

Executive Summary

The 2018-2020 air zone reporting period is the first to apply the 2020 Canadian Ambient Air Quality Standards (CAAQS) for fine particulate matter and ozone, and the first to include nitrogen dioxide and sulphur dioxide. In this report, the Coastal Air Zone is assigned “yellow” management levels for fine particulate matter and nitrogen dioxide, and “green” management levels for ozone and sulphur dioxide.

Table 1. Management levels in the Coastal Air Zone based on the 2018-2020 air zone reporting period.

Air Zone	PM _{2.5}	Ozone	NO ₂	SO ₂
Coastal	Yellow	Green	Yellow	Green

Introduction

This is the eighth annual air zone report for the Coastal Air Zone. Air zone reporting is a commitment under the national Air Quality Management System (AQMS). This report describes achievement of the Canadian Ambient Air Quality Standards (CAAQS) for fine particulate matter (PM_{2.5}), ground-level ozone (O₃), nitrogen dioxide (NO₂), and sulphur dioxide (SO₂), the associated management levels and recent actions to improve air quality.

Air Quality Management System

The AQMS is the comprehensive and collaborative approach of managing air quality by federal, provincial, and territorial governments in Canada. Under the AQMS, the CAAQS are developed to drive actions to protect human health and the environment based on the principles of continuous improvement and keeping clean areas clean. Air zones are defined under the AQMS as areas with similar air quality characteristics, issues, and trends, and serve as the basis for monitoring, reporting, and actions to improve air quality. Under the AQMS, progressively more rigorous actions are expected as air quality approaches or exceeds the CAAQS. The level of action is guided by the Air Zone Management Framework (Table 2).

Table 2. AQMS management levels and objectives for air pollutants based on the 2020 CAAQS.

Management Level	Objectives	PM _{2.5}		Ozone	NO ₂		SO ₂	
		Annual (µg/m ³)	24-hour (µg/m ³)	8-hour (ppb)	Annual (ppb)	1-hour (ppb)	Annual (ppb)	1-hour (ppb)
Red	Achieve CAAQS	>8.8	>27	>62	>17.0	>60	>5.0	>70
Orange	Prevent CAAQS Exceedance	>6.4 and ≤8.8	>19 and ≤27	>56 and ≤62	>7.0 and ≤17.0	>31 and ≤60	>3.0 and ≤5.0	>50 and ≤70
Yellow	Prevent Air Quality Deterioration	>4.0 and ≤6.4	>10 and ≤19	>50 and ≤56	>2.0 and ≤7.0	>20 and ≤31	>2.0 and ≤3.0	>30 and ≤50
Green	Keep Clean Areas Clean	≤4.0	≤10	≤50	≤2.0	≤20	≤2.0	≤30

Coastal Air Zone

The Coastal Air Zone (Figure 1) is one of seven air zones across B.C. It covers coastal areas of B.C. outside of the Georgia Basin and includes Haida Gwaii, the north and central coasts, and northern Vancouver Island. Air quality monitoring in the Coastal Air Zone includes a Ministry-operated station in Terrace, a Prince Rupert Port Authority-operated station in Prince Rupert, and monitoring stations in Kitimat. Kitimat has three monitoring stations, one equipped to measure PM_{2.5}, Ozone, NO₂, and SO₂ and the others, equipped to measure PM_{2.5}, SO₂ and other pollutants. Kitimat also has several fenceline stations to monitor industrial emissions.



Figure 1. Map of B.C. highlighting (in red) the Coastal Air Zone and its major population centres.

PM_{2.5} Levels

PM_{2.5} or fine particulate matter refers to solid particles and liquid droplets suspended in air that are smaller than or equal to 2.5 micrometre (µm) in diameter. These particles when inhaled, travels deep into the lungs and the bloodstream, and can cause adverse health effects like cardiovascular and respiratory diseases. PM_{2.5} is considered a non-threshold pollutant, that is, there are associated adverse health effect at any level of exposure.

Figure 2 gives a summary of the PM_{2.5} levels at five locations in the Coastal Air Zone for the 2018-2020 reporting period. Daily concentrations (upper plot) based on the 24-hour metric¹ ranged from 9 to 15 µg/m³. The annual metric² ranged from 3.1 to 5.5 µg/m³. All sites achieved the more stringent 2020 CAAQS of 27 µg/m³ for the 24-hour metric and 8.8 µg/m³ for the annual metric. No Transboundary Flow/Exceptional Events (TF/EE) adjustments for wildfire were made because the values were well below the standards.

Figure 3 shows the wildfire adjusted levels and trends of the 24-hour and annual metric in the Coastal Air Zone. The figure features the 2015 and 2020 CAAQS and the reporting period where these standards apply. Figure also shows the recommended management levels based on either metric. Table 2 shows the AQMS management levels for the air zone and communities in the air zone through various reporting periods. The overall management level for the entire air zone is “yellow” based on the metrics reported at Terrace.

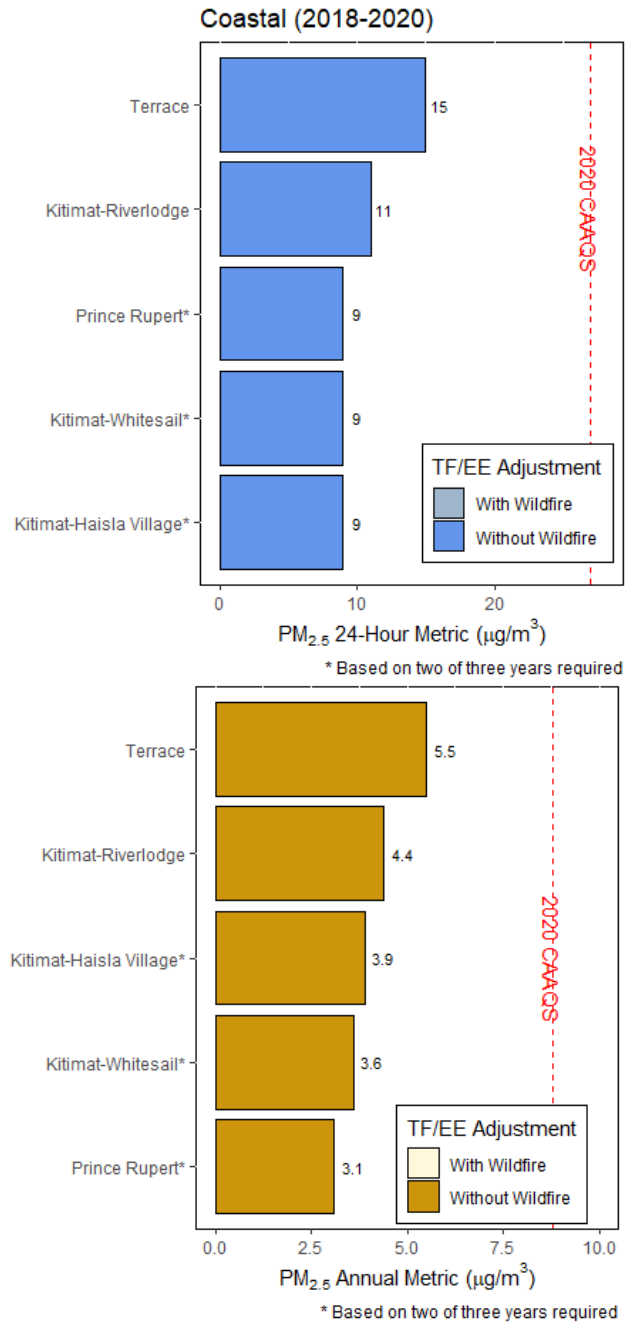


Figure 2. PM_{2.5} concentrations in the Coastal Air Zone based on the 24-hour (top) and annual (bottom) metrics. The red dashed lines identify the 2020 CAAQS of 60 ppb for the 1-hour metric, and 17 ppb for the annual metric.

¹ PM_{2.5} 24-hour metric is the annual 98th percentile of the 24-hour value, averaged over three years (2018-2020).

² PM_{2.5} annual metric is the annual average of 24-hour values, averaged over three years (2018-2020).

Table 2. Summary of PM_{2.5} metrics and air zone management levels for the Coastal Air Zone.

	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020
COASTAL (CAAQS)	YELLOW (2015)	YELLOW (2015)	YELLOW (2015)	YELLOW (2015)	YELLOW (2015)	YELLOW (2020)
Kitimat-Riverlodge	14/5.7	12/5.3	11/4.7	11/4.7	12/4.7	11/4.4
Prince Rupert						9/3.1
Terrace			17/5.9	18/6.2	17/6.1	15/5.5

Management Goals for PM_{2.5} based on the Air Quality Management System

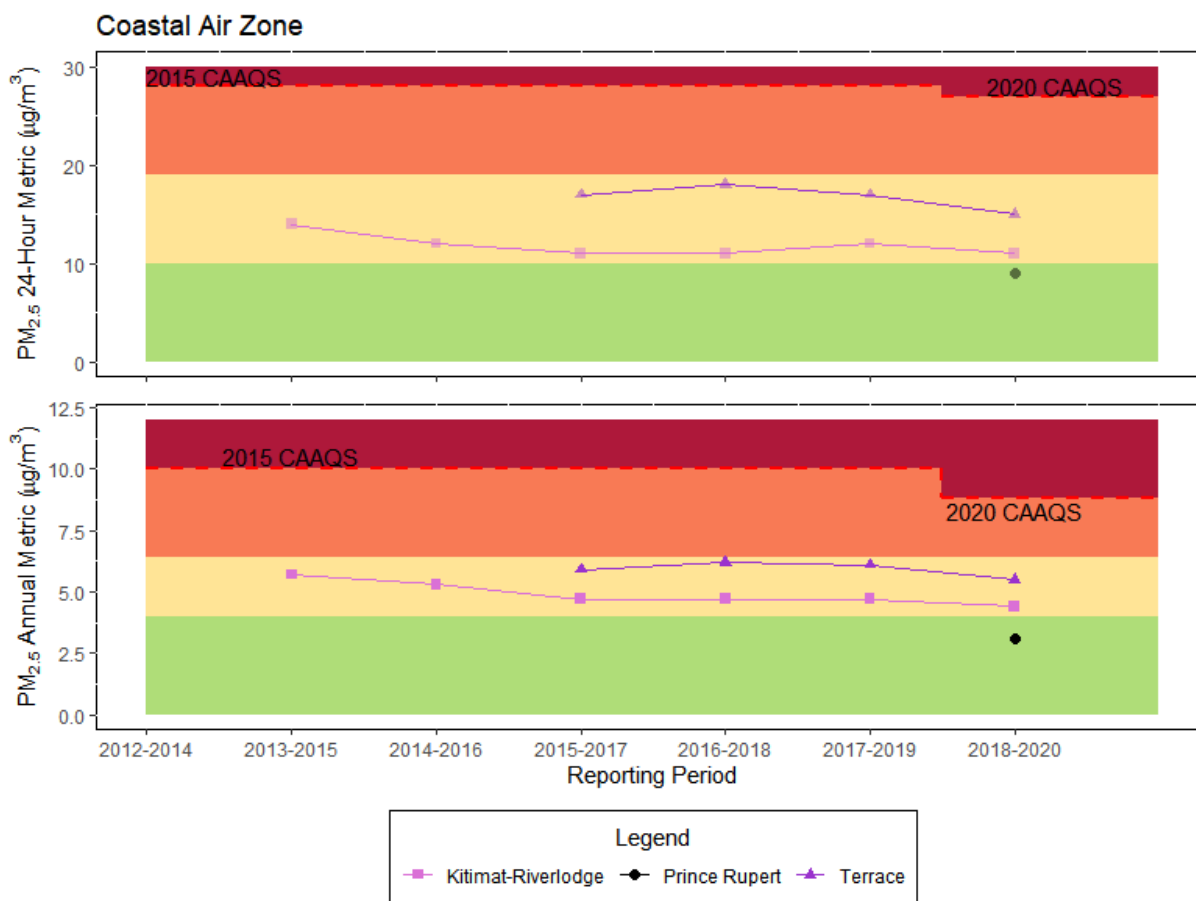
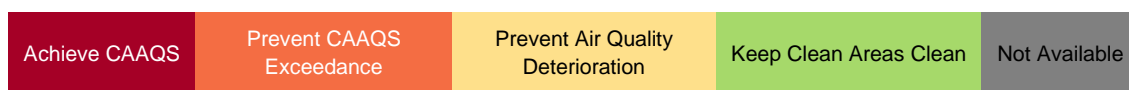


Figure 3. Wildfire-adjusted trends in the 24-hour and annual metrics of PM_{2.5} throughout the 2012-2014 until the 2018-2020 periods. The red dashed lines and background colours define the applicable CAAQS and AQMS management levels based on the metric.

All the sites in the Coastal Air Zone had reported within “yellow” or “green” management levels for PM_{2.5}. This means that levels of PM_{2.5} are lower than 19 µg/m³ for the 24-hour metric and less than 6.4 µg/m³ for the annual metric. Overall, the Coastal Air Zone has been under “yellow” management levels for PM_{2.5} from the 2013-2015 to the 2018-2020 reporting periods. Under “yellow” management level, PM_{2.5}-related actions are recommended to prevent the deterioration of air quality.

Ozone Levels

Ground-level ozone is a colourless and irritating gaseous pollutant. It forms just above the earth’s surface through chemical reactions between “ozone precursor” emissions. Unlike naturally occurring ozone in the ozone layer, ground-level ozone can be harmful to people, animals, and plants.

Figure 4 summarizes the ozone levels in the Coastal Air Zone during the 2018-2020 reporting period. Ozone levels based on the 8-hour metric in the air zone ranged from 41 parts per billion (ppb) at Prince Rupert and 45 ppb at Terrace.³ Both sites achieved the new national standard of 62 ppb for the ozone metric. There were no data adjustments for transboundary flow and exceptional events (TF/EE) as levels did not exceed the standard.

Annual trends and associated AQMS management levels of the ozone metric are presented in Figure 5 and summarized in Table 3. Since the 2014-2016 reporting period, both Coastal Air Zone locations had been reporting “green” management levels for ozone, which means near-background levels that are below 50 ppb. Under a “green” management level, preventative measures are recommended to “keep clean areas clean” by avoiding or minimising increases in ozone levels.

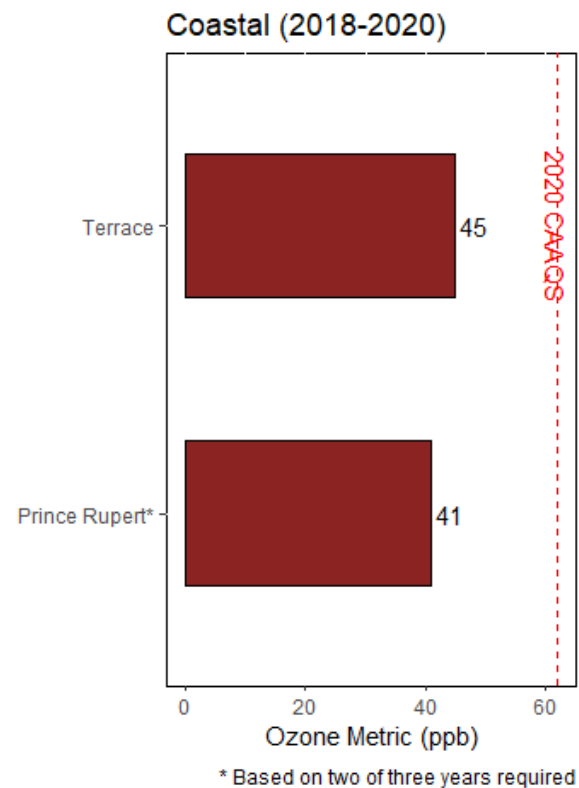


Figure 4. Ozone concentration in the Coastal Air Zone based on the annual 4th highest daily 8-hour maximums averaged over 2018-2020. Red dashed line identifies the 2020 CAAQS of 62 ppb.

³ Ozone 8-hour metric are based on the 4th highest daily 8-hour maximum, averaged over three years (2018-2020).

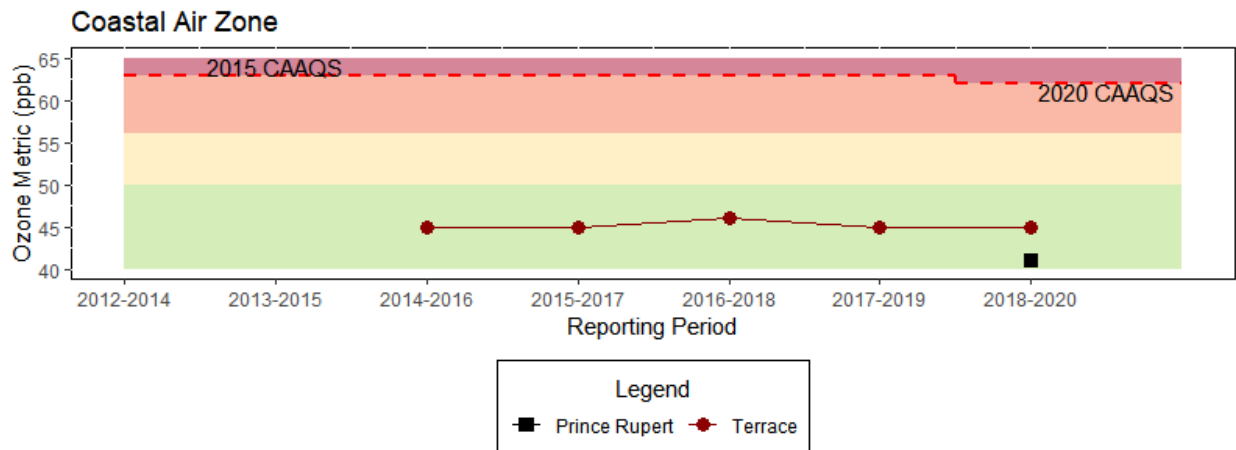


Figure 5. Trends in ozone concentrations based on the annual 4th highest daily 8-hour maximums averaged over three consecutive years. Red dashed line identifies the 2015 and 2020 CAAQS on the reporting period where it applies. Background colour shows management levels for the metric.

Table 3. Summary of ozone metrics and air zone management levels for the Coastal Air Zone.

	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020
COASTAL (CAAQS)			GREEN (2015)	GREEN (2015)	GREEN (2015)	GREEN (2015)	GREEN (2020)
Prince Rupert							41
Terrace			45	45	46	45	45

Management Goals for O₃ based on the Air Quality Management System

Achieve CAAQS	Prevent CAAQS Exceedance	Prevent Air Quality Deterioration	Keep Clean Areas Clean	Not Available
---------------	--------------------------	-----------------------------------	------------------------	---------------

Nitrogen Dioxide Levels

Nitrogen Dioxide (NO₂) is a gaseous pollutant formed along with other nitrogen oxides (NO_x) during the high temperature combustion of fossil fuels. It plays a major role in atmospheric reactions that form ground-level ozone and smog.

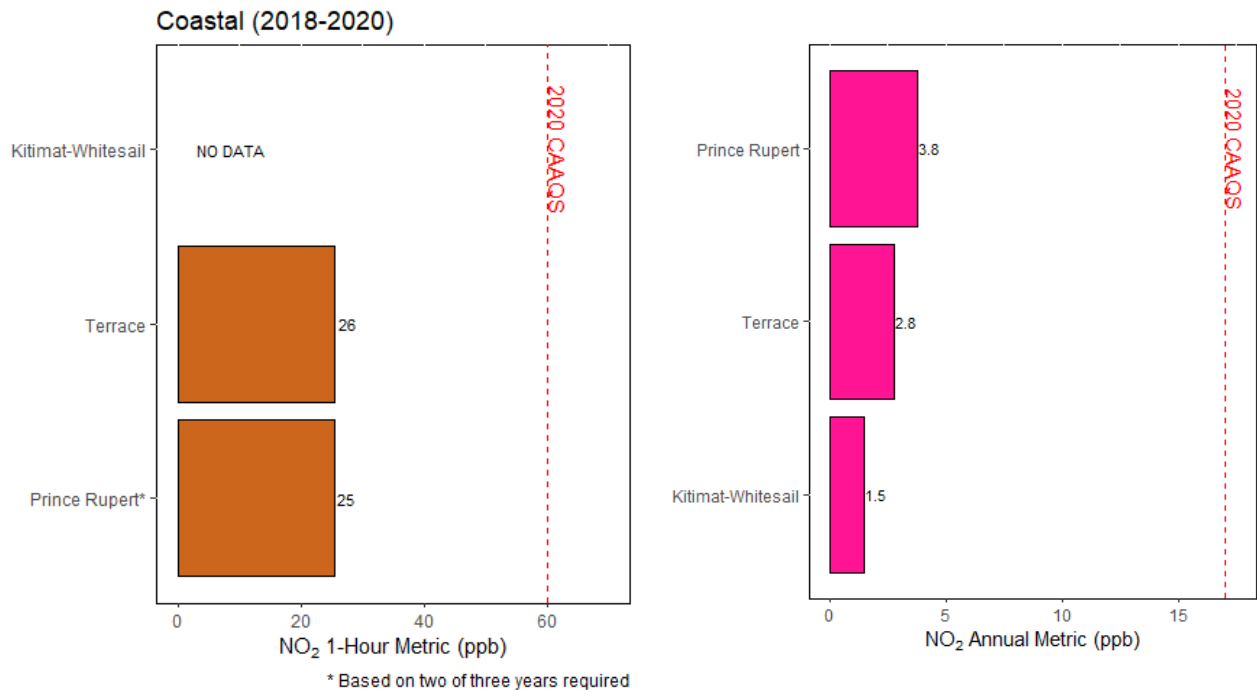


Figure 6. NO₂ concentrations in the Coastal Air Zone based on the 1-hour (left) and annual (right) metrics. The red dashed lines identify the 2020 CAAQS of 60 ppb for the 1-hour metric, and 17 ppb for the annual metric.

Figure 6 summarizes the NO₂ 1-hour and annual metrics for the 2018-2020 reporting period. The figure shows NO₂ levels from three air quality monitoring stations in the Coastal Air Zone reported as 1-hour and annual metrics. It shows 1-hour metrics are around 25.4-25.5 ppb and annual metric ranges from 1.5 ppb to 3.8 ppb. All sites are well-below the 2020 CAAQS of 60 ppb for the 1-hour metric⁴, and 17 ppb for the annual metric⁵. There were no data adjustments for transboundary flow and exceptional events (TF/EE) as levels did not exceed the standard.

Figure 7 and Table 4 contains summary of NO₂ metrics, CAAQS achievement, and AQMS management levels. Reporting periods from 2012-2014 to 2018-2020 are all included to illustrate annual trends even though 2020 CAAQS for NO₂ are not implemented before the 2018-2020 reporting period. In the Coastal Air Zone, Prince Rupert and Terrace had been reporting “yellow” management levels throughout their available reporting periods. This means values remained below 31 ppb for the 1-hour metric and 7 ppb

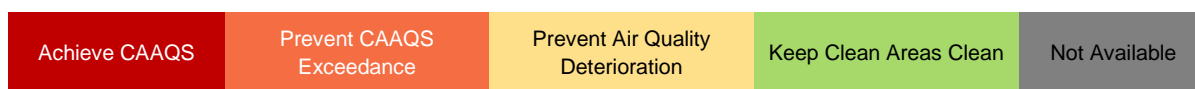
⁴ NO₂ 1-hour metrics are based on the 98th percentile of daily 1-hour maximum over three consecutive years (2018-2020).

⁵ NO₂ annual metrics are based on the average of 1-hour readings over a single calendar year (2020).

Table 4. Summary of NO₂ metrics (shown below are 1-hour/annual metrics) and air zone management levels for the Coastal Air Zone.

	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020
COASTAL (CAAQS)	2020 CAAQS for NO ₂ not applicable before 2018-2020 period. Data shown for illustration only.						YELLOW (2020)
Kitimat-Whitesail							-/1.5
Prince Rupert						-/4.8	25/3.8
Terrace			-/2.2	21/2.6	24/3	25/3	26/2.8

Management Goals for NO₂ based on the Air Quality Management System



Coastal Air Zone

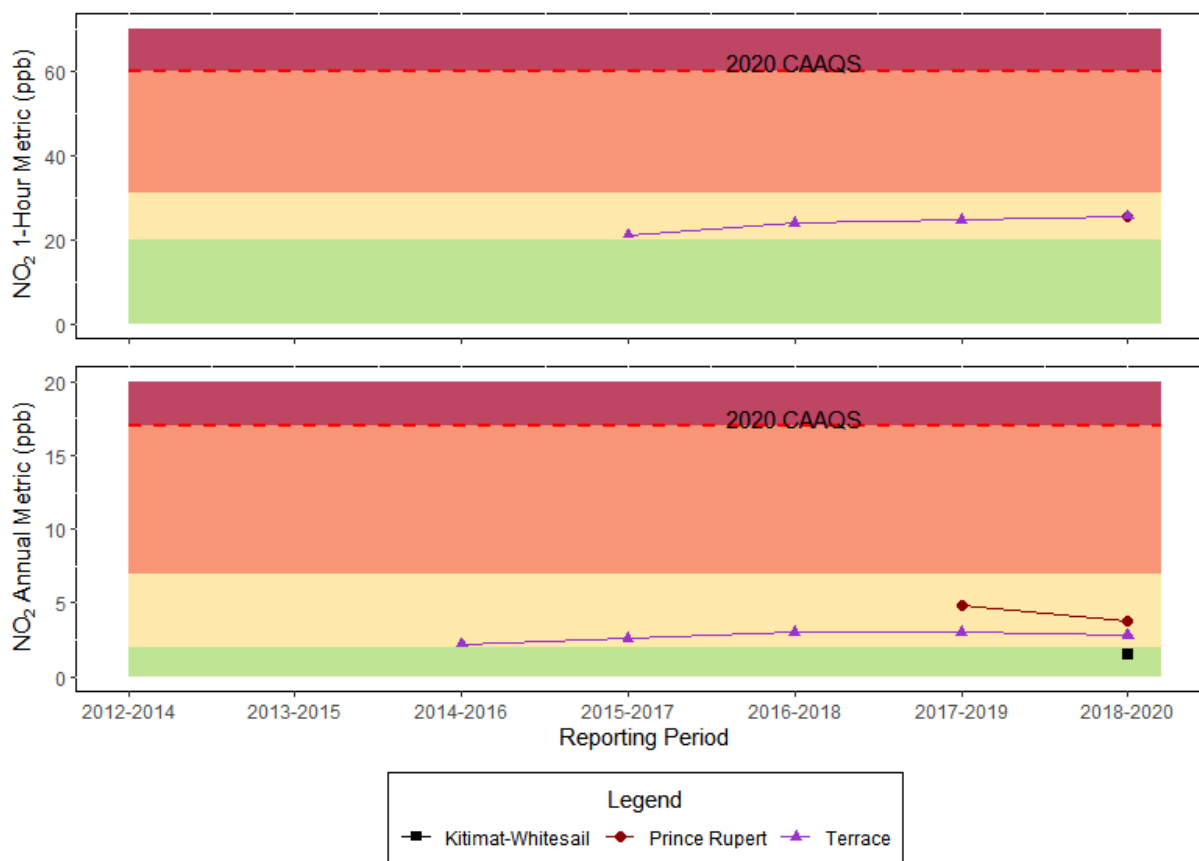


Figure 7. Trends in the 1-hour and annual metrics of NO₂ in the Coastal Air Zone. The 2020 CAAQS for NO₂ (red dashed lines) only applies during the 2018-2020 reporting period but presented throughout all reporting periods to visualize trends. The background colour shows the AQMS management levels.

for the annual metric. NO₂ monitoring was recently added at Kitimat and the site can only satisfy reporting requirements for the annual metrics.

Overall, the Coastal Air Zone is assigned a “yellow” management level for NO₂ based on readings at Prince Rupert and Terrace. This means actions are recommended to prevent the deterioration of air quality. In order to improve to the “green” management level, the 1-hour metric would need to drop below 20 ppb and the annual metric below 2 ppb. Only Terrace has adequate data to observe multi-year trends of both NO₂ metrics (Figure 7). It shows slightly increasing levels since the 2015-2017 reporting period.

Sulphur Dioxide Levels

Sulphur dioxide (SO₂) is a toxic gas produced from volcanic eruptions, use of sulphur-bearing fossil fuels, and industrial emissions. SO₂ emissions can form secondary fine particulate matter and acid rain.

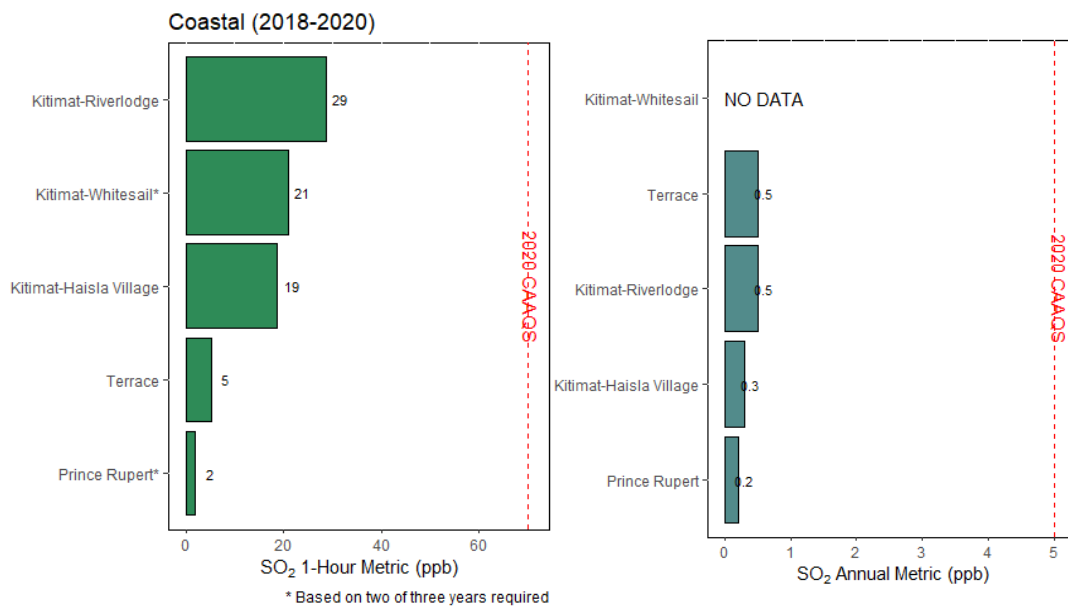


Figure 8. SO₂ concentrations in the Coastal Air Zone based on the 1-hour (left) and annual (right) metrics. The red dashed lines identify the 2020 CAAQS of 70 ppb for the 1-hour metric, and 5 ppb for the annual metric.

There are several stations in the Coastal Air Zone that are equipped to monitor SO₂. These stations are situated in urban areas and near emission sources in Kitimat, Prince Rupert, and Terrace. Some stations that do not represent community levels of SO₂ are excluded from CAAQS reporting. Figure 8 shows the levels of SO₂ based on the 1-hour and annual metrics. The figure shows values of the 1-hour metric⁶ vary widely from 1.9 ppb in Prince Rupert to 28.7 ppb in Kitimat, but the annual metrics⁷ are consistent

⁶ SO₂ 1-hour metrics are based on the 99th percentile of daily 1-hour maximum over three consecutive years (2018-2020).

⁷ SO₂ annual metrics are based on the average of 1-hour readings over a single calendar year (2020).

varying from 0.2 ppb in Prince Rupert to 0.5 ppb.in Terrace. The measurements are well below the 2020 CAAQS of 70 ppb defined for the 1-hour metric and 5 ppb defined for the annual metric.

Table 5. Summary of SO₂ metrics and air zone management levels for the Coastal Air Zone.

	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020
COASTAL (CAAQS)	2020 CAAQS for SO ₂ not applicable before 2018-2020 period. Data shown for illustration only.						GREEN (2020)
Kitimat-Riverlodge	-/0.3	16/0.4	18/0.5	21/0.4	26/0.5	32/0.5	29/0.5
Kitimat-Whitesail			-/0.5	18/0.4	19/0.3	21/0.4	21/-
Prince Rupert						-/0.3	2/0.2
Terrace		-/0.2	3/0.5	4/0.5	6/0.4	6/0.5	5/0.5

Management Goals for SO₂ based on the Air Quality Management System

Achieve CAAQS	Prevent CAAQS Exceedance	Prevent Air Quality Deterioration	Keep Clean Areas Clean	Not Available
---------------	--------------------------	-----------------------------------	------------------------	---------------

Trends of SO₂ in the Coastal Air Zone are illustrated in Figure 9. The figure shows SO₂ levels from 2012-2014 to the 2018-2020 period had been below the 2020 CAAQS and had been under “green” management level except in the 2017-2019 period at Kitimat-Riverlodge. There are upward trends observed in the 1-hour metrics at Kitimat-Riverlodge, and Kitimat-Haisla Village, but the annual metric has remained consistently below 1 ppb.

For the 2018-2020 reporting period, all CAAQS-reporting sites in the Coastal Air Zone are assigned “green” management level for SO₂. This means that all sites achieved CAAQS and are below 30 ppb on the 1-hour metric and 2 ppb on the annual metric. Overall, the Coastal Air Zone is assigned “green” management level for SO₂. Under this management level, preventative actions are recommended to “Keep Clean Areas Clean” by avoiding or minimising increases in SO₂ levels.

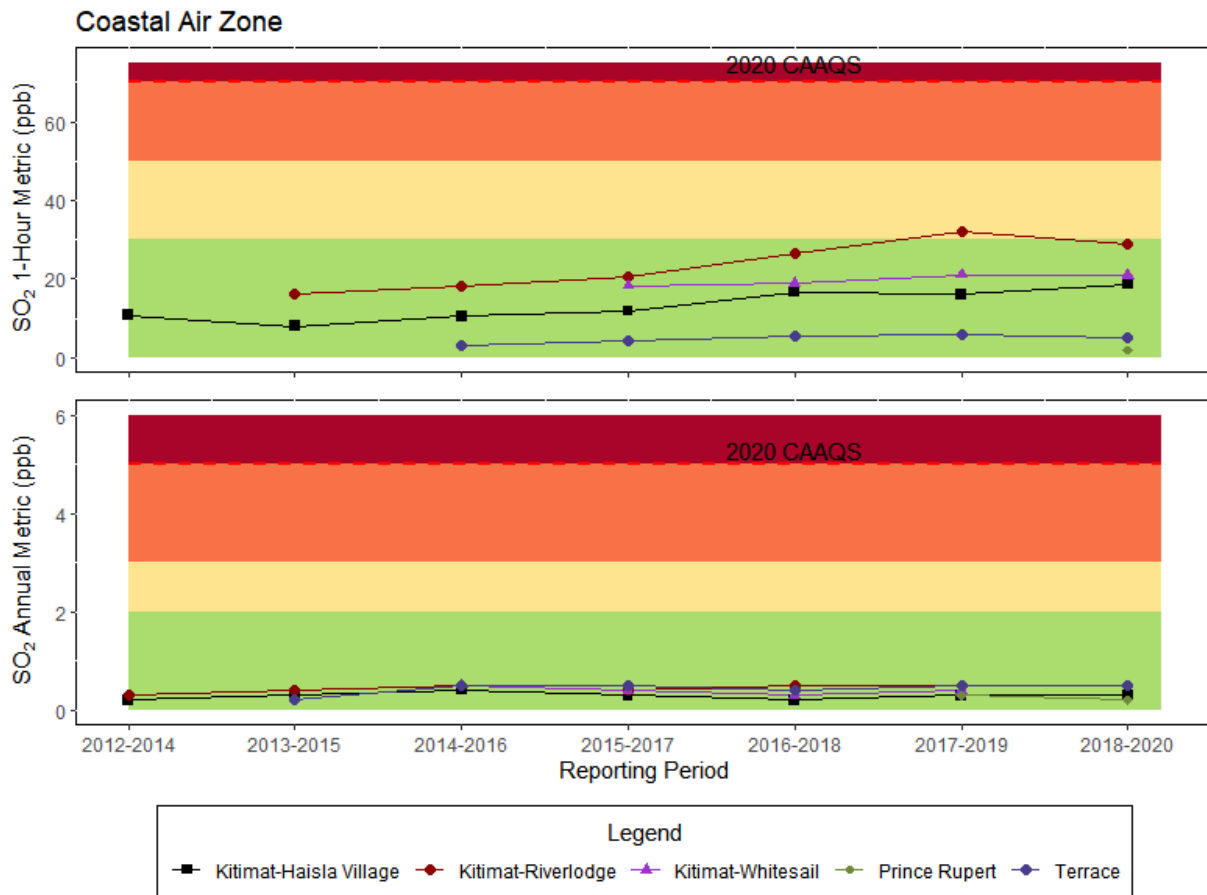


Figure 9. Trends in the 1-hour and annual metrics of SO₂ in the Coastal Air Zone. The 2020 CAAQS for SO₂ (red dashed lines) only apply during the 2018-2020 reporting period but are presented throughout all reporting periods to visualize trends. The background colour shows the AQMS management levels

Actions to Protect Air Quality

In 2016, the Province adopted a new Solid Fuel Burning Domestic Appliance Regulation. This piece of legislation requires nearly all wood burning appliances sold in B.C. to be certified to meet particulate emissions standards set by the US Environmental Protection Agency (EPA) in 2015, or equivalent standards set by the Canadian Standards Association (CSA) in 2010. The regulation also specifies the types of fuels that can be burnt and has provisions around the sale and installation of outdoor wood boilers. For more information on the regulation, see:

<https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-pollution/smoke-burning/regulations/solid-fuel-burning-domestic-appliance-regulation>.

In 2019 the Ministry updated the Open Burning Smoke Control Regulation (OBSCR) to reduce the smoke from open burning. The revised OBSCR has shorter burn periods to discourage smoldering piles. It also increases the required setbacks between open burning and neighbouring residences and businesses.

The OBSCR allows a Ministry director to prohibit open burning when there is a risk of pollution and also to vary requirements of the regulation when doing so is necessary to protect the environment or to meet the intent of the regulation.

The Provincial Wood Stove Exchange Program encourages residents to change out their older, smoky wood stoves for low-emission appliances including new CSA-/EPA-certified clean-burning wood stoves. A wood stove change-out program was supported in the Strathcona Regional District in 2017.⁸ Additional programs in the Alberni-Clayoquot Regional District have provided enhanced incentives to further encourage the transition away from wood stoves to natural gas or pellet stoves and electric heat pumps. Both Strathcona Regional District and Alberni-Clayoquot Regional District straddle the Coastal Air Zone boundaries.

In October 2020, representatives from the District of Kitimat, the Haisla Nation, Rio Tinto, LNG Canada, Kitimat Chamber of Commerce, Unifor2301, Northern Health, Kitimat Terrace Clean Air Coalition, community members, ENV, and surrounding First Nations held their first formal meeting as members of the Kitimat Airshed Group. The group aims to facilitate communications and collaboration on air quality between interested parties. The group recently published its official website:

<https://www.kitimatairshedgroup.com/air-quality/kitimat/>

⁸ For more information, see: <https://srd.ca/services/wood-stove-exchange-program/>

Appendix I – Approach to Identify Wildfire-influenced Data

Summertime air quality in British Columbia is periodically influenced by wildfire smoke – from local fires as well as long-range transport from outside of the province. The wildfire season in B.C. typically occurs between May and September, when warm and dry conditions prevail.

A myriad of different pollutants is emitted from wildfires. These include PM_{2.5} and gases such as nitrogen oxides and volatile organic compounds that can react in the atmosphere to form ground-level ozone and additional PM_{2.5}.

Given that smoke-affected areas may be extensive, and that smoke may linger for days before being fully dispersed from an airshed, the current analysis has focussed on those periods when wildfire smoke may have contributed to an exceedance of the CAAQS levels for ground-level ozone or PM_{2.5}. Criteria used to flag and evaluate wildfire-influenced data included the following:

- 24-hour PM_{2.5} concentrations in excess of the CAAQS level of 28 µg/m³ and/or 8-hour daily maximum ozone concentrations in excess of the CAAQS level of 63 ppb between May and September;
- Wildfires of interest identified based on data from the B.C. Wildfire Management Branch;
- Smoky Skies bulletins issued by the Ministry of Environment and Climate Change Strategy to notify the public of rapidly changing smoke conditions;
- NASA satellite images showing smoke impacts over the region; and
- Multiple monitoring sites in the area of concern showing elevated pollutant levels, suggesting a common regional source of air pollutants.

Wildfire-influenced data were excluded from the calculation of air zone management levels. Excluded data are as summarized in Appendix II.

Appendix II – Wildfire-influenced Data in the Coastal Air Zone (2018-2020)

Ozone and PM_{2.5} data from 2018-2020 for the Coastal Air Zone were evaluated based on the criteria set out in Appendix I for TF/EE influences. Various pieces of evidence were used to support identification of wildfire-influenced periods. These included the following:

- Wildfires of note – either due to size or proximity to populated areas – are tracked by the BC Wildfire Service (see: <https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary>).
 - The 2018 wildfire season was record-breaking in terms of the area of land burned. Approximately 1.35 million hectares were burned throughout B.C.
 - Monitoring sites in the Coastal Air Zone were particularly affected during the summer of 2018. While numerous fires contributed to the overall loading of B.C. valleys with smoke, examples of those fires particularly relevant to the Coastal Air Zone are listed in Table II-1.
- Days flagged as wildfire-influenced (Table II-2) coincided with Smoky Skies Bulletins issued by the Ministry. Elevated PM_{2.5} levels were observed across the Kitimat-Terrace airshed.
- Satellite images during this period (see Figure II-1) provide additional supporting information on both the number of wildfires and the spatial extent of wildfire smoke in and adjacent to the Coastal Air Zone.

Table II-1. Examples of notable wildfires in the central interior during 2018.⁹

Date Discovered	Size (ha)	Geographic Location	Description
2018-07-27	92,412	Fraser Complex - Shovel Lake	6.7 km northwest of Endako; caused by equipment use
2018-07-30	20,813	Fraser Complex - Chutanli Lake	11 km northeast of Tatelkuz Lake; caused by equipment use
2018-07-31	79,394	Tweedsmuir Complex – Ramsey Creek	Tweedsmuir Provincial Park; lightning-caused
2018-07-31	86,767	Babine Complex – Nadina Lake	40 km south of Burns Lake
2018-08-01	21,381	Fraser Complex - Island Lake	Adjacent to Island Lake; lightning-caused
2018-08-01	44,817	Tweedsmuir Complex - Dean River	Tweedsmuir Provincial Park; lightning-caused
2018-08-03	60,631	Tweedsmuir Complex – Pondosy Bay	Tweedsmuir Provincial Park; lightning-caused

⁹ <https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary>

Table II-2 – Wildfire-influenced PM_{2.5} data from 2018. No wildfire-influenced smoke events were identified in 2017 and 2019.

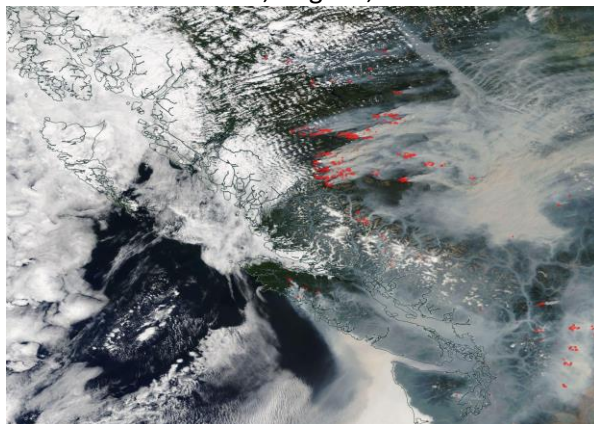
Location	Date	Daily Mean (µg/m ³)	Smoky Skies Bulletin?
Kitimat Whitesail	2018-08-20	28.3	Y
Kitimat-Riverlodge	2018-08-21	57.9	Y
Kitimat Whitesail	2018-08-21	61.0	Y
Kitimat Haisla Village	2018-08-21	67.1	Y
Terrace-Skeena	2018-08-21	43.5	Y



a. NASA Worldview, Aug. 20, 2018



b. NASA Worldview, Aug. 21, 2018



c. NASA Worldview, Aug. 22, 2018

Figure II-1. Satellite images covering Aug. 20-22, 2018, showing wildfire smoke (grey plumes) over the west coast of B.C., including the Coastal Air Zone. Red dots indicate fires and thermal anomalies. Large red circle in Figure II-1(a) identifies the approximate location of Kitimat on the map. Source of images: NASA Worldview Snapshots at: <https://worldview.earthdata.nasa.gov/>.