections in these communities. Respondents with lower levels of education stated that messages should be simpler and easier to understand, while half of the respondents did not know they can receive automatic air quality alerts by email or text. Approximately 90% of participants said they follow public health advice during times of poor air quality.

Governments, health agencies, and community organizations can use these findings to improve how and what they communicate to protect British Columbians during future wildfire smoke events. Simplified messaging, and expanding the reach of alerts will help reduce exposure to wildfire smoke and its negative health effects.

To sign up for automatic air quality advisory alerts via email or text visit: *https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-quality/air-advisories/air-quality-subscription-service)*

Contact: LEGACY FOR AIRWAY HEALTH, www.legacyairwayhealth.ca
Diamond Health Care Centre, The Lung Centre, Rm 7267
2775 Laurel Street, Vancouver, BC., Canada, V5Z 1M9
(604)-875-4111 x 23137, info@legacyairwayhealth.ca

Photo credits Landon Parenteau from Unsplash

UPDATES From Partner Agencies

metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

Clean Air Plan and Climate 2050 Roadmaps

Metro Vancouver is seeking public feedback on a new draft Clean Air Plan — our latest air quality and greenhouse gas management plan for the region. Actions in the plan will reduce air contaminant emissions and impacts, including greenhouse gases, over the next 10 years. In doing so, it supports the 30-year commitment of a carbon neutral region by 2050 and ensures we maintain the good air quality we generally experience.

The draft Clean Air Plan was developed with input from stakeholders who participated in a first phase of engagement in 2020. It includes 132 recommendations in key areas to reduce emissions from the largest sources in this region: buildings, transportation, and industrial sources.

The draft plan proposes three targets for 2030:

1. Reduce regional greenhouse gas emissions by 45% from 2010 levels
2. Ensure ambient air quality in the region meets or is better than the health-based standards set by Metro Vancouver, the BC and federal governments
3. Increase the amount of time that visual air quality is classified as excellent

The Clean Air Plan is also coordinated with Metro Vancouver's Climate 2050 Roadmaps, which lay out Metro Vancouver's long-term strategies and actions to achieve a carbon neutral and resilient region by 2050. Roadmaps are being developed on a sector basis, such as buildings, transportation, industry, and others.

For more, visit www.metrovancouver.org and search 'Clean Air Plan' or 'Climate 2050', to see how these plans explore the most effective actions for improving air quality, reducing greenhouse gas emissions, and preparing our communities for a changing climate.

Residential Wood Burning Bylaw

Residential wood smoke is the most significant source of fine particulate matter emissions in the region. Particulate matter, which is also in the wildfire smoke that has become pervasive in recent summers, can have negative health effects.

In March 2020, a new bylaw was adopted to reduce emissions from residential indoor wood burning in Metro Vancouver. The new bylaw requires those with indoor wood burning appliances, such as fireplaces and wood stoves, to use best burning practices when operating their appliance. The bylaw includes measures that will be phased in over the coming years. Warm season restrictions were introduced this year and will be in effect from May 15 to September 15 every year. During this period, use of residential indoor wood-burning appliances will not be permitted unless they are the sole source of heat in a residence, they are located in an off-grid home outside the Urban Containment Boundary, or there is an emergency.

Proposed Expansion of Non-Road Diesel Engine Bylaw

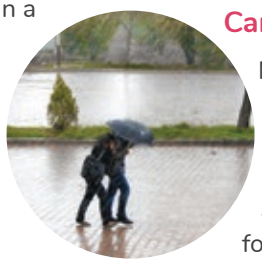
Metro Vancouver is proposing amendments to a regional bylaw for non-road diesel engines, to reduce harmful emissions from these engines. Proposed amendments to the bylaw would expand the scope of the bylaw to further reduce diesel particulate matter emissions and also address harmful emissions of nitrogen oxides produced by all tiers of non-road diesel engines. The current bylaw has reduced emissions from older Tier 0 and Tier 1 engines.

Proposed Updates to Air Quality Management Fees

Metro Vancouver is reviewing its air quality fees bylaw to better address air contaminant emissions from permitted and regulated industries. As part of the review, Metro Vancouver engaged with interested parties to seek feedback on the proposed changes. The changes proposed are designed to achieve health and environmental benefits associated with the reduction of harmful emissions and improved air quality, ensure that fees promote continuous improvement, and recover the costs of monitoring and enforcement while maintaining Metro Vancouver's commitment to discharger-pay, equity, and fairness principles.

For additional updates on consultation activities, visit www.metrovancouver.org/services/air-quality/engagement.

Caring for the Air



Metro Vancouver's annual Caring for the Air Report has more air quality and climate change stories at www.metrovancouver.org/services/air-quality/about/caring-for-the-air.

Photo credits Daniel Moqvist, Juan Gomez, and Atilla Bingol from Unsplash

(Cont'd on p.14)

(Cont'd from p.13)

Fraser Valley Regional District (FVRD)

FVRD Air Quality Management Plan

The Fraser Valley Regional District (FVRD) produced its first Air Quality Management Plan (AQMP) in 1998. Since then, new comprehensive air quality data have become available, as has new research on air pollution effects, signalling the need to revise the AQMP. The updated FVRD Air Quality Management Plan is in its final stage before being finalized in summer of 2021. During its preparation, regional stakeholders were invited to provide comments and this engagement has elicited valuable feedback and suggestions which will go into the final document. The FVRD AQMP represents our long-standing commitment to the improvement of regional air quality. It identifies the strategic directions and practical mechanisms of the management for our part of the airshed. The focus is on reducing emissions, changing behaviours, and promoting sustainability, so our residents and visitors can enjoy clean air, beautiful vistas, and healthy living.

LFV Air Quality Monitoring Station Network in the FVRD

The FVRD continues to work collaboratively with Metro Vancouver on the management of the Lower Fraser Valley Air Quality Monitoring Network. The existing air quality stations provide both regions with high quality data from across our shared airshed. The FVRD hosts 6 stations. In 2020, the FVRD and Metro Vancouver updated an agreement for the operation and maintenance related to the FVRD portion of the network. This collaboration will help preserve the integrity of the network, ensure compliance to the best standards and practices, and clarify roles and responsibilities in maintaining the FVRD portion of the network. The continuation of the arrangement between the two regional districts will contribute to achievement of our goals for clean air in the region.

Health Canada / Santé Canada

The Government of Canada estimates that 15,300 premature deaths per year in Canada can be linked to air pollution from fine particulate matter, nitrogen dioxide and ozone, as outlined in Health Impacts of Air Pollution in Canada – Estimates of Premature Deaths and Nonfatal outcomes - 2021 Report (https://www.canada.ca/en/health-canada/services/publications/healthy-living/2021-health-effects-indoor-air-pollution.html). The total economic valuation of the health impacts attributable to air pollution in Canada is $120B per year. Health Canada research and science assessments are drivers for regulatory and non-regulatory measures to reduce emissions of air pollution across the country, and serve as the basis for risk mitigation actions to reduce exposure.

Pandemic Response

Health Canada provided support to the Public Health Agency of Canada in the development of guidance for using ventilation to reduce the risk of aerosol transmission of COVID-19 in homes and in long term care residences (https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/guidance-documents/guide-ltch-ventilation-covid-19-pandemic.html, https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/guidance-documents/guide-home-ventilation-covid-19-pandemic.html). Projects were initiated that investigated the potential impact of short and long-term air pollution exposure on COVID-19 incidence. Dr. David Stieb and collaborators published two peer-reviewed papers and other research is continuing.

Wood Smoke Information

Health Canada recently provided support to the Fraser Basin Council to complete a wood smoke information resource online portal and an online course on residential wood smoke (https://www.fraserbasin.bc.ca/woodsmoke_info.html). These resources were designed to inform British Columbians about the impacts of residential woodstoves to air quality and health, and to support those who rely on woodstoves to help improve air quality in their community through better burning practices.

Science Assessments

A health assessment of the impact of traffic related air pollution on asthma allergy and lung function was published in June 2020. Residential Indoor Air Quality Guidelines have been published for acrolein and carbon dioxide and a guidance document was published on Cleaner Air Spaces during Wildfire Smoke Events (https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-cleaner-air-spaces-during-wildfire-smoke-events.html).

(Cont'd on p.15)

BRITISH COLUMBIA | Ministry of Environment and Climate Change Strategy

Regulatory Updates

The Ministry of Environment and Climate Change Strategy (ENV) released an intentions paper to seek comment and feedback on a proposal to adopt new Provincial Air Quality Objectives for Nitrogen Dioxide. If the proposal is adopted, it strengthens the objectives for nitrogen dioxide from 100 parts per billion (ppb) to 60 ppb for the 1-hour objective and 32 ppb to 17 ppb for the annual objective. For more information on the proposal, see: https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-quality-management/regulatory-framework/objectives-standards/objectivesforno2 .

Provincial Wood Stove Exchange Program

In 2020 the program assisted in the replacement of 500 appliances, bringing the total number of replacements under the program to approximately 9,500. Approximately 60% of the replacements in 2020 were non-wood burning options, while the balance were certified wood-burning appliances.

ENV has recently commissioned an independent third-party evaluation of the BC Wood Stove Exchange Program (WSEP). The purpose of the work was to assess the effectiveness of the program in reducing pollution from old appliances and educating the public on clean wood-burning practices, and to gather learnings from participants in the program, stakeholders, and programs elsewhere that can be used to improve the program. Some key recommendations include changes on the overall rebate scheme targeting reducing $PM_{2.5}$ emission in red zone communities, accessibility of the program for low-income wood burners, and reflection on Indigenous people's participation in WSEP, etc. The WSEP is supported by the ENV and British Columbia Lung Association. In 2021-2022 ENV is providing a one-time funding boost to support additional exchanges and to implement the recommendations from the evaluation. More information on the Provincial Wood Stove Exchange Program can be found at: https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-pollution/smoke-burning/exchange.

Airshed Management Activities

In the summer of 2020, the Comox Valley Regional District (CVRD) launched an airshed roundtable called Comox Valley Airshed Roundtable Project. It aims to develop and implement a Regional Airshed Protection Strategy for the Comox Valley through collaborative initiatives represented by local stakeholders and the general public. For more information, see: https://www.comox-valleyrd.ca/projects-initiatives/past-current-projects/airshed-roundtable-project

Since establishment in 2019, the Clean Air Task Force (CATF) at the Village of Valemount has conducted a residential home heating and air quality survey and implemented an anti-idling by-law in 2020. It is currently working on a draft by-law to reduce residential woodsmoke.

ENV and the Ministry of Energy, Mines, and Low Carbon Innovation (EMLI) have partnered to support the Village of Valemount to conduct a data review of ambient air quality during dust episodes from the Kinbasket Reservoir. The goal is to determine the levels of respirable particulate matter (PM_{10} or $PM_{2.5}$) from dust events, particularly during periods with low reservoir water levels. The data review is scheduled to be completed by the summer of 2021.

AQHI Update

The AQHI is a tool developed by Canadian health researchers to communicate short-term health risks to the public. Originally based on data from the largest Canadian cities, the AQHI has been shown to periodically under-report health risks during smoky conditions. In 2018, ENV supported work by the BC Centre for Disease Control to develop an adjustment to the AQHI (the so-called "AQHI-Plus") to better characterize health risks due to wildfire smoke. The AQHI-Plus pilot was successfully run during the wildfire season of 2018 and has been extended throughout the year following further evaluation as a health risk indicator during the cool season. Peer-reviewed scientific health studies in 2019-2020 validated the suitability of AQHI-Plus as indicator of health risk in B.C. In March 2021, ENV officially ended the pilot status of AQHI-Plus and adopted its use as the default method when reporting AQHI.

(Cont'd from p.14 Health Canada)

Research

Health Canada scientists continued collaborative research into the sources, nature and mechanisms of air pollution health damage and contributed to more than forty research papers during the year. These included studies of the health impacts of wildfire smoke, and the analysis of the contribution of the various components of particulate matter to cardiovascular outcomes. The impacts of industrial sources of air pollution on childhood asthma onset and on inflammatory markers were reported. Cohort studies were also used to investigate the associations between exposure to air pollution and asthma, cancer, and brain tumors.

Photo credits Jordan Brierley, Austin J, Beazy and National Cancer Institute from Unsplash

Contact Information of Agencies

BRITISH COLUMBIA LUNG ASSOCIATION
www.bc.lung.ca
2675 Oak St.
Vancouver, B.C. V6H 2K2
(604) 731-5864 or toll-free at 1-800-665-5864 (in B.C. but outside the Lower Mainland)

BC MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE STRATEGY
www.gov.bc.ca/bcairquality
Environmental Standards Branch
525 Superior Street
Victoria, B.C. V8W 9M1
(250) 387-9537

HEALTH CANADA ENVIRONMENTAL HEALTH PROGRAM-BC REGION
www.hc-sc.gc.ca/ewh-semt/air/index-eng.php
Federal Building Sinclair Centre
420-757 Hastings St. W
Vancouver, B.C. V6C 1A1
(604) 666 – 2083

BC CENTRE FOR DISEASE CONTROL
www.bccdc.ca
655 West 12th Ave
Vancouver, B.C. V5Z 4R4
(604) 707-2400

ENVIRONMENT AND CLIMATE CHANGE CANADA
www.ec.gc.ca
401 Burrard Street
Vancouver, B.C. V6C 3S5
(604) 664-9100

METRO VANCOUVER
www.metrovancouver.org
4730 Kingsway
Burnaby, B.C. V5H 0C6
(604) 432-6200

FRASER VALLEY REGIONAL DISTRICT
www.fvrd.ca
45950 Cheam Ave.
Chilliwack, B.C. V2P 1N6
(604) 702-5000
1-800-528-0661

BC MINISTRY OF HEALTH
http://www2.gov.bc.ca/gov/content/governments/organizational-structure/ministries-organizations/ministries/health
Health Protection Branch
1515 Blanshard Street, RBB 4-2
Victoria, B.C. V8W 3C8
(250) 952-1911

NORTHERN HEALTH AUTHORITY
www.northernhealth.ca
Suite 600, 299 Victoria St.
Prince George, B.C. V2L 5B8
(250) 565-2649

ISLAND HEALTH AUTHORITY
www.viha.ca
1952 Bay Street
Victoria, B.C. V8R 1J8
(250) 370- 8699

VANCOUVER COASTAL HEALTH AUTHORITY
www.vch.ca
601 West Broadway, 11th Floor,
Vancouver, B.C. V5Z 4C2
(604) 736-2033 or
1-866-884-0888

FRASER HEALTH AUTHORITY
www.fraserhealth.ca
Suite 400, Central City Tower
13450 – 102nd Ave
Surrey, B.C. V3T 0H1
(604) 587-4600 or
1-877- 935-5699

INTERIOR HEALTH AUTHORITY
www.interiorhealth.ca
220 – 1815 Kirschner Rd.
Kelowna, B.C. V1Y 4N7
(250) 862-4200

FIRST NATIONS HEALTH AUTHORITY
www.fnha.ca
501-100 Park Royal South
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(250) 862-4200

LEGACY FOR AIRWAY HEALTH
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Diamond Health Care Centre
The Lung Centre, Rm 7267
2775 Laurel Street, Vancouver, BC.
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Marina Richter
Jerome Robles
Meghan Roushorne

state of the air 2021

technical appendix

Forget-Me-Not: Illustration by Natalia Lopes

2021 BC Lung State of the Air Report -- Technical Appendix

Data Source:

B.C. Ministry of Environment and Climate Change Strategy, Metro Vancouver, Prince Rupert Port Authority

Units:

All data presented in ppb except $PM_{2.5}$, which is presented in micrograms per cubic metre

Monitoring sites:

Monitoring is often conducted to address various objectives that may include measuring concentrations representative of: community exposure, industrial impacts, background concentrations, etc.

For the State of Air Report, monitoring sites immediately adjacent to industrial facilities were not included unless these sites were also near areas of high population density.

Data completeness:

Data completeness criteria have been relaxed relative to previous reports to enable reporting of data from more stations.

In this report, a valid day has data for at least 18 hours (75%).

A valid year has data for at least 60% of days in each quarter and 75% of of hours over an entire year, with the following exceptions.

For peak (4th highest) 8-hour ozone levels, a valid 8-hour period has data for at least 6 hours, a valid day has data for at least 18 hours, and a valid year has at least 75% of days in the second and third quarters (April 1 to September 30).

For peak (1-hour) SO_2 and NO_2 levels, a valid daily maximum includes those days where less than 18 hours are available in a day but the maximum concentration exceeds the objective level.

Annual mean $PM_{2.5}$ levels are based on the annual mean of daily $PM_{2.5}$ concentrations.

Where data completeness requirements are not met, only number of hours per year, maximum value and number of exceedances are shown.

Collocated monitors:

Where more than one $PM_{2.5}$ monitor is operating at a single site, data are shown for the monitor currently considered the primary reporting monitor and/or the monitor reporting a complete year of data.

Disclaimer:

While the information in these data summaries are believed to be accurate, the data summaries are provided as is without any warranty, and may be subject to change as changes to the underlying database occur.

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3. The information provided in these data is intended for educational and informational purposes only. These data are not intended to endorse or recommend any particular product, material or service provider nor is it intended as a substitute for engineering, legal or other professional advice. Such advice should be sought from qualified professionals.

Site	Year	No. Valid Hrs	Annual Avg	Percentiles (1h)					Max 1h	No. Valid Days	24h Average			No. of Days		% of Valid Days Per Quarter				CAAQS $PM_{2.5}$ Metrics*	
				25th	50th	75th	98th	99th			Annual Avg	Annual 98th Percentile*	Annual Max	>27 µg/m^3	>25 µg/m^3	Q1	Q2	Q3	Q4	Annual	24-Hour
Abbotsford-Airport	2020	8709	6.7	2.0	3.6	6.1	39.3	82.9	217.8	364	6.7	24.7	172.5	7	7	100.0	100.0	98.9	98.9	6.6	23
Abbotsford-Mill Lake	2020	8633	6.4	2.2	3.6	6.1	33.1	63.8	222.9	358	5.6	18.0	93.2	5	5	95.6	98.9	96.7	100.0	6	21
Agassiz	2020	8467	6.7	2.6	4.4	6.6	37.6	79.6	199.1	347	6.7	46.6	137.6	8	8	90.1	96.7	96.7	95.7	6.5	29
Burnaby South	2020	8712	6.3	2.0	3.6	6.2	26.8	84.8	243.1	362	5.8	17.2	140.1	6	6	100.0	100.0	95.7	100.0	5.6	32
Burnaby-Kensington	2020	8514	6.1	1.6	3.1	5.4	47.8	97.3	228.3	352	6.1	51.5	172.3	8	8	94.5	93.4	97.8	98.9	5.8	18
Burns Lake	2020	8360	7.1	1.9	4.1	8.9	33.9	42.2	172.0	344	7.1	18.3	35.8	3	3	90.1	93.4	92.4	100.0	7.9	38
Campbell River	2020	8079	8.1	3.1	5.3	8.2	38.5	87.8	210.9	339	8.1	30.6	160.9	7	7	95.6	82.4	100.0	92.4	7.3	23
Castlegar	2020	7860	10.9	2.8	5.2	9.2	59.7	209.7	514.9	326	11.0	60.5	423.5	9	9	95.6	98.9	98.9	63.0	11.6	74
Chilliwack	2020	8614	6.0	1.9	3.4	5.8	33.1	71.9	222.4	356	5.9	18.2	159.6	7	7	95.6	96.7	96.7	100.0	6.6	28
Colwood	2020	8400	7.3	2.0	4.0	7.0	37.0	126.0	205.0	355	7.3	44.9	168.5	8	8	95.6	96.7	100.0	95.7	7.5	39
Courtenay	2020	8432	8.8	3.0	5.0	9.0	48.0	92.8	205.0	349	8.8	27.1	147.4	7	9	87.9	95.6	100.0	97.8	8.3	27
Cranbrook	2020	8656	6.6	0.9	2.7	7.2	37.0	60.5	323.6	361	5.9	17.2	73.1	5	5	100.0	100.0	96.7	97.8	5.6	15
Crofton Elementary	2020	8062	5.4	0.0	2.0	5.0	50.0	111.6	180.0	334	5.4	58.8	160.6	9	9	87.9	100.0	93.5	83.7	6.3	26
Crofton-Substation	2020	8510	6.4	1.0	4.0	6.0	50.0	101.9	182.0	360	6.4	42.3	153.1	9	9	100.0	97.8	100.0	95.7	-	-
Duncan	2020	8601	7.9	2.0	5.0	8.0	48.0	98.0	176.0	362	7.9	35.1	145.2	10	12	100.0	100.0	100.0	95.7	7.8	28
Duncan-Deykin	2020	8713	7.8	3.0	5.0	8.0	45.8	100.9	174.0	363	7.8	39.8	149.3	9	9	100.0	100.0	100.0	96.7	8	28
Fort St. John	2020	8703	5.0	2.1	3.6	6.1	19.2	24.2	83.4	363	5.0	13.6	29.5	1	2	100.0	97.8	98.9	100.0	7	32
Fort St. John-Old Fort	2020	8616	3.8	0.9	2.0	4.3	19.6	26.2	221.8	362	3.8	17.7	35.6	1	2	98.9	96.7	100.0	100.0	5.2	19
Golden	2020	8586	9.0	2.6	5.0	10.0	46.6	59.1	156.0	352	9.0	27.3	135.7	8	12	97.8	97.8	97.8	91.3	9.9	42
Grand Forks	2020	8731	12.6	3.1	6.1	11.6	59.5	119.3	541.2	364	12.4	64.5	374.7	13	14	100.0	100.0	97.8	100.0	12.3	60
Harmac	2020	8638	8.1	2.0	4.0	8.0	48.0	91.6	182.0	366	8.0	45.3	142.9	10	10	100.0	100.0	100.0	100.0	8.9	34
Hope	2020	8546	6.4	2.3	3.7	6.0	28.9	76.8	240.6	354	6.2	18.6	199.0	7	7	97.8	96.7	95.7	96.7	6.4	31
Horseshoe Bay	2020	7424	-	-	-	-	-	-	181.8	305	-	-	155.5	7	7	46.2	91.2	98.9	96.7	4.7	31
Houston	2020	8696	8.2	1.6	3.7	8.6	53.6	64.6	141.3	361	8.2	30.8	36.7	11	13	97.8	96.7	100.0	100.0	9.4	31
Hudsons Hope	2020	2393	-	-	-	-	-	-	52.9	100	-	-	19.2	0	0	0.0	0.0	8.7	100.0	-	-
Kamloops-Fed. Bldg.	2020	8722	7.1	3.1	5.2	8.6	23.6	47.0	140.3	363	7.1	19.3	97.6	6	6	100.0	98.9	97.8	100.0	9	35
Kelowna	2020	8714	7.6	2.3	4.1	7.5	32.6	65.1	294.1	363	7.6	23.1	263.7	7	7	100.0	98.9	98.9	98.9	9.6	53
Kitimat-Haisla	2020	8608	3.7	2.0	3.0	5.0	12.0	15.0	47.0	361	3.7	8.0	12.2	0	0	100.0	100.0	94.6	100.0	3.9	9
Kitimat-Riverlodge	2020	8559	3.5	1.0	3.0	5.0	11.0	13.0	34.0	358	3.5	9.2	11.2	0	0	100.0	100.0	91.3	100.0	4.4	11
Kitimat-Whitesail	2020	8000	2.7	1.0	2.0	4.0	9.0	11.0	35.0	334	2.7	6.8	10.5	0	0	100.0	100.0	85.9	79.3	3.6	9
Langdale	2020	7877	6.5	1.0	3.0	7.0	55.0	82.0	206.0	332	6.5	52.3	163.4	8	8	87.9	93.4	95.7	85.9	6.3	33
Langley	2020	8545	6.5	1.7	3.3	5.7	46.4	97.3	200.9	356	6.4	40.4	146.9	8	8	96.7	100.0	97.8	94.6	6.4	30
Mission	2020	8612	7.5	2.1	4.0	7.4	52.5	105.4	218.8	356	7.5	51.9	170.9	8	9	97.8	97.8	95.7	97.8	7	36
N. Vancouver-2nd Narrows	2020	8677	7.4	2.9	4.7	7.6	28.2	81.7	188.9	359	7.0	21.9	129.4	7	7	96.7	100.0	96.7	98.9	7.1	22
N. Vancouver-Mahon Park	2020	8711	5.9	1.9	3.2	5.2	50.3	85.5	203.0	363	5.9	58.1	168.1	8	8	97.8	98.9	100.0	100.0	5.6	35
Nanaimo	2020	8655	6.5	2.0	4.0	6.0	39.8	108.5	177.0	360	6.5	42.5	158.1	8	8	97.8	98.9	97.8	98.9	5.3	23
New Westminster	2020	8317	7.5	3.2	4.9	7.4	27.3	77.3	230.8	341	6.5	19.1	108.2	4	4	97.8	86.8	88.0	100.0	6.9	21
North Delta	2020	8246	6.7	2.5	4.1	6.6	33.6	79.8	201.4	341	6.4	24.8	157.9	6	6	100.0	81.3	91.3	100.0	6.3	22
Penticton Industrial Place	2020	2780	-	-	-	-	-	-	386.8	116	-	-	290.0	9	9	0.0	12.1	100.0	14.1	-	-
Pitt Meadows	2020	8492	6.2	1.8	3.5	6.0	42.0	84.3	215.5	352	6.2	48.9	146.3	8	8	97.8	98.9	97.8	90.2	6.1	31
Port Alberni-Elem. School	2020	8745	8.9	3.0	6.0	9.0	44.0	89.6	197.0	366	8.9	27.0	141.7	8	10	100.0	100.0	100.0	100.0	9.4	26
Port Moody	2020	8662	6.7	1.9	3.6	6.4	46.6	98.8	234.6	359	6.7	55.8	172.5	8	8	98.9	98.9	96.7	97.8	6	33
Powell River-J Thomson	2020	8434	7.1	2.7	3.8	5.3	48.2	102.7	232.8	351	7.1	36.6	223.2	9	9	83.5	100.0	100.0	100.0	4.4	23
Prince George-Plaza 400	2020	7332	-	-	-	-	-	-	84.9	304	-	-	56.9	5	6	94.5	100.0	38.0	100.0	-	-
Prince Rupert-Fairview	2020	8605	2.9	1.0	2.1	3.9	10.7	13.4	29.6	353	2.9	7.9	16.4	0	0	100.0	91.2	96.7	97.8	3.1	9
Quesnel	2020	6925	-	-	-	-	-	-	88.4	283	-	-	41.5	1	1	92.3	54.9	62.0	100.0	12.8	72
Richmond South	2020	8731	7.0	2.3	4.2	6.9	40.3	97.1	178.0	365	7.1	28.7	142.6	8	9	100.0	100.0	98.9	100.0	6.1	26
Richmond-Airport	2020	8677	6.1	2.0	3.4	5.6	45.3	95.3	177.5	360	6.1	35.7	144.8	8	8	95.6	100.0	97.8	100.0	6.8	25
Smithers	2020	8730	6.7	1.9	3.9	8.4	30.2	36.0	128.9	363	6.7	20.2	25.0	0	1	98.9	100.0	97.8	100.0	7.6	21
Squamish	2020	8694	6.4	2.0	3.9	6.4	34.1	82.4	186.3	361	6.5	41.8	155.3	9	10	100.0	95.6	100.0	98.9	6.4	34
Surrey	2020	8643	7.1	2.3	3.9	6.7	50.4	106.9	271.1	359	7.1	42.8	157.2	8	8	97.8	98.9	98.9	96.7	6.6	29
Terrace	2020	8664	4.6	1.7	2.7	4.8	23.4	30.6	72.9	360	4.6	12.9	18.5	0	0	100.0	100.0	93.5	100.0	5.5	15
Tsawwassen	2020	8717	5.8	2.1	3.3	5.3	27.3	85.9	157.0	364	5.7	15.0	139.7	7	7	100.0	100.0	98.9	98.9	5.1	16
Valemount	2020	8363	9.8	2.0	3.7	8.3	71.0	93.7	244.6	346	9.6	42.2	61.4	24	27	97.8	100.0	95.7	84.8	-	77
Vancouver-Clark Dr	2020	8716	7.9	3.0	4.9	7.5	48.7	94.3	214.9	364	7.9	47.4	161.0	10	10	100.0	100.0	97.8	100.0	7.9	35
Vanderhoof	2020	6513	-	-	-	-	-	-	61.0	246	-	-	41.2	5	6	95.6	46.2	84.8	42.4	-	88
Vernon	2020	8747	9.1	3.2	5.7	10.5	32.5	54.0	268.2	364	9.1	28.6	226.6	8	8	100.0	100.0	100.0	97.8	10.3	43
Victoria	2020	8670	8.0	3.0	5.0	7.0	41.0	141.0	203.0	362	8.0	50.3	164.4	8	8	100.0	95.6	100.0	100.0	7.9	31
Whistler	2020	7800	7.0	2.0	4.0	7.0	38.0	67.0	210.0	325	6.9	37.0	166.6	8	8	100.0	65.9	89.1	100.0	6.6	38
Williams Lake	2020	8445	5.1	1.7	3.5	6.6	21.4	26.0	59.8	350	5.0	16.2	28.5	1	1	86.8	97.8	97.8	100.0	9.2	51

*CAAQS metrics for $PM_{2.5}$ includes an annual metric based on the annual mean of daily values averaged over three years, and a 24-hour metric based on the 98th percentile of daily values averaged over three years.

Site	Year	No. Valid Hrs	Annual Avg.	Percentiles (1h)						Daily 8h Max		No. Days >62 ppb	% of Valid Days Per Quarter					CAAQS 8-Hr Metric*
				25th	50th	75th	98th	99th	1h Max	Annual Max	Annual 4th Highest		Q1	Q2	Q3	Q4	Q2+Q3	
Abbotsford-Airport	2020	8690	20.9	10.8	21.0	30.3	43.0	46.3	82.7	54.8	62.3	1	100.0	100.0	100.0	100.0	100.0	56
Abbotsford-Mill Lake	2020	8754	19.0	9.5	18.5	28.1	40.8	44.1	79.4	53.4	60.2	0	100.0	100.0	100.0	100.0	100.0	56
Agassiz	2020	8636	18.0	7.8	17.2	27.4	41.6	44.8	75.6	50.3	66.7	1	96.7	100.0	100.0	100.0	100.0	56
Burnaby South	2020	8731	18.4	10.4	18.4	25.7	39.5	42.4	63.5	45.0	52.7	0	100.0	100.0	100.0	100.0	100.0	47
Burnaby-Kensington	2020	8750	18.5	9.8	17.9	26.2	40.9	43.9	68.5	45.4	57.4	0	100.0	100.0	100.0	100.0	100.0	53
Burnaby-Mtn	2020	8641	28.0	21.8	28.3	34.2	47.0	50.1	78.5	53.4	67.6	1	100.0	100.0	100.0	98.9	100.0	45
Castlegar	2020	8388	17.9	9.1	16.2	25.6	41.6	44.1	54.2	45.1	46.7	0	100.0	100.0	100.0	100.0	100.0	48
Chilliwack	2020	8712	19.7	8.9	18.8	29.6	44.5	48.3	86.7	57.8	68.7	2	100.0	100.0	100.0	100.0	100.0	58
Colwood	2020	8199	22.2	12.6	23.0	31.5	43.5	45.9	64.3	48.8	60.1	0	96.7	100.0	100.0	100.0	100.0	50
Coquitlam	2020	8763	16.5	7.2	15.4	24.5	40.3	42.7	80.3	51.8	62.3	1	100.0	100.0	100.0	100.0	100.0	53
Courtenay	2020	8161	19.8	10.2	20.2	28.8	41.9	43.5	67.2	47.5	61.0	0	95.6	100.0	98.9	100.0	99.5	48
Cranbrook	2020	8384	23.9	16.7	24.8	31.1	42.8	44.5	53.9	46.7	52.8	0	100.0	100.0	100.0	100.0	100.0	50
Duncan	2020	8228	18.2	7.0	17.8	27.8	43.1	46.2	59.0	49.6	54.0	0	98.9	96.7	100.0	100.0	98.4	52
Farmington	2020	8375	26.0	18.2	26.3	34.2	45.6	47.6	54.6	49.6	51.1	0	100.0	100.0	100.0	100.0	100.0	51
Fort St. John	2020	6272	-	-	-	-	-	-	-	44.9	-	0	91.2	67.0	50.0	100.0	58.5	51
Hope	2020	8673	18.9	7.4	18.1	29.0	44.3	47.2	76.4	53.3	67.8	1	100.0	100.0	100.0	100.0	100.0	59
Kamloops-Fed. Bldg.	2020	8403	20.3	10.6	20.2	29.4	44.1	46.4	54.3	47.3	49.6	0	100.0	100.0	100.0	100.0	100.0	50
Kelowna	2020	8273	20.8	12.7	20.9	29.0	41.1	43.6	60.4	45.4	50.8	0	100.0	97.8	100.0	100.0	98.9	51
Kitimat-Whitesail	2020	7966	20.0	12.4	20.2	27.7	38.4	40.0	47.4	41.5	44.2	0	90.1	100.0	97.8	100.0	98.9	-
Langley	2020	8719	21.2	11.8	21.7	30.3	43.6	46.5	73.6	55.3	61.9	0	100.0	100.0	100.0	100.0	100.0	57
Maple Ridge	2020	8288	19.8	10.1	19.6	28.8	43.5	46.3	77.4	55.8	66.9	1	100.0	80.2	100.0	100.0	90.2	59
Mission	2020	8379	21.0	11.9	21.0	29.3	45.1	48.6	99.2	57.0	73.9	3	84.6	100.0	100.0	100.0	100.0	62
N. Vancouver-2nd Narrows	2020	8741	13.9	6.3	13.0	20.3	34.0	36.7	68.9	38.8	52.5	0	100.0	100.0	100.0	100.0	100.0	40
N. Vancouver-Mahon Park	2020	8755	18.8	10.1	18.5	26.5	41.5	43.9	69.0	44.5	53.7	0	100.0	100.0	100.0	100.0	100.0	46
Nanaimo	2020	8203	22.5	15.8	22.2	29.0	41.4	43.2	60.3	45.3	51.3	0	97.8	100.0	98.9	98.9	99.5	46
New Westminster	2020	8457	14.4	2.8	11.8	23.4	41.9	45.1	68.7	48.9	59.5	0	100.0	89.0	100.0	100.0	94.5	47
North Delta	2020	7861	19.3	10.6	19.2	27.7	40.6	43.0	67.3	43.9	50.9	0	64.8	100.0	100.0	100.0	100.0	45
Pitt Meadows	2020	8581	18.2	7.8	18.6	27.6	41.0	43.7	88.8	47.3	61.0	0	98.9	100.0	100.0	96.7	100.0	51
Port Moody	2020	8705	13.6	3.8	12.0	21.4	38.1	41.0	72.8	46.5	58.3	0	100.0	100.0	100.0	100.0	100.0	47
Prince George-Plaza 400	2020	8377	19.4	8.8	19.5	28.8	42.5	44.6	51.9	47.4	51.0	0	100.0	100.0	100.0	100.0	100.0	51
Prince Rupert-Fairview	2020	7685	18.2	10.0	17.8	26.9	35.3	36.3	45.0	36.2	37.6	0	100.0	100.0	100.0	63.0	100.0	41
Quesnel	2020	8212	14.4	4.5	11.7	21.0	43.0	45.6	101.1	47.3	48.3	0	100.0	93.4	100.0	100.0	96.7	49
Richmond South	2020	8743	18.1	6.6	18.1	28.0	41.9	43.9	67.9	45.5	55.2	0	100.0	100.0	100.0	100.0	100.0	45
Richmond-Airport	2020	8714	18.4	8.2	18.4	27.6	41.7	43.8	64.6	45.5	52.4	0	100.0	100.0	100.0	100.0	100.0	46
Smithers	2020	8372	13.6	3.3	10.9	21.2	40.2	42.3	50.8	44.0	48.1	0	100.0	100.0	100.0	100.0	100.0	45
Squamish	2020	8678	16.6	7.2	15.8	24.5	38.1	40.3	75.7	41.7	62.8	1	100.0	97.8	100.0	100.0	98.9	47
Surrey	2020	8708	21.1	12.2	21.1	29.9	43.8	46.3	76.0	49.8	61.4	0	100.0	100.0	100.0	100.0	100.0	53
Taylor Townsite	2020	7986	21.9	11.4	21.3	31.2	46.5	49.1	55.7	51.3	53.4	0	100.0	100.0	87.0	98.9	93.4	52
Terrace	2020	8306	19.7	10.1	19.3	29.1	42.4	44.1	49.7	45.7	47.7	0	100.0	100.0	97.8	100.0	98.9	45
Tsawwassen	2020	8735	22.9	15.5	23.2	30.7	42.4	43.9	56.1	46.4	51.2	0	100.0	100.0	100.0	100.0	100.0	47
Vancouver-Clark Dr	2020	8705	13.0	2.8	11.0	20.7	37.3	40.9	65.5	42.8	48.5	0	100.0	100.0	100.0	98.9	100.0	43
Vancouver-Dwtn	2020	8637	12.1	3.4	9.7	19.2	34.6	37.7	51.8	39.8	45.9	0	97.8	100.0	100.0	100.0	100.0	38
Vernon	2020	8408	18.9	7.7	17.6	29.1	44.8	47.1	54.2	48.2	48.8	0	100.0	100.0	100.0	100.0	100.0	51
Victoria	2020	8367	20.6	12.8	21.1	28.8	39.7	42.0	57.7	43.6	50.7	0	100.0	100.0	100.0	100.0	100.0	46
Whistler	2020	8711	20.3	10.2	19.6	29.6	44.6	47.1	53.4	48.3	49.3	0	100.0	100.0	100.0	100.0	100.0	50
Williams Lake	2020	8352	20.5	9.4	20.3	30.2	46.0	47.8	53.2	50.6	52.0	0	100.0	100.0	100.0	100.0	100.0	52

*CAAQS metrics for O_3 is an 8-hour metric based on the annual 4th highest of the daily maximum 8-hour averaged concentration averaged over three years.

2020 Nitrogen Dioxide

Site	Year	No. Valid Hrs	Annual Avg	Percentiles (1h)					Max 1h	Annual 98th Percentile of Daily 1-Hour Maximum	No. Days			% of Valid Days Per Quarter				CAAQS NO_2 Metrics*	
				25th	50th	75th	98th	99th			>42 ppb	>60 ppb	>100ppb	Q1	Q2	Q3	Q4	Annual	1-Hour
Abbotsford-Airport	2020	8723	6.3	2.4	4.8	8.8	19.7	22.3	36.9	28.7	0	0	0	100.0	100.0	100.0	98.9	6.3	29.5
Abbotsford-Mill Lake	2020	8731	7.7	3.5	6.1	10.3	23.0	25.8	36.7	32.3	0	0	0	100.0	100.0	98.9	100.0	7.7	35.1
Agassiz	2020	8663	6.8	2.8	5.3	9.8	19.6	21.7	28.7	26.1	0	0	0	97.8	100.0	100.0	96.7	6.8	29
Burnaby-Kensington	2020	8175	8.6	4.7	7.4	11.4	22.7	25.2	38.9	31.0	0	0	0	91.2	100.0	79.3	100.0	8.6	36.6
Burnaby-Mtn	2020	8745	6.1	3.1	5.0	7.9	19.2	22.9	35.6	29.5	0	0	0	100.0	100.0	100.0	98.9	6.1	33.8
Burnaby South	2020	8698	10.6	5.7	9.2	14.3	27.0	29.3	39.4	35.9	0	0	0	100.0	100.0	100.0	100.0	10.6	37.9
Castlegar	2020	8081	5.1	1.9	3.8	6.9	17.5	19.4	33.6	24.9	0	0	0	83.5	100.0	100.0	100.0	5.1	26.4
Chilliwack	2020	8646	7.0	3.2	5.8	9.8	20.1	22.3	52.3	26.9	1	0	0	97.8	95.6	100.0	100.0	7	29.8
Colwood	2020	8188	3.9	1.0	2.5	5.3	15.5	17.4	33.7	22.6	0	0	0	90.1	100.0	100.0	100.0	3.9	24.4
Coquitlam	2020	8743	8.1	3.9	6.6	11.0	22.9	25.8	40.1	30.9	0	0	0	100.0	100.0	100.0	100.0	8.1	34
Courtenay	2020	8224	3.0	0.9	2.0	4.1	12.7	14.8	25.2	19.9	0	0	0	91.2	100.0	100.0	97.8	3	24.3
Cranbrook	2020	8100	3.9	0.9	1.9	5.1	18.5	21.0	32.7	27.0	0	0	0	98.9	85.7	97.8	100.0	3.9	29.2
Duncan	2020	8361	3.6	1.1	2.6	5.2	13.5	15.9	28.6	21.2	0	0	0	100.0	100.0	98.9	100.0	3.6	22.3
Farmington	2020	8361	2.1	0.6	1.3	2.8	9.5	11.4	22.9	16.9	0	0	0	100.0	98.9	96.7	97.8	2.1	22
Fort St. John	2020	8365	5.9	1.4	2.9	7.1	30.6	36.3	57.0	47.6	14	0	0	97.8	100.0	98.9	98.9	5.9	49.8
Hope	2020	8692	5.7	2.4	4.7	8.2	16.0	17.7	32.8	22.6	0	0	0	98.9	100.0	100.0	100.0	5.7	22
Hudsons Hope	2020	2384	-	-	-	-	-	-	169.3	-	0	0	0	0.0	0.0	8.7	97.8	-	-
Kamloops-Fed. Bldg.	2020	8381	10.5	4.6	8.4	14.4	30.7	32.6	39.5	35.9	0	0	0	100.0	98.9	100.0	100.0	10.5	41
Kelowna	2020	8375	5.8	2.3	4.1	7.8	19.6	22.2	33.7	27.1	0	0	0	100.0	97.8	100.0	100.0	5.8	29.5
Kitimat-Whitesail	2020	8308	1.5	0.6	1.0	1.6	7.5	9.5	19.0	15.1	0	0	0	95.6	96.7	96.7	96.7	1.5	-
Langdale	2020	7629	3.8	2.0	3.1	4.9	11.8	13.8	23.4	18.5	0	0	0	98.9	98.9	78.3	84.8	3.8	22.5
Langley	2020	8735	5.4	2.4	4.1	7.2	16.1	18.4	29.8	22.4	0	0	0	98.9	100.0	100.0	100.0	5.4	24.4
Maple Ridge	2020	8290	6.8	3.0	5.3	9.0	21.3	23.9	38.0	30.2	0	0	0	100.0	78.0	100.0	100.0	6.8	32.6
Mission	2020	8757	6.1	2.5	4.4	8.2	20.4	22.7	38.9	28.0	0	0	0	100.0	100.0	100.0	100.0	6.1	30.6
N. Vancouver-2nd Narrows	2020	8744	11.7	6.2	9.9	15.2	32.2	36.4	63.1	45.8	20	1	0	98.9	100.0	100.0	100.0	11.7	60.2
N. Vancouver-Mahon Park	2020	8750	9.3	4.4	7.7	12.6	26.8	30.1	43.3	35.1	1	0	0	100.0	100.0	100.0	100.0	9.3	38.9
Nanaimo	2020	8251	4.5	1.3	3.4	6.5	15.4	17.1	33.4	22.2	0	0	0	95.6	100.0	97.8	97.8	4.5	26.6
New Westminster	2020	8460	14.3	8.4	13.6	19.4	30.7	33.6	49.3	39.7	4	0	0	100.0	86.8	100.0	100.0	14.3	42.8
North Delta	2020	8567	10.1	4.4	8.1	14.2	29.2	31.6	49.4	36.9	1	0	0	98.9	97.8	92.4	96.7	10.1	41.9
Pitt Meadows	2020	8634	6.9	2.6	5.3	9.6	23.1	25.8	45.1	33.1	1	0	0	100.0	100.0	98.9	94.6	6.9	37.4
Port Moody	2020	8715	10.5	5.8	9.5	14.2	25.5	28.3	42.4	35.6	2	0	0	98.9	100.0	100.0	97.8	10.5	37.7
Prince George-Plaza 400	2020	8406	7.8	2.8	5.3	10.3	31.0	34.8	49.3	39.5	2	0	0	100.0	100.0	100.0	100.0	7.8	47.2
Prince Rupert-Fairview	2020	8236	3.8	0.8	2.5	5.7	14.9	16.5	29.8	23.2	0	0	0	98.9	98.9	85.9	97.8	3.8	25.4
Quesnel	2020	7962	8.5	3.4	6.2	11.6	28.3	31.5	40.6	37.5	0	0	0	97.8	91.2	89.1	96.7	8.5	40
Richmond-Airport	2020	8704	11.0	4.2	8.8	16.1	31.1	33.2	44.8	39.8	4	0	0	97.8	100.0	100.0	100.0	11	44
Richmond South	2020	8610	10.2	3.5	7.7	15.6	29.0	31.2	39.7	35.6	0	0	0	98.9	95.6	100.0	100.0	10.2	38.1
Smithers	2020	7503	6.4	2.7	4.7	8.9	20.7	23.0	33.9	26.5	0	0	0	100.0	100.0	65.2	83.7	6.4	30
Squamish	2020	8659	5.0	2.4	4.0	6.6	15.3	17.6	29.3	22.7	0	0	0	100.0	100.0	100.0	94.6	5	24.3
Surrey	2020	8696	7.7	3.3	5.9	10.6	24.3	27.0	35.4	31.8	0	0	0	97.8	100.0	98.9	100.0	7.7	34.6
Taylor Townsite	2020	8243	5.8	1.1	3.1	7.9	26.2	29.8	46.7	35.5	1	0	0	97.8	96.7	94.6	96.7	5.8	39.6
Terrace	2020	8306	2.8	0.5	1.2	3.2	15.1	18.1	33.0	24.1	0	0	0	100.0	100.0	94.6	97.8	2.8	25.5
Tsawwassen	2020	8750	5.3	1.8	3.5	7.0	20.3	23.1	33.8	28.7	0	0	0	98.9	98.9	100.0	100.0	5.3	31.1
Vancouver-Clark Dr	2020	8709	15.8	9.2	15.0	21.6	34.6	37.1	61.6	45.6	17	1	0	100.0	100.0	98.9	97.8	15.8	49.9
Vancouver-Dwtn	2020	8763	15.5	9.4	15.0	20.8	31.2	33.3	47.1	38.7	1	0	0	100.0	100.0	100.0	100.0	15.5	41.2
Vernon	2020	8411	9.3	3.7	6.9	13.2	28.8	31.5	47.3	36.0	1	0	0	100.0	100.0	100.0	100.0	9.3	35.2
Victoria	2020	8270	6.2	2.2	4.5	8.5	21.6	24.5	63.9	33.3	2	1	0	93.4	98.9	98.9	98.9	6.2	37.2
Whistler	2020	8751	3.3	1.1	2.1	4.0	14.2	16.6	29.5	20.9	0	0	0	100.0	100.0	100.0	100.0	3.3	22
Williams Lake	2020	8380	6.1	1.7	3.9	9.1	22.1	25.6	37.9	30.3	0	0	0	97.8	100.0	97.8	100.0	6.1	35.4

*CAAQS metrics for NO_2 includes an annual metric based on the average of all 1-hour concentrations over the year, and a 24-hour metric based on the 98th percentile of the daily maximum 1-hour concentration averaged over three years.

2020 Sulfur Dioxide

Site	Year	No. Valid Hrs	Annual Avg	Percentiles (1h)					Max	Annual 99th Percentile of D1HM*	No. of Days		% of Valid Days Per Quarter				CAAQS SO_2 Metrics*	
				25th	50th	75th	98th	99th			>75 ppb	>70 ppb	Q1	Q2	Q3	Q4	Annual	1-Hour
Abbotsford-Airport	2020	8737.0	0.3	0.1	0.3	0.4	0.8	1.0	3.1	2.7	0	0	100.0	100.0	100.0	98.9	0.3	3
Abbotsford-Mill Lake	2020	8751.0	0.2	0.1	0.1	0.2	0.6	0.8	3.2	2.1	0	0	100.0	100.0	100.0	100.0	0.2	4
Bessborough 237 Road	2020	8354.0	0.5	0.1	0.3	0.5	2.3	3.8	67.4	35.7	0	0	100.0	98.9	100.0	100.0	0.5	22
Burnaby-Kensington	2020	8761.0	0.3	0.1	0.2	0.4	1.1	1.5	7.1	4.7	0	0	100.0	100.0	100.0	100.0	0.3	6
Burnaby North Eton	2020	8600.0	0.5	0.1	0.2	0.5	3.0	4.4	27.6	12.7	0	0	100.0	97.8	98.9	100.0	0.5	11
Burnaby South	2020	8557.0	0.3	0.1	0.2	0.3	1.1	1.5	5.7	3.0	0	0	100.0	100.0	100.0	100.0	0.3	4
Castlegar	2020	8406.0	1.7	0.1	0.2	1.1	16.2	20.4	59.9	36.6	0	0	100.0	100.0	100.0	100.0	1.7	39
Chilliwack	2020	8647.0	0.1	0.0	0.1	0.1	0.4	0.5	2.9	1.9	0	0	97.8	100.0	100.0	100.0	0.1	3
Crofton Elementary	2020	6165.0	-	-	-	-	-	-	24.7	-	0	0	100.0	100.0	82.6	10.9	-	-
Farmington	2020	8358.0	0.4	0.1	0.3	0.4	1.4	2.0	9.8	5.6	0	0	98.9	98.9	96.7	97.8	0.4	8
Fort St. John	2020	8192.0	0.6	0.3	0.6	0.8	1.5	1.7	12.6	4.7	0	0	90.1	100.0	97.8	98.9	0.6	5
Hudsons Hope	2020	1455.0	-	-	-	-	-	-	1.8	-	0	0	0.0	0.0	0.0	65.2	-	-
Kamloops-Fed. Bldg.	2020	8402.0	0.3	0.2	0.3	0.4	1.0	1.4	5.3	3.6	0	0	100.0	100.0	100.0	100.0	0.3	4
Kelowna	2020	8395.0	0.3	0.2	0.3	0.4	0.7	0.9	2.8	1.5	0	0	98.9	100.0	100.0	100.0	0.3	2
Kitimat-Haisla	2020	8343.0	0.3	0.1	0.1	0.2	1.5	2.7	42.6	19.8	0	0	100.0	100.0	97.8	98.9	0.3	19
Kitimat-Riverlodge	2020	8282.0	0.5	0.1	0.2	0.3	4.6	7.8	41.0	18.0	0	0	94.5	100.0	100.0	98.9	0.5	29
Kitimat-Whitesail	2020	7518.0	-	-	-	-	-	-	29.1	-	0	0	100.0	98.9	58.7	100.0	-	-
Langdale	2020	7635.0	0.8	0.3	0.5	1.0	3.6	4.8	18.6	10.5	0	0	100.0	98.9	78.3	84.8	0.8	12
Langley	2020	8731.0	0.1	0.1	0.1	0.1	0.6	0.7	2.5	2.2	0	0	98.9	100.0	100.0	100.0	0.1	3
N. Vancouver-2nd Narrows	2020	8741.0	0.3	0.1	0.2	0.3	0.9	1.1	14.6	2.0	0	0	98.9	98.9	100.0	100.0	0.3	4
N. Vancouver-Mahon Park	2020	8735.0	0.2	0.1	0.1	0.3	0.9	1.2	23.6	3.3	0	0	100.0	100.0	100.0	97.8	0.2	4
North Burnaby Capitol Hill	2020	8723.0	0.3	0.1	0.1	0.2	1.8	3.4	27.6	17.1	0	0	100.0	100.0	97.8	98.9	0.3	35
Pitt Meadows	2020	8252.0	0.3	0.1	0.2	0.4	1.1	1.4	5.1	2.8	0	0	98.9	87.9	97.8	94.6	0.3	4
Port Moody	2020	8742.0	0.3	0.1	0.1	0.2	1.8	2.2	42.7	6.3	0	0	98.9	100.0	100.0	100.0	0.3	6
Prince George-CBC	2020	6527.0	-	-	-	-	-	-	151.4	-	10	13	95.6	97.8	97.8	16.3	-	156
Prince George-Jail	2020	8388.0	3.0	0.4	0.7	1.4	29.9	38.2	120.9	76.2	4	5	100.0	97.8	100.0	100.0	3.0	73
Prince George-Plaza 400	2020	8396.0	1.0	0.2	0.4	0.8	7.4	10.3	55.9	32.6	0	0	100.0	98.9	98.9	100.0	1.0	40
Prince Rupert-Fairview	2020	8475.0	0.2	0.1	0.2	0.3	1.0	1.1	4.2	2.2	0	0	98.9	98.9	98.9	97.8	0.2	2
Quesnel	2020	7506.0	0.4	0.2	0.3	0.5	1.2	1.7	4.7	4.0	0	0	100.0	84.6	69.6	97.8	0.4	9
Richmond-Airport	2020	8687.0	0.2	0.0	0.1	0.2	0.9	1.3	19.9	5.4	0	0	97.8	100.0	100.0	100.0	0.2	4
Richmond South	2020	8537.0	0.1	0.0	0.1	0.2	0.8	1.0	2.8	1.6	0	0	100.0	100.0	100.0	100.0	0.1	3
Squamish	2020	8014.0	0.2	0.1	0.2	0.3	0.8	1.1	6.9	3.5	0	0	83.5	97.8	97.8	100.0	0.2	5
Taylor South Hill	2020	8176.0	0.3	0.1	0.2	0.4	1.8	2.8	21.3	7.8	0	0	96.7	100.0	91.3	98.9	0.3	24
Taylor Townsite	2020	8284.0	0.6	0.1	0.2	0.4	5.2	8.6	44.6	31.9	0	0	100.0	97.8	95.7	98.9	0.6	45
Terrace	2020	7796.0	0.5	0.1	0.3	0.7	2.1	2.5	5.5	3.8	0	0	90.1	100.0	94.6	82.6	0.5	5
Trail-Birchbank	2020	7805.0	5.7	0.2	1.0	6.5	38.7	45.9	143.3	87.2	8	9	73.6	98.9	100.0	98.9	5.7	98
Trail-Columbia Gardens	2020	8378.0	2.7	0.3	0.7	2.4	18.4	23.8	75.0	52.8	1	2	100.0	98.9	100.0	100.0	2.7	60
Trail Butler Park	2020	8326.0	5.9	0.5	1.5	5.0	46.4	62.2	302.9	206.8	38	45	98.9	98.9	100.0	100.0	-	-
Tsawwassen	2020	8757.0	0.1	0.0	0.1	0.1	0.5	0.7	3.6	3.0	0	0	100.0	98.9	100.0	100.0	0.1	4
Vancouver-Clark Dr	2020	8711.0	0.3	0.1	0.2	0.4	1.2	1.5	9.5	2.9	0	0	100.0	100.0	98.9	97.8	0.3	4
Vancouver-Dwtn	2020	8523.0	0.3	0.1	0.2	0.4	1.5	2.0	30.2	7.0	0	0	87.9	100.0	100.0	100.0	0.3	5
Victoria	2020	8224.0	0.3	0.1	0.2	0.3	1.3	1.7	5.5	4.8	0	0	100.0	100.0	100.0	91.3	0.3	5
Victoria-James Bay	2020	3692.0	-	-	-	-	-	-	1.1	-	0	0	100.0	70.3	0.0	0.0	-	-

*CAAQS metrics for SO_2 includes an annual metric based on the average of all 1-hour concentrations over the year, and a 24-hour metric based on the 99th percentile of the daily maximum 1-hour concentration averaged over three years.