

Introduction

This is the fifth annual air quality report for the Central Interior Air Zone. Annual 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 ground-level ozone (O₃) and fine particulates (PM_{2.5}), the associated management levels and recent actions to improve air quality. A province-wide summary can be found at: <http://www.env.gov.bc.ca/soe/indicators/air/>.

Background

The AQMS is the national approach to managing air quality in Canada. Under the AQMS, the CAAQS are developed to drive action to protect human health and the environment. Air zones are areas that exhibit similar air quality characteristics, issues and trends, and that form the basis for monitoring, reporting and taking action on air quality. The Central Interior Air Zone (see Figure 1) is one of seven broad air zones across the province. 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 outlined in Table 1.

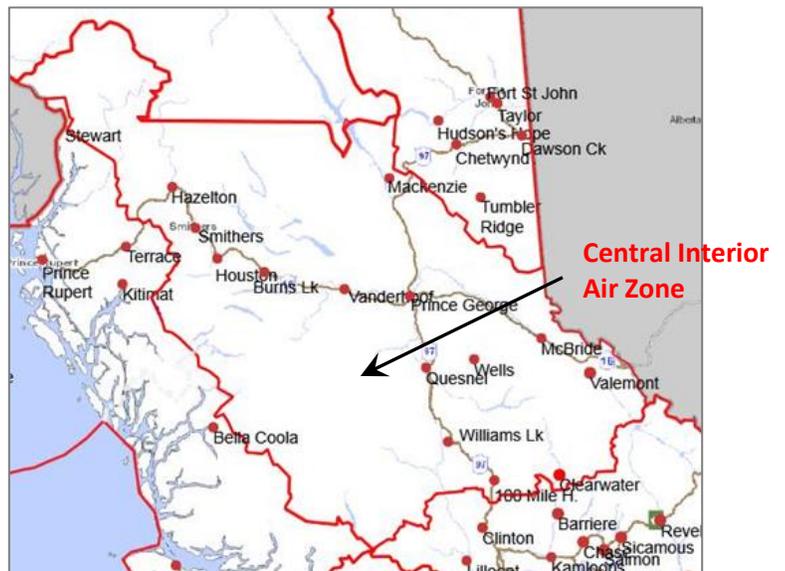


Figure 1. Central Interior Air Zone.

Table 1. Air zone management framework for ground-level ozone and PM_{2.5}. The CAAQS define the upper threshold, separating the “red” and “orange” management levels.

Management Level	O ₃ (ppb)		PM _{2.5} – Annual (µg/m ³)		PM _{2.5} - 24h (µg/m ³)	
	2015	2020	2015	2020	2015	2020
Red	Actions for Achieving Air Zone CAAQS					
Threshold (CAAQS)	63	62	10	8.8	28	27
Orange	Actions for Preventing CAAQS Exceedance					
Threshold	56		6.4		19	
Yellow	Actions for Preventing Air Quality Deterioration					
Threshold	50		4		10	
Green	Actions for Keeping Clean Areas Clean					

Ozone Levels

Ozone measurements in the Central Interior Air Zone are summarized in Figure 2. Concentrations ranged from 48-52 ppb.¹ All sites achieved the national standard of 63 ppb.

Trends in ozone levels are shown in Figure 3.² Ozone concentrations have remained below the level of the national standard throughout this period.

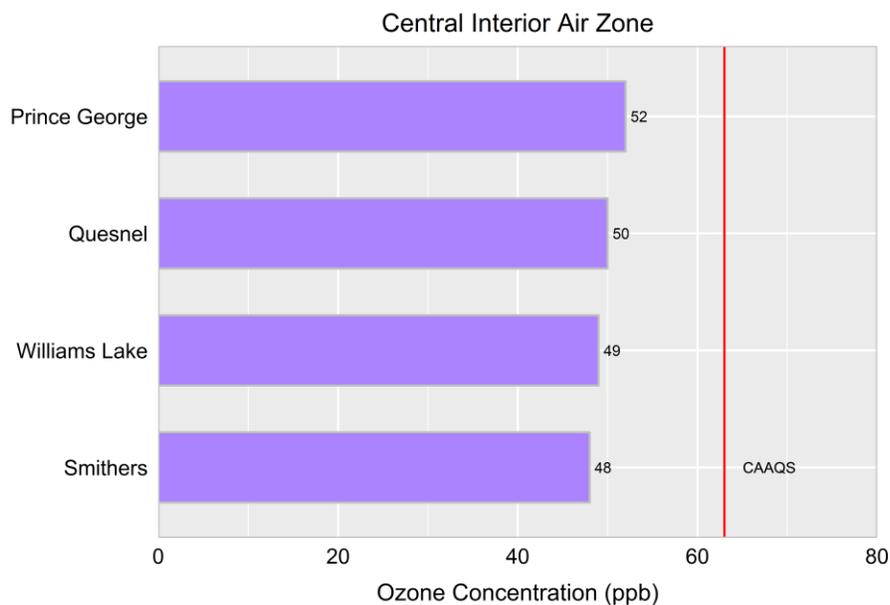


Figure 2. Ozone concentrations in the Central Interior Air Zone, based on annual 4th highest daily 8-hour maxima, averaged over 2015-2017. Red dashed line identifies the CAAQS of 63 ppb.

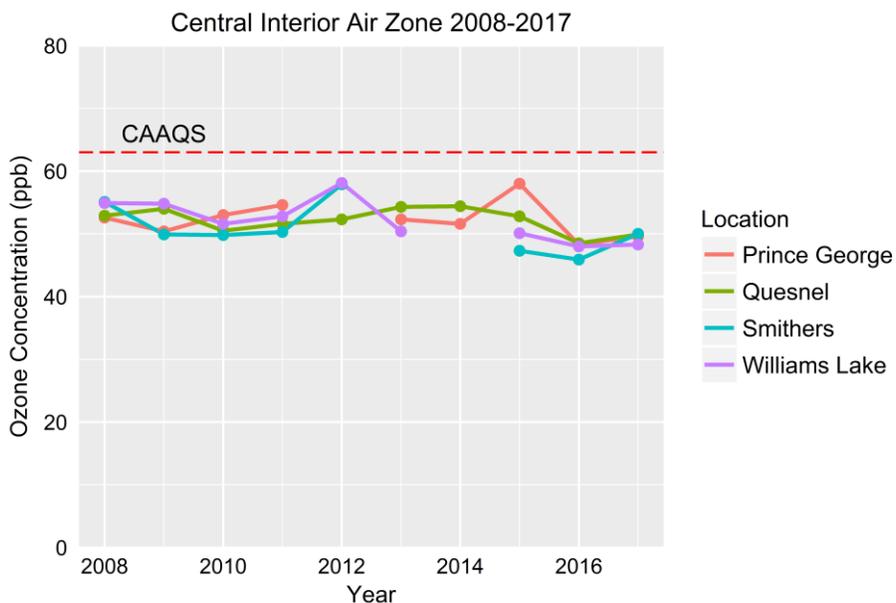


Figure 3. Trends in ozone concentrations (2008-2017), based on annual 4th highest daily 8-hour maxima over a single year. The red dashed line identifies the CAAQS level of 63 ppb.

¹ Concentrations based on 4th highest daily 8-hour maximum, averaged over three years (2015-2017).

² Concentrations based on 4th highest daily 8-hour maximum, over a single year.

PM_{2.5} Levels

PM_{2.5} refers to inhalable particles up to 2.5 micrometres in diameter. PM_{2.5} measurements are summarized in Figure 4. All measurements for this reporting period were based on the Federal Equivalent Method (FEM), which provides a more complete measure of PM_{2.5} than the older TEOM instruments.

Daily concentrations (upper plot) ranged from 21 to 96 µg/m³.³ Five of seven sites shown exceeded the national standard of 28 µg/m³: Valemount, Williams Lake, Quesnel, Vanderhoof and Houston. Annual concentrations (lower plot) ranged from 7.0 to 15.3 µg/m³. Three of seven sites exceeded the annual standard of 10 µg/m³: Valemount, Williams Lake and Quesnel.⁴ As described further in the Appendices, wildfire smoke had a major impact on air quality in the Central Interior Air Zone in 2017.

Trends in annual mean concentrations between 2008 and 2017 are shown for a subset of sites in Figure 5.⁵ A shift to higher

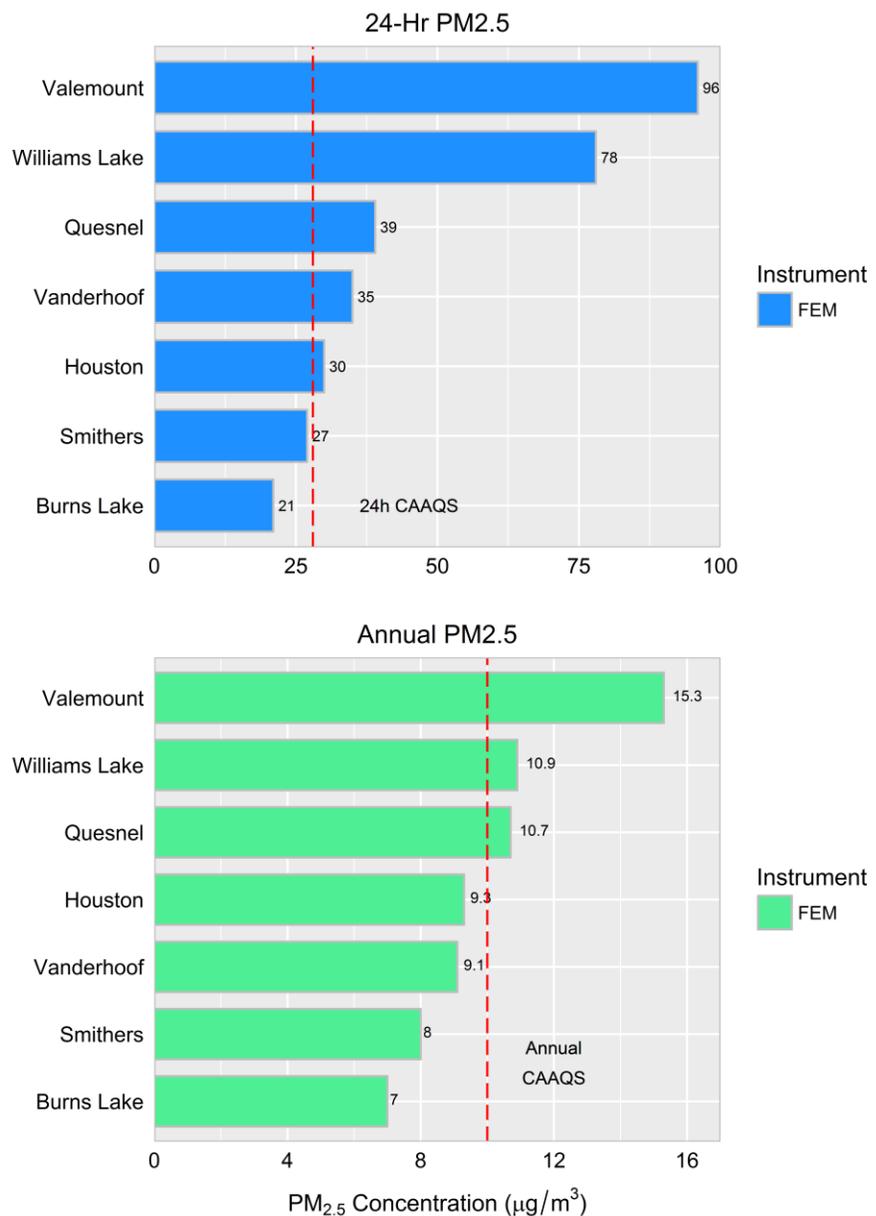


Figure 4. PM_{2.5} concentrations in Central Interior Air Zone. Upper plot based on 24-hour concentration (annual 98th percentile, averaged over 2015-2017). Lower plot based on annual mean concentration (averaged over 2015-2017). The red dashed lines identify CAAQS of 28 µg/m³ (upper plot) and 10 µg/m³ (lower plot). There was insufficient data to calculate CAAQS achievement for Prince George.

³ Concentrations based on the annual 98th percentile of the 24-hour value, averaged over three years (2015-2017).

⁴ Concentrations based on the annual average of 24-hour values, averaged over three years (2015-2017).

⁵ Concentrations based on the annual average of 24-hour values over single year.

reported concentrations is seen with the change from TEOM to FEM instruments from about 2010 onward.

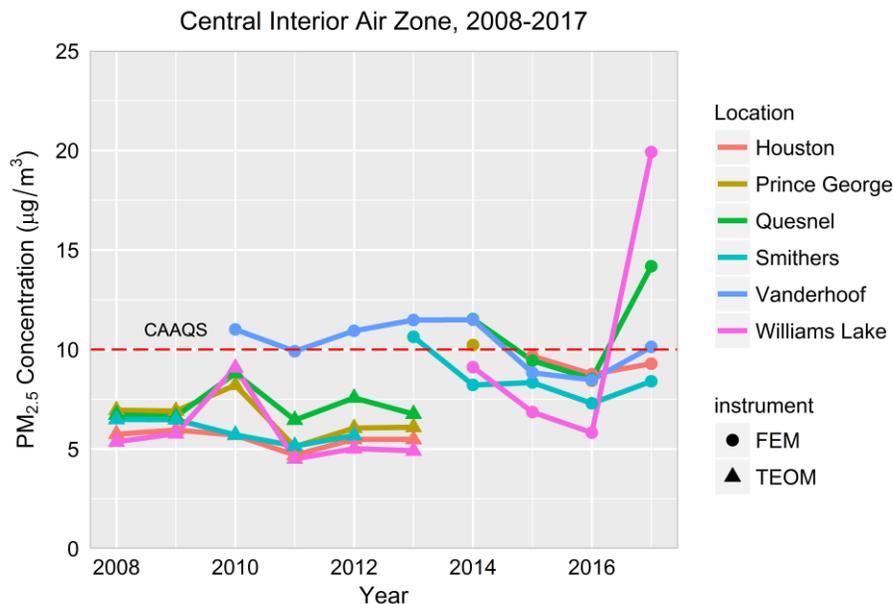


Figure 5. Trends in PM_{2.5} concentrations (2008-2017), based on annual mean concentrations from a single year. The CAAQS value of 10 µg/m³ is shown by the dashed line. PM_{2.5} measurements prior to 2011 are reported at 25°C and 1 atm. From 2011 onward, measurements are reported at local conditions.

Air Zone Management Levels

Air zone management levels are assigned on the basis of the highest concentrations within an air zone, excluding contributions from transboundary flows (TF) and exceptional events (EE) such as wildfires, and preferentially based on stations with three complete years of data. TF/EE influences are removed so that long-term management strategies are not developed on the basis of events that are beyond local or provincial control.

In the Central Interior Air Zone, wildfires are the primary contributor to TF/EE. The methodology for identifying wildfire-influenced data is provided in Appendix I and excluded data are summarized in Appendix II. The wildfire season of 2017 was one of the most severe on record, with over 1.2 million hectares of land burned and roughly 65,000 persons evacuated, including the City of Williams Lake.

Table 2 summarizes ozone concentrations as measured and after consideration of any TF/EE influences. No TF/EE influences were identified. Consequently, the Central Interior Air Zone is assigned a “yellow” management level based on concentrations in Prince George. This indicates that any ozone-related actions should focus on preventing further air quality deterioration.

Table 2. Summary of ozone concentrations as measured and air zone management levels for the Central Interior Air Zone (based on 2015-2017 data).

Location	No. Valid Years	4 th Highest Daily 8-hour Maxima (ppb)		Air Zone Management Level
		As Measured	TF/EE Influences Removed	
Prince George	3	52	52	Goal: Preventing Air Quality Deterioration
Quesnel	3	50	50	
Smithers	3	48	48	
Williams Lake	3	49	49	

Table 3 summarizes PM_{2.5} concentrations as measured and with TF/EE influences removed for each monitoring site. Overall, the Central Air Zone is assigned a “red” management level based on elevated PM_{2.5} levels in Vanderhoof and Houston.⁶ This indicates that PM_{2.5}-related actions should be an important priority in these communities, with activities focused on achieving the CAAQS. Although as-measured PM_{2.5} concentrations in Williams Lake and Quesnel also exceeded the CAAQS level, this was determined to be a result of wildfire influence. For more information on these analyses, see Appendix II.

Table 3. Summary of PM_{2.5} concentrations as measured and air zone management levels for the Central Interior Air Zone (based on 2015-2017 data).

Location	Monitor Type	No. Valid Years	Daily Mean (98 th Percentile, µg/m ³)		Annual Mean (µg/m ³)		Air Zone Management Level
			As Measured	TF/EE Removed	As Measured	TF/EE Removed	
Burns Lake	FEM	3	21	19	7.0	6.9	Goal: Achieving the CAAQS
Houston	FEM	3	30	29	9.3	9.1	
Prince George-Plaza 400	FEM	1	NA	NA	NA	NA	
Quesnel-Sr. Sec.	FEM	3	39	22	10.7	9.2	
Smithers	FEM	3	27	25	8.0	7.9	
Valemount	FEM	2	96	96	15.3	14.4	
Vanderhoof	FEM	3	35	32	9.1	8.9	
Williams Lake	FEM	3	78	20	10.9	7.0	

⁶ Valemount has only two years of data. This is sufficient to determine CAAQS achievement, but preference is given to those sites with three years of data (i.e. Vanderhoof and Houston) to assign air zone management levels.

Actions to Protect Air Quality

The reduction of PM_{2.5} emissions has been a top air quality priority across the Central Interior Air Zone over the past several years. Strategies and actions to reduce PM_{2.5} emissions have been documented in local airshed plans that have been developed and implemented for the Bulkley Valley-Lakes District,⁷ Prince George,⁸ Quesnel^{9,10} and Williams Lake¹¹.

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. Between 2015 and 2017, wood stove change-out programs were supported in the Bulkley Valley and Prince George. Additional funding support is being provided in 2017.

A description of other activities underway in B.C. air zones can be found in the “Air Zone Management Response for British Columbia” (see: www.gov.bc.ca/bcairquality).

⁷ <http://www.cleanairplan.ca/cleanairplan2012.pdf>

⁸ http://www.pgairquality.com/uploads/PGAIR_PhaseIII.pdf

⁹ http://www.quesnelairshed.org/wp-content/uploads/2012/09/airshed_management_plan2.pdf

¹⁰ http://www.env.gov.bc.ca/epd/bcairquality/reports/pdfs/airshed_review_2011.pdf

¹¹ https://breatheasywilliamslake.files.wordpress.com/2015/03/wlairshed_mgt_plan_final.pdf

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 are emitted from wildfires, including PM_{2.5} and gases that include nitrogen oxides and volatile organic compounds (VOCs) 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 PM_{2.5} levels. Criteria used to flag and evaluate wildfire-influenced data included the following:

- 24-hour PM_{2.5} concentrations exceeded the CAAQS level of 28 µg/m³ or 8-hour daily maximum ozone levels exceeded the CAAQS level of 63 ppb between May and September,
- Wildfires of interest were identified based on data from B.C. Wildfire Management Branch,
- Wildfire smoke advisories had been issued by the Ministry of Environment & Climate Change Strategy during the period of interest,
- NASA satellite images indicated smoke impacts over the region,
- Multiple monitoring sites in the area of concern exhibited similar air quality characteristics, suggesting a common source or contributing source, and
- Modelling studies identify enhanced pollutant concentrations due to wildfire smoke.

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 Central Interior Air Zone (2015-2017)

PM_{2.5} data from 2015-2017 for the Central Interior Air Zone were evaluated based on the criteria set out in Appendix I for TF/EE influences.¹² Supporting evidence included the following:

- A number of very large wildfires in central/northern B.C. that included the largest fire in B.C.’s recorded history, the 2017 Plateau Complex (see Table II-1);
- Elevated PM_{2.5} concentrations that coincided or overlapped with periods of active and nearby wildfires and/or wildfire smoke advisories issued by the Ministry of Environment & Climate Change Strategy, as identified in Tables II-2 and II-3;
- Coincidentally high PM_{2.5} concentrations at multiple sites across a broad area;
- NASA satellite images that showed smoke plumes over affected monitoring locations (see Figure II-1 and II-2).

Table II-1. Summary of notable wildfires in central/northern B.C. between 2015-2017.¹³

Date Discovered	Size (ha)	Geographic Location	Description
09 May 2015	25,569	Little Bobtail Lake	70 km southwest of Prince George and ~65 km southeast of Vanderhoof
08 Jul 2015	8,078	Puntzi Lake	~180 km west of Williams Lake
06 Jul 2017	5,700	Gustafsen fire	West of 100 Mile House
~07 Jul 2017	545,151	Plateau Complex	Complex of ~20 fires on the Chilcotin Plateau
~07 Jul 2017	241,160	Hanceville Complex	Fires around Hanceville, Riske Creek, Alexis Creek and surrounding areas
~07 Jul 2017	33,018	West Chilcotin Complex	Complex of fires that included the 7,368 ha Precipice fire 52 km east of Bella Coola
~07 Jul 2017	31,181	Central Cariboo Complex	Complex of fires around Williams Lake, Soda Creek and surrounding areas

¹² Wildfire influences on ozone concentrations were not assessed given that as-measured concentrations were well below the CAAQS.

¹³ <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 in 2015.

Location	Date	24-Hr PM _{2.5} (µg/m ³)	Wildfire Smoke-related Air Quality Advisory or nearby wildfire
Vanderhoof Courthouse	2015-05-13	28.6	No advisory; coincided with Little Bobtail Lake fire
Vanderhoof Courthouse	2015-05-15	31.7	
Quesnel Senior Secondary	2015-05-17	34	
Williams Lake Columneetza School	2015-07-11	39.9	No advisory; coincided with Puntzi Lake fire

Table II-3. Wildfire-influenced PM_{2.5} data in 2017.

Location	Date	24-Hr PM _{2.5} (µg/m ³)	Wildfire Smoke- related Air Quality Advisory
Williams Lake Columneetza School	2017-07-08	138.8	Y
Quesnel Senior Secondary	2017-07-09	49.9	Y
Williams Lake Columneetza School	2017-07-09	205.5	Y
Quesnel Senior Secondary	2017-07-10	31.4	Y
Valemount	2017-07-10	29.5	Y
Williams Lake Columneetza School	2017-07-10	73.1	Y
Prince George Plaza 400	2017-07-11	29.6	Y
Quesnel Senior Secondary	2017-07-11	64.3	Y
Valemount	2017-07-11	59.2	Y
Williams Lake Columneetza School	2017-07-11	273.4	Y
Quesnel Senior Secondary	2017-07-12	42.9	Y
Valemount	2017-07-12	41.5	Y
Williams Lake Columneetza School	2017-07-12	122.4	Y
Williams Lake Columneetza School	2017-07-13	62.8	Y
Williams Lake Columneetza School	2017-07-14	83	Y
Quesnel Senior Secondary	2017-07-15	62.9	Y
Williams Lake Columneetza School	2017-07-15	194.3	Y
Williams Lake Columneetza School	2017-07-16	293.8	Y
Williams Lake Columneetza School	2017-07-17	270.6	Y
Prince George Plaza 400	2017-07-18	70.6	Y
Quesnel Senior Secondary	2017-07-18	81.1	Y
Valemount	2017-07-18	50.9	Y
Vanderhoof Courthouse	2017-07-18	52.2	Y
Williams Lake Columneetza School	2017-07-18	260.3	Y

Table II-3 (continued)

Location	Date	24-Hr PM _{2.5} (µg/m ³)	Wildfire Smoke- related Air Quality Advisory
Prince George Plaza 400	2017-07-19	48.4	Y
Quesnel Senior Secondary	2017-07-19	67.5	Y
Valemount	2017-07-19	75.9	Y
Vanderhoof Courthouse	2017-07-19	33.9	Y
Williams Lake Columneetza School	2017-07-19	287.6	Y
Prince George Plaza 400	2017-07-20	28.7	Y
Quesnel Senior Secondary	2017-07-20	64.2	Y
Valemount	2017-07-20	32.3	Y
Williams Lake Columneetza School	2017-07-20	128.4	Y
Williams Lake Columneetza School	2017-07-25	31.8	Y
Quesnel Senior Secondary	2017-07-26	28.9	Y
Williams Lake Columneetza School	2017-07-26	50.4	Y
Williams Lake Columneetza School	2017-07-27	29	Y
Williams Lake Columneetza School	2017-07-28	37.1	Y
Prince George Plaza 400	2017-07-29	31.7	N/A
Quesnel Senior Secondary	2017-07-29	46.9	Y
Williams Lake Columneetza School	2017-07-29	57.9	Y
Quesnel Senior Secondary	2017-07-30	35	Y
Williams Lake Columneetza School	2017-07-30	59.7	Y
Williams Lake Columneetza School	2017-08-02	43.2	Y
Quesnel Senior Secondary	2017-08-03	34.6	Y
Williams Lake Columneetza School	2017-08-03	124.5	Y
Williams Lake Columneetza School	2017-08-06	95	Y
Williams Lake Columneetza School	2017-08-07	38.2	Y
Burns Lake Fire Centre	2017-08-08	28.9	Y
Houston Firehall	2017-08-08	34.7	Y
Burns Lake Fire Centre	2017-08-09	35.2	Y
Houston Firehall	2017-08-09	59	Y
Smithers St Josephs	2017-08-09	42.2	Y
Williams Lake Columneetza School	2017-08-09	74.9	Y
Burns Lake Fire Centre	2017-08-10	31.5	Y
Houston Firehall	2017-08-10	63.3	Y
Smithers St Josephs	2017-08-10	62.6	Y
Williams Lake Columneetza School	2017-08-10	72.5	Y

Table II-3 (continued)

Location	Date	24-Hr PM _{2.5} (µg/m ³)	Wildfire Smoke- related Air Quality Advisory
Burns Lake Fire Centre	2017-08-11	34.3	Y
Houston Firehall	2017-08-11	48.9	Y
Prince George Plaza 400	2017-08-11	53.8	Y
Quesnel Senior Secondary	2017-08-11	99.9	Y
Smithers St Josephs	2017-08-11	37.1	Y
Vanderhoof Courthouse	2017-08-11	68.4	Y
Williams Lake Columneetza School	2017-08-11	104.3	Y
Prince George Plaza 400	2017-08-12	282.5	Y
Quesnel Senior Secondary	2017-08-12	173.4	Y
Valemount	2017-08-12	36.6	Y
Vanderhoof Courthouse	2017-08-12	91.9	Y
Williams Lake Columneetza School	2017-08-12	92.5	Y
Prince George Plaza 400	2017-08-13	135.9	Y
Quesnel Senior Secondary	2017-08-13	115.3	Y
Valemount	2017-08-13	75.9	Y
Williams Lake Columneetza School	2017-08-13	77.4	Y
Quesnel Senior Secondary	2017-08-14	127.1	Y
Valemount	2017-08-14	42.3	Y
Williams Lake Columneetza School	2017-08-14	200.1	Y
Prince George Plaza 400	2017-08-15	34.5	Y
Quesnel Senior Secondary	2017-08-15	66.5	Y
Valemount	2017-08-15	45.9	Y
Williams Lake Columneetza School	2017-08-15	93.4	Y
Prince George Plaza 400	2017-08-16	48.2	Y
Quesnel Senior Secondary	2017-08-16	73.9	Y
Valemount	2017-08-16	52.4	Y
Williams Lake Columneetza School	2017-08-16	96.1	Y
Prince George Plaza 400	2017-08-17	68	Y
Quesnel Senior Secondary	2017-08-17	129.1	Y
Valemount	2017-08-17	65.7	Y
Williams Lake Columneetza School	2017-08-17	87.4	Y
Quesnel Senior Secondary	2017-08-18	48.2	Y
Valemount	2017-08-18	35.1	Y
Williams Lake Columneetza School	2017-08-18	31.5	Y
Quesnel Senior Secondary	2017-08-19	33.7	Y
Williams Lake Columneetza School	2017-08-19	34.7	Y

Table II-3 (continued)

Location	Date	24-Hr PM _{2.5} (µg/m ³)	Wildfire Smoke- related Air Quality Advisory
Quesnel Senior Secondary	2017-08-20	53.5	Y
Williams Lake Columneetza School	2017-08-20	43.7	Y
Prince George Plaza 400	2017-08-21	41.6	Y
Quesnel Senior Secondary	2017-08-21	42.4	Y
Quesnel Senior Secondary	2017-08-30	63	Y
Quesnel Senior Secondary	2017-08-31	53.8	Y
Williams Lake Columneetza School	2017-08-31	64.8	Y
Quesnel Senior Secondary	2017-09-01	80.9	Y
Williams Lake Columneetza School	2017-09-01	80.7	Y
Quesnel Senior Secondary	2017-09-02	38.4	Y
Williams Lake Columneetza School	2017-09-02	30.3	Y
Williams Lake Columneetza School	2017-09-05	36.8	Y
Quesnel Senior Secondary	2017-09-06	40.8	Y
Valemount	2017-09-06	34.6	Y
Williams Lake Columneetza School	2017-09-06	88	Y
Quesnel Senior Secondary	2017-09-07	70	Y
Valemount	2017-09-07	75.8	Y
Vanderhoof Courthouse	2017-09-07	43.6	Y
Williams Lake Columneetza School	2017-09-07	119.4	Y
Valemount	2017-09-08	47.7	Y

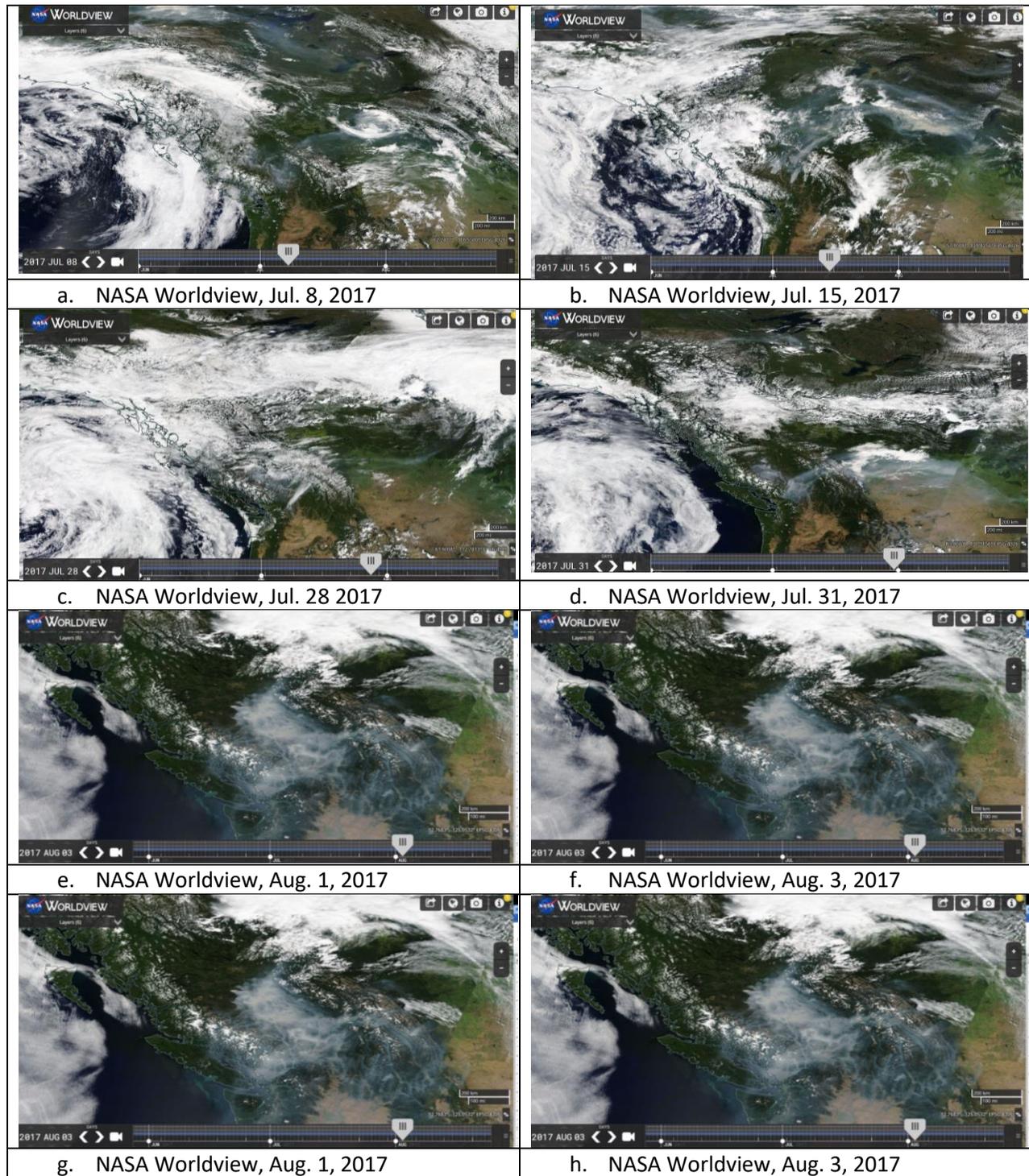


Figure II-1. Satellite images between Jul. 8 – Aug. 3, 2017, showing wildfire smoke (grey plumes) over the B.C., including the Central Interior Air Zone. Source of images: NASA Worldview at: <https://worldview.earthdata.nasa.gov/>.

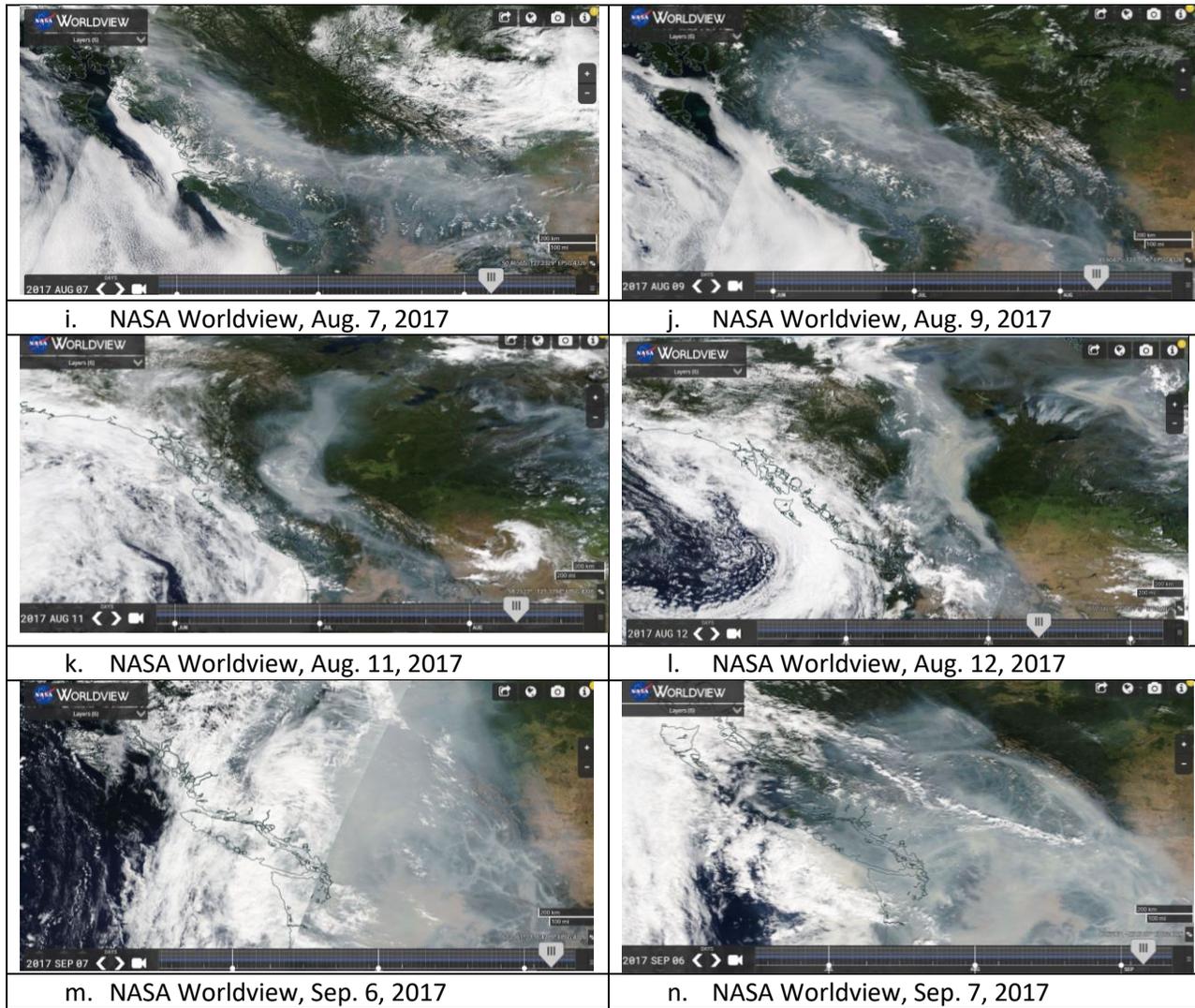


Figure II-2. Satellite images between Aug. 7 – Sep. 7, 2017, showing wildfire smoke (grey plumes) over the B.C., including the Central Interior Air Zone. Source of images: NASA Worldview at: <https://worldview.earthdata.nasa.gov/>.