Ministry of Environment and Climate Change Strategy

LOWER FRASER VALLEY AIR ZONE REPORT (2012-2014)

Introduction

This is the second annual quality report for the Lower Fraser Valley (LFV) 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 (O_3) 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 Lower Fraser Valley (LFV) 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. Lower Fraser Valley 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 ($\mu g/m^3$)		$PM_{2.5}$ - 24h ($\mu g/m^3$)	
	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 LFV Air Zone are summarized in Figure 2. Concentrations ranged from 37 ppb in downtown Vancouver to 58 ppb in Hope.[1] All sites achieved the national standard of 63 ppb.

Trends in ozone concentrations are shown in Figure 3.[2] Ozone concentrations have remained below the CAAQS level since 2009, although Hope approached this level in 2014.

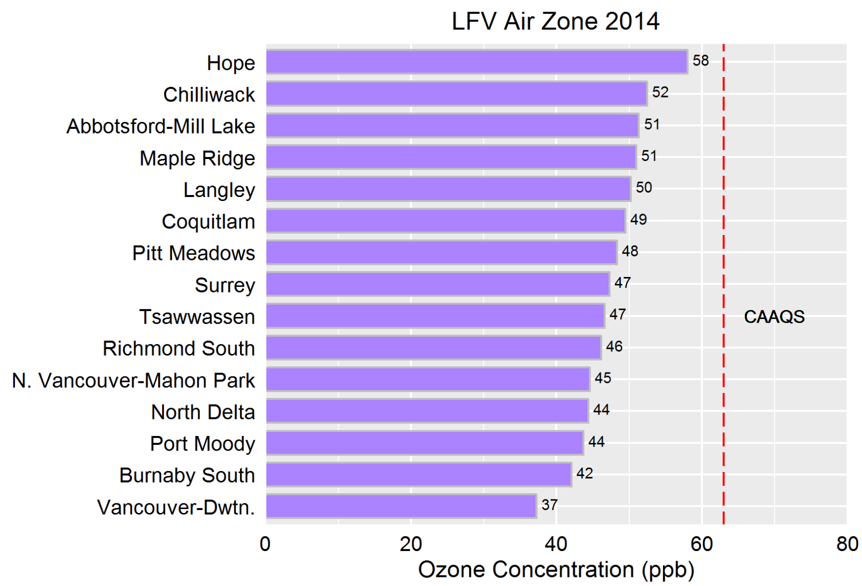

Figure 2. Ozone concentrations in the LFV Air Zone, based on annual 4th highest daily 8-hour maxima, averaged over 2012-2014. Red dashed line identifies the CAAQS of 63 ppb.

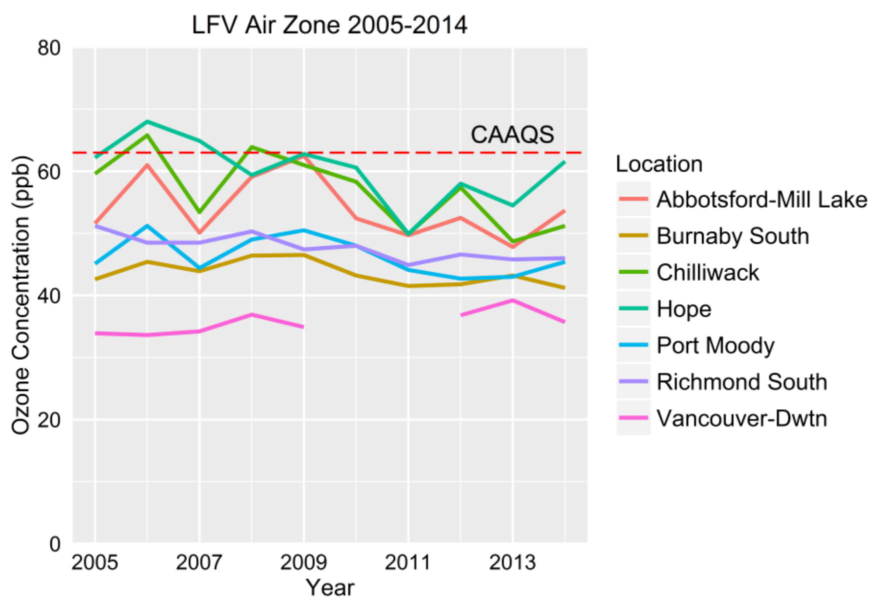

Figure 3. Trends in ozone concentrations (2005-2014), based on annual 4th highest daily 8-hour maxima for a single year. Red dashed line identifies CAAQS of 63 ppb.

[1] Concentrations based on 4th highest daily 8-hour maximum, averaged over three years (2012-2014).
[2] Concentrations based on 4th highest daily 8-hour maximum, averaged 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. A distinction is made between data collected using the new Federal Equivalent Method (FEM) technology and the older TEOM instruments that were used prior to 2013 in the LFV. The FEMs are the preferred monitor type as they provide a more complete measure of $PM_{2.5}$ than the older TEOM instruments.

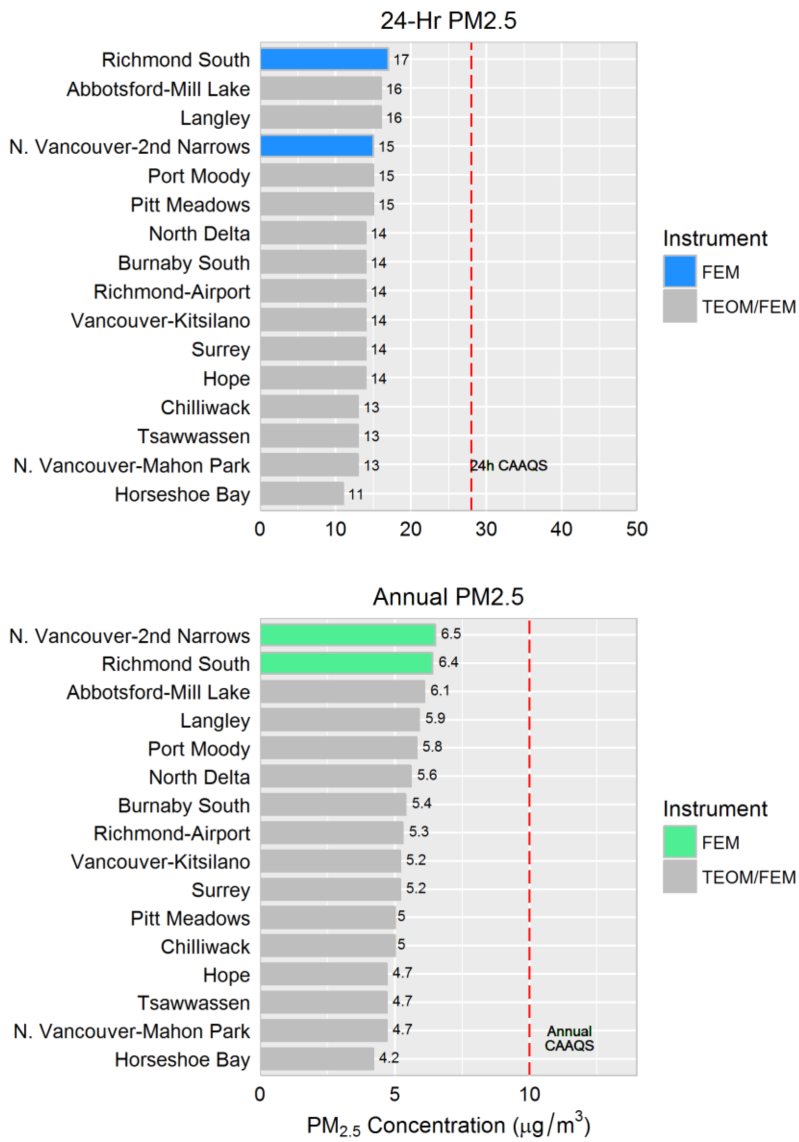

Figure 4. $PM_{2.5}$ concentrations in the LFV Air Zone. Upper plot based on 24-hour concentration (annual 98th percentile, averaged over 2012-2014). Lower plot based on annual mean concentration (averaged over 2012-2014). The red dashed lines identify CAAQS of 28 µg/m³ (upper plot) and 10 µg/m³ (lower plot).

Daily concentrations (upper plot) ranged from 11 to 17 µg/m³.[3] All sites achieved the national standard of 28 µg/m³. Annual concentrations (lower plot) ranged from 4.2 to 6.5 µg/m³.[4] All monitoring sites achieved the national standard of 10 µg/m³.

Trends in annual mean concentrations between 2005 and 2014 are shown in Figure 5 for a subset of these sites.[5] A shift to higher reported concentrations is seen with the change from TEOM to FEM instruments from 2013 onward but concentrations have remained below the CAAQS level.

[3] Concentrations based on the annual 98th percentile of 24-hour values, averaged over three years (2012-2014).
[4] Concentrations based on the annual average of 24-hour values, averaged over three years (2012-2014).
[5] Concentrations based on the annual average of 24-hour values over single year.

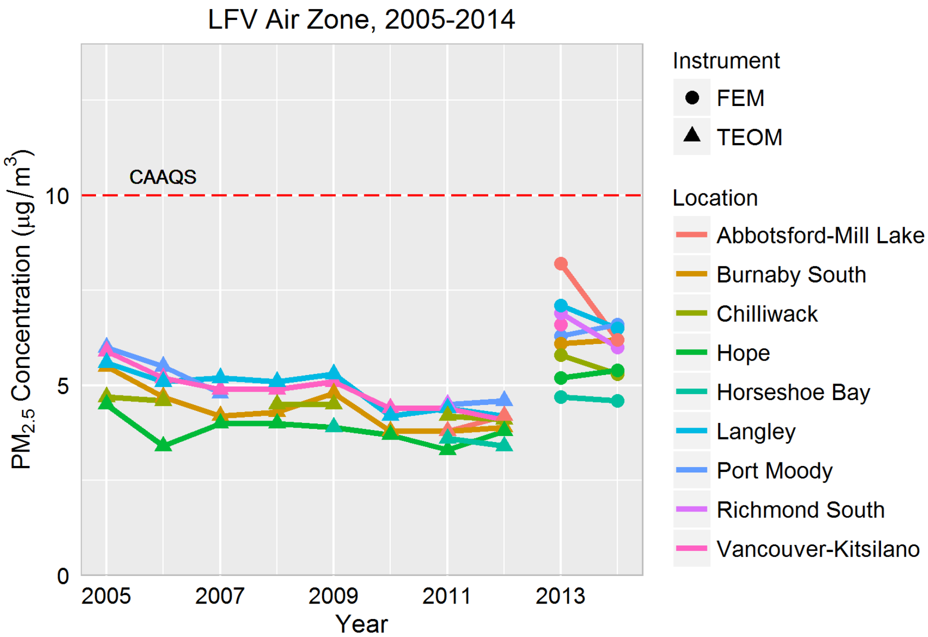

Figure 5. Trends in $PM_{2.5}$ concentrations (2005-2014), based on annual mean concentrations from a single year. The CAAQS value of 10 µg/m^3 is shown by the dashed line. $PM_{2.5}$ measurements prior to 2011 are reported at 25°C and 1 atm. From 2011 onward, measurements are reported at local conditions.

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. This is done so that long-term management strategies are not developed on the basis of events that are beyond local or provincial control.

Across B.C., wildfires are the primary contributor to TF/EE. The methodology for identifying wildfire-influenced data is provided in Appendix I.

Table 2 summarizes ozone concentrations as measured and after TF/EE influences have been considered. While studies have estimated that Siberian wildfire smoke led to an enhancement of ozone concentrations in the LFV, this did not result in an exceedance of the CAAQS level. As a result, this data was not excluded for this analysis.[6] Overall, the LFV Air Zone is assigned an "orange" management level based on ozone concentrations in Hope. This suggests that ozone-related actions should focus on preventing CAAQS exceedances, particularly in the eastern LFV, including Hope.

[6] 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.

Table 2. Summary of ozone concentrations as measured and air zone management levels for the LFV Air Zone (based on 2012-2014 data).

Location	No. Valid Years	4th Highest Daily 8-hour Maxima		Air Zone Management Level
		As Measured	TF/EE Influences Removed	
Abbotsford-Airport	2	50	50	**Goal: Preventing CAAQS Exceedance**
Abbotsford-Mill Lake	3	51	51	
Burnaby Mtn	3	52	52	
Burnaby South	3	42	42	
Burnaby-Kensington	3	43	43	
Chilliwack	3	52	52	
Coquitlam	3	49	49	
Hope	3	58	58	
Langley	3	50	50	
Maple Ridge	3	51	51	
N. Vancouver-2nd Narrows	3	40	40	
N. Vancouver-Mahon Park	3	45	45	
North Delta	3	44	44	
Pitt Meadows	3	48	48	
Port Moody	3	44	44	
Richmond South	3	46	46	
Richmond-Airport	3	44	44	
Surrey	3	47	47	
Tsawwassen	3	47	47	
Vancouver-Dwtn	3	37	37	
Vancouver-Kitsilano	2	46	46	

Table 3 summarizes $PM_{2.5}$ concentrations as measured and with TF/EE influences removed for each monitoring site. As air zone management levels are preferentially based on three complete years of data, the LFV Air Zone is assigned a “yellow” management level based on $PM_{2.5}$ concentrations at several sites in the region (as opposed to North Vancouver-2nd Narrows, which had only two complete years of data).

Table 3. Summary of $PM_{2.5}$ concentrations as measured and air zone management levels for the LFV Air Zone (based on 2012-2014 data).

Location	Monitor Type	No. Valid Years	Daily Mean (98th Percentile)		Annual Mean		Air Zone Management Level
			As Measured	TF/EE Removed	As Measured	TF/EE Removed	
Abbotsford-Airport	TEOM/FEM	2	16	16	6.2	6.2	Goal: Preventing Further Deterioration
Abbotsford-Mill Lake	TEOM/FEM	3	16	16	6.1	6.1	
Burnaby South	TEOM/FEM	3	14	14	5.4	5.4	
Chilliwack	TEOM/FEM	3	13	13	5	5	
Hope	TEOM/FEM	3	14	14	4.7	4.7	
Horseshoe Bay	TEOM/FEM	3	11	11	4.2	4.2	
Langley	TEOM/FEM	3	16	16	5.9	5.9	
N. Vancouver-2nd Narrows	FEM	2	15	15	6.5	6.5	
N. Vancouver-Mahon Park	TEOM/FEM	3	13	13	4.7	4.7	
North Delta	TEOM/FEM	3	14	14	5.6	5.6	
Pitt Meadows	TEOM/FEM	2	15	15	5	5	
Port Moody	TEOM/FEM	3	15	15	5.8	5.8	
Richmond South	FEM	2	17	17	6.4	6.4	
Richmond-Airport	TEOM/FEM	2	14	14	5.3	5.3	
Surrey	TEOM/FEM	3	14	14	5.2	5.2	
Tsawwassen	TEOM/FEM	3	13	13	4.7	4.7	

Actions to Protect Air Quality

Through delegated authority under the *Environmental Management Act*, Metro Vancouver has responsibility for managing air emissions within its boundaries.

Metro Vancouver developed an Integrated Air Quality Management and Greenhouse Gas Management Plan in 2011.[7] This plan contains 12 strategies, 81 actions and 10 performance measures. It seeks to reduce levels of $PM_{2.5}$, ground-level ozone, and other priority pollutants to protect human health and the environment, improve visual air quality and minimize contributions to climate change. The first progress report on plan implementation was released in 2014.[8] More information on air quality-related activities in Metro Vancouver can be found at: http://www.metrovancouver.org/services/air-quality/Pages/default.aspx.

[7] http://www.metrovancouver.org/services/air-quality/AirQualityPublications/IntegratedAirQualityGreenhouseGasManagementPlan-October2011.pdf
[8] http://www.metrovancouver.org/services/air-quality/AirQualityPublications/2014IAQGGMPProgressReport.pdf

The Fraser Valley Regional District is in the process of updating its Air Quality Management Plan that was first developed in 1998.[9] This plan highlights several air quality issues, including ground-level ozone and $PM_{2.5}$.

Regional air quality agencies including Metro Vancouver and the Fraser Valley Regional District developed a Regional Ground-Level Ozone Strategy in 2014.[10] This strategy identifies goals and strategic policy direction for the LFV. The strategy is currently in the implementation phase.

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).

[9] http://www.fvrd.ca/assets/Services/Documents/FVRD%20AQManagementPlan.pdf
[10] http://www.metrovancouver.org/services/air-quality/AirQualityPublications/RGLOS2014.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. These include $PM_{2.5}$ and gases such as nitrogen oxides and volatile organic compounds (VOCs) that can react in the atmosphere to form ground-level ozone and additional $PM_{2.5}$.

Various supporting evidence can be used to draw linkages between wildfire events and elevated $PM_{2.5}$ levels. However, photochemical dispersion modelling is typically used to identify the degree to which wildfire plumes enhance ozone levels. Such modelling was not available for the current analysis.

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 $PM_{2.5}$ 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 $\mu g/m^3$ or 8-hour daily maximum ozone concentrations 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-related advisories had been issued by Metro Vancouver during the period of interest,
- MODIS 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.

Based upon the above criteria, no ozone or $PM_{2.5}$ data were excluded from the determination of air zone management levels.