BRITISH COLUMBIA | Ministry of Environment

LOWER FRASER VALLEY AIR ZONE REPORT

(2011-2013)

OVERVIEW

This is the first air quality report for the Lower Fraser Valley Air Zone, which covers Metro Vancouver and the Fraser Valley Regional District. Air zone reports are a commitment under the national Air Quality Management System (AQMS) to annually report on the achievement of the Canadian Ambient Air Quality Standards (CAAQS) for ground-level ozone and fine particulates ($PM_{2.5}$).

For the current reporting period of 2011 to 2013, ozone concentrations ranged from 38-54 ppb, and were below the CAAQS of 63 ppb. $PM_{2.5}$ concentrations ranged from 9-14 $\mu g/m^3$ (24-hour) and 3.8-5.6 $\mu g/m^3$ (annual), and were below the respective CAAQS of 28 and 10 $\mu g/m^3$.

The Air Zone Management Framework defines colour-coded management levels associated with air quality. On this basis, the Lower Fraser Valley Air Zone has been assigned a management level of "yellow" for both ozone and $PM_{2.5}$, indicating that actions should focus on preventing further deterioration of air quality levels.

1. Introduction

Fine particulates ($PM_{2.5}$) and ground-level ozone are two of the most important outdoor air pollutants from a public health perspective. Both pollutants are key components of urban smog and associated with short-term and long-term impacts on human health and the environment.

In 2012, the Canadian Council of Ministers of the Environment committed to implementing a new comprehensive air management system designed to better protect human health and the environment.[1] The Air Quality Management System (AQMS) is comprised of the following key elements:

- Canadian Ambient Air Quality Standards (CAAQS) for $PM_{2.5}$ and ozone, to drive air quality improvements,
- Base-Level Industrial Emission Requirements (BLIERS) for major industries to set a consistent level of good performance across Canada,
- Air zone management that supports actions to improve air quality and keep clean areas clean,
- Enhanced coordination where air pollution crosses jurisdictional borders, and
- Increased collaboration on actions to reduce transportation emissions

Under AQMS, air zones are the basis for monitoring, reporting and taking action on air quality. Air zones are areas that exhibit similar air quality characteristics, issues and trends. Individual provinces and territories are responsible for delineating and managing their air zones based on local conditions. The level of response is expected to be proportional to the level of air quality degradation. As outlined in the *Air Zone Management Framework* (see Table 1), air quality is assigned to one of four colour-coded management levels (i.e. red, orange, yellow and green), with recommended actions associated with each level.

Table 1. Air Zone Management Framework

Management Level	Ozone Daily max 8h (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					

[1] For more information on AQMS, see: http://www.ccme.ca/en/resources/air/aqms.html.

Under the AQMS, provinces and territories are expected to report on CAAQS achievement. This includes the assignment of a colour-coded management level to each air zone, based on the highest concentrations within the air zone, and a summary of actions being taken to protect local air quality.

Figure 1. B.C. air zones under AQMS.

As part of the province's commitments under AQMS, B.C. has been divided into seven broad air zones as shown in Figure 1. This document represents the first annual report for the Lower Fraser Valley Air Zone. The summarized data are also provided in a map-driven web-based format via Environmental Reporting BC at: http://www.env.gov.bc.ca/soe/indicators/air.

2. Lower Fraser Valley Air Zone

The Lower Fraser Valley (LFV) Air Zone consists of two regional districts as shown in Figure 2: Metro Vancouver (Greater Vancouver Regional District) and the Fraser Valley Regional District (FVRD). It is a densely populated region of approximately 2.74 million inhabitants[2], and is expected to grow by almost one million residents over the next thirty years. Major population centres in the western part of the air zone are located in Vancouver and Surrey, and in the eastern part in Abbotsford and Chilliwack.

Across the LFV, mobile and non-road sources are significant contributors to total emissions.[3] There is more industrial activity in the western part of the LFV, such as around Port Metro Vancouver, and more agricultural activity in the eastern part. Air quality issues in the LFV are international in scope, as geographically, it also includes Whatcom County in the United States. Whatcom County has both an appreciable amount of agricultural activity as well as industrial activity (e.g. refineries), which can impact air quality in the Canadian portion of the LFV.[4]

[2] http://www.bcstats.gov.bc.ca/StatisticsBySubject/Demography/PopulationEstimates.aspx
[3] Metro Vancouver (2013) *2010 Lower Fraser Valley Air Emissions Inventory and Forecast and Backcast. Final Report and Summarized Results.* http://www.metrovancouver.org/services/air-quality/emissions-monitoring/emissions/emission-inventories/Pages/default.aspx
[4] Environment Canada and U.S. Environmental Protection Agency (2014) *The Georgia Basin-Puget Sound Airshed Characterization Report, 2014*. http://ec.gc.ca/Publications/default.asp?lang=En&xml=A9CF39C3-5E85-4EDF-BBC0-EBA062D8138B

Figure 2. Lower Fraser Valley Air Zone

At times, air quality in the LFV is influenced by exceptional events and transboundary influences. For example, in 2012, the LFV experienced degraded air quality due to long-range transport of Siberian wildfire smoke.[5] Wildfires in the B.C. interior or elsewhere in North America can also increase concentrations of fine particulate matter in the LFV.

3. Ozone Levels

Ozone measurements are reported for 20 sites in Figure 3. All monitoring sites were below the national standard of 63 ppb. Ozone levels ranged from 38-54 ppb, with the highest concentrations observed in Hope (54 ppb) and Chilliwack (52 ppb).

> Ozone is a secondary pollutant formed from reactions involving nitrogen oxides (NOx) and volatile organic compounds (VOCs) in the presence of sunlight.

Ten-year trends in annual ozone levels are shown in Figure 4. The highest concentrations in the eastern LFV (e.g. Hope, Chilliwack) have declined over the past decade in response to reductions in emissions of smog-forming pollutants like NOx and VOCs. In contrast, ozone levels in downtown Vancouver in 2013 were the highest since 2004. This may be a result of several factors, including reduced emissions of NOx, which can have a scavenging effect on ozone in densely populated areas with higher traffic emissions, and/or increasing hemispheric background concentrations.

[5] Cottle P., Strawbridge K. and I. McKendry (2014) Long-range transport of Siberian wildfire smoke to British Columbia: Lidar observations and air quality impacts. *Atmos. Environ*. 90, pp. 71-77.

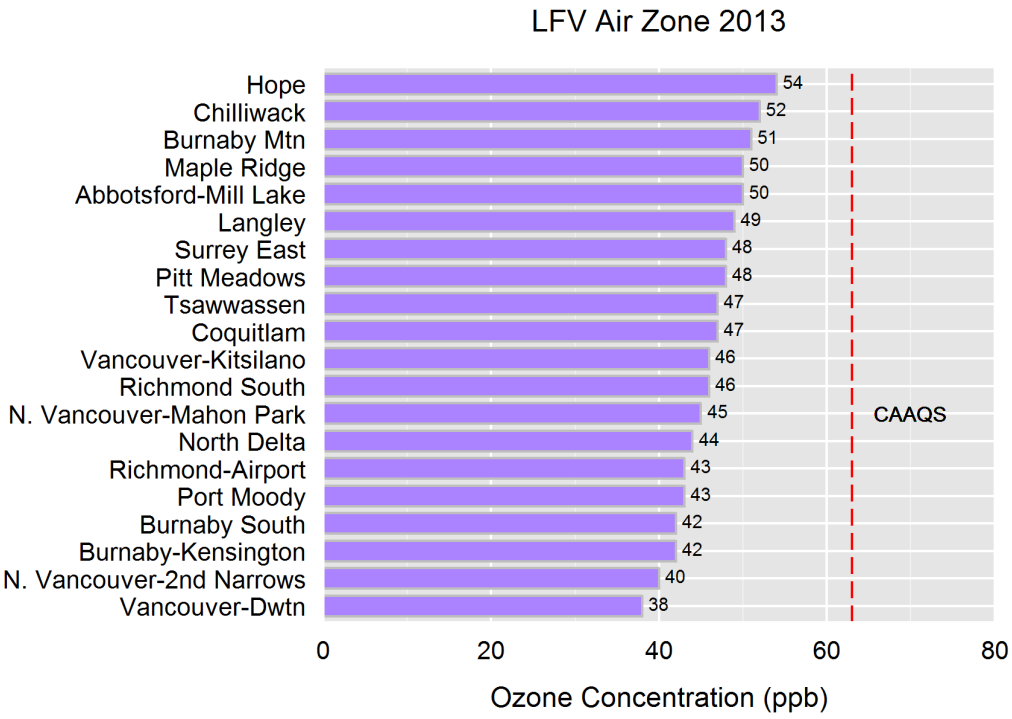

Figure 3. Ozone concentrations in the LFV Air Zone (2013), based on the annual 4th highest daily 8-hour maxima, averaged over three consecutive years. Red dashed line identifies the national standard (CAAQS) of 63 ppb.

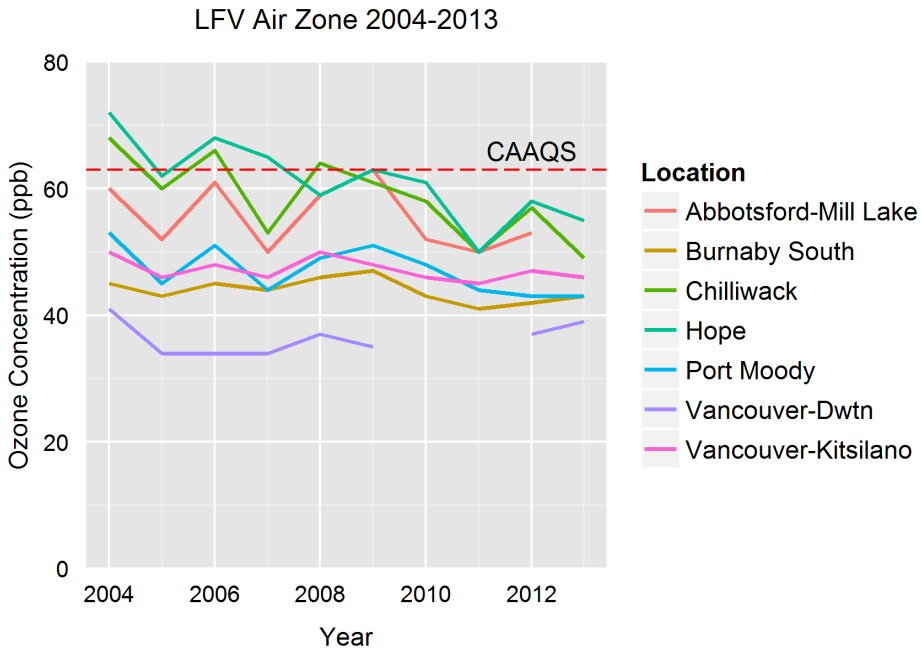

Figure 4. Annual trends in ozone concentrations (2004-2013), based on annual 4th highest daily 8-hour maxima. The CAAQS value of 63 ppb is shown for reference purposes only, as CAAQS achievement is based on a three-year average of the annual 4th highest daily 8-hour maxima.

4. $PM_{2.5}$ Levels

$PM_{2.5}$ measurements are reported for 16 sites in the air zone. The entire monitoring network was switched over from the old TEOM instruments to new FEM monitors at the beginning of 2013. The CAAQS metrics calculated for the LFV Air Zone are based on TEOM data from 2011 to 2012, and FEM data in 2013. It is likely that the reported CAAQS values for this reporting period are underestimated.

Data are summarized in Figure 5 and compared to the national standards based on short-term (24-hour) and long-term (annual) averaging periods. The 24-hour levels ranged from 9 $\mu g/m^3$ in Horseshoe Bay to 14 $\mu g/m^3$ in Abbotsford, Langley and Richmond, and were well below the national standard of 28 $\mu g/m^3$. Annually averaged levels ranged from 3.8 $\mu g/m^3$ in Horseshoe Bay to 5.6 $\mu g/m^3$ in Richmond, and were within the national standard of 10 $\mu g/m^3$.

$PM_{2.5}$ refers to inhalable particles up to 2.5 micrometres in diameter but of varying size, shape and chemical composition. This makes $PM_{2.5}$ a challenge to measure. The TEOM instruments were the first used in B.C. that could measure $PM_{2.5}$ concentrations in real-time. These instruments heated the sample air to remove excess water, and in the process, lost some of the sample due to evaporation. New monitors (the "FEMs") provide a more complete measure by accounting for the $PM_{2.5}$ that was previously lost to evaporation. As a result, higher concentrations are expected with the new monitors, even though actual air

Ten-year trends in annual mean $PM_{2.5}$ concentrations are shown in Figure 6 for a subset of monitoring sites that span the range of concentrations in the air zone. Decreasing trends are seen through 2012. Higher concentrations in 2013 are largely a function of the switch to the new-technology FEM instruments across the air zone that provide a more complete measure of $PM_{2.5}$.

5. Influence of Transboundary Flows and Exceptional Events (TF/EE)

In some instances, the CAAQS may be exceeded as a result of external influences (i.e. transboundary flows) or exceptional events (e.g. wildfires). Under the Air Zone Management Framework, where such influences can be demonstrated using a weight-of-evidence approach, the contribution of such events to air quality measurements can be removed. This is done so that long-term management strategies are not developed on the basis of events that are beyond local or provincial control.

In B.C., wildfires are generally the largest contributor to TF/EE-influenced days. In 2012, smoke from Siberian wildfires contributed to both elevated $PM_{2.5}$ and ozone concentrations in the LFV, but overall air quality levels for the 2011-2013 reporting period remained below the CAAQS.

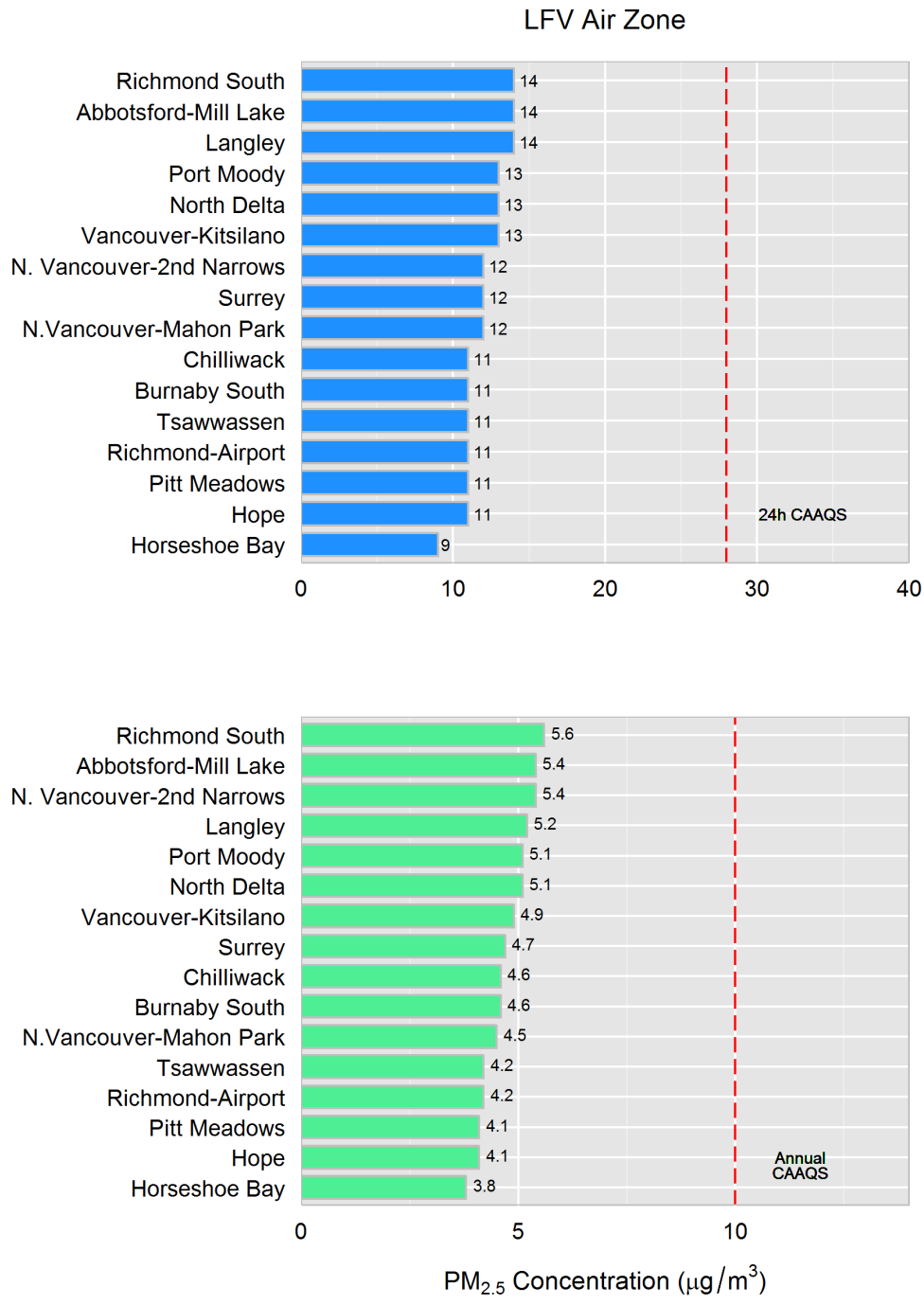

Figure 5. $PM_{2.5}$ concentrations in the LFV Air Zone (2011-2013), based on 24-hour (upper plot) and annual mean (lower plot) concentrations. Red dashed line identifies CAAQS of 28 µg/m^3 (upper plot) and 10 µg/m^3 (lower plot). Data from 2013 is FEM-based. Prior to 2013, data are TEOM-based. Due to an incomplete dataset from Richmond-Airport and Pitt Meadows in 2013, the average concentration is based on 2011-2012 TEOM data only.

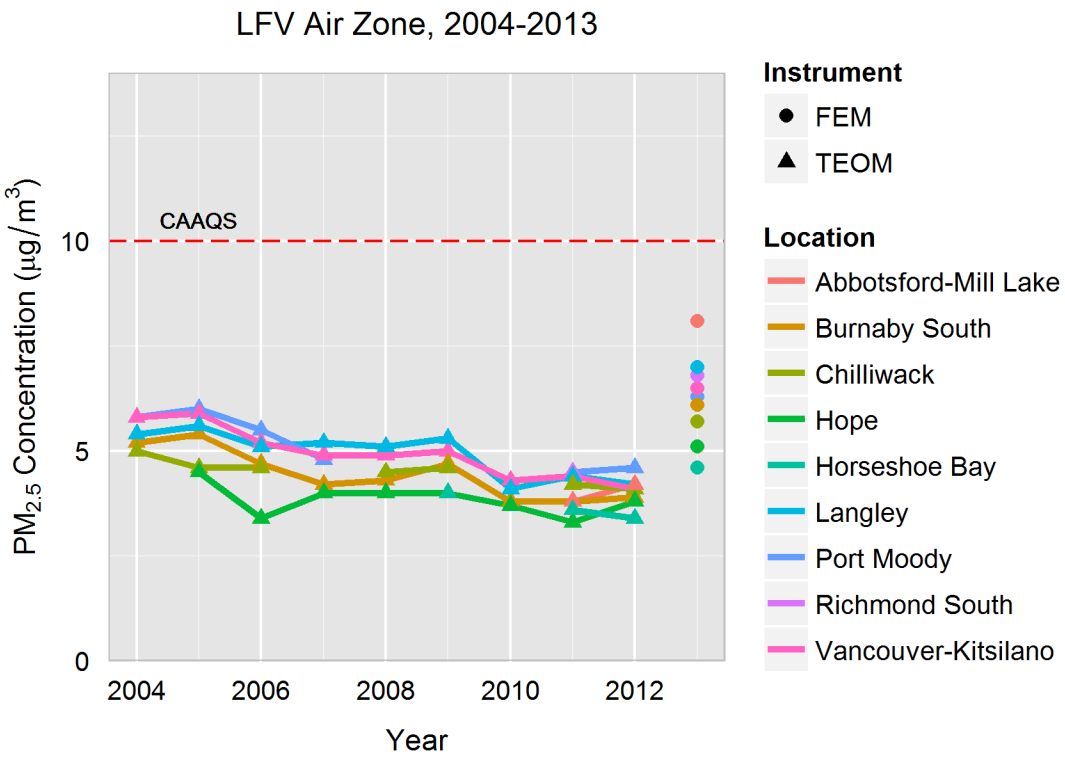

Figure 6. Annual trends in $PM_{2.5}$ concentrations (2004-2013), based on annual mean concentrations. The CAAQS value of 10 µg/m^3 is shown by the red dashed line. $PM_{2.5}$ measurements prior to 2011 are reported at 25^{o}C and 1 atm. From 2011 onward, measurements are reported at local conditions.

6. Air Zone Management

Air zone management levels are assigned on the basis of the highest concentrations within an air zone, excluding contributions from transboundary flows and exceptional events such as wildfires. On the basis of ozone levels between 2011 and 2013, as summarized in Table 2, the LFV Air Zone is assigned a management level of “yellow. This indicates that actions should be taken to prevent deterioration of ozone levels.

Table 2. Summary of air zone management levels for ozone in the Georgia Basin Air Zone.

Location	No. Valid Years 2011-2013	4th Highest Daily 8h Max.		Air Zone Management Level
		2013	2011-2013	
Abbotsford-Airport	1	47.9	.	Goal: Preventing Deterioration
Abbotsford-Mill Lake	3	47.8	50	
Burnaby-Kensington Park	3	42.9	42	
Burnaby Mtn	3	51.3	51	
Burnaby South	3	43.2	42	
Chilliwack	3	48.7	52	
Coquitlam	3	46.5	47	
Hope	3	54.5	54	
Langley	3	47.2	49	
Maple Ridge	3	47.8	50	
North Delta	3	43.6	44	
North Vancouver-Mahon Park	3	45	45	
North Vancouver-2nd Narrows	3	40.5	40	
Pitt Meadows	3	46.9	48	
Port Moody	3	43	43	
Richmond-Airport	3	44.5	43	
Richmond South	3	45.8	46	
Surrey	3	46.8	48	
Tsawwassen	3	46.6	47	
Vancouver-Kitsilano	3	46.5	46	
Vancouver-Dwtn	2	39.2	38	

Air zone management levels for $PM_{2.5}$ are based on the highest concentrations relative to both the 24-hour and annual national standards, once adjusted for TF/EE events. As summarized in Table 3, air zone management for $PM_{2.5}$ is assigned a “yellow” level. The implication is that actions should be taken to prevent future deterioration of $PM_{2.5}$ levels.

Table 2. Summary of air zone management levels for $PM_{2.5}$ in the LFV Air Zone.

Location	Monitor Type* T=TEOM F=FEM	No. Valid Years 2011-2013	Annual Mean		Daily Mean (98th Percentile)		Air Zone Management Level
			2013	2011-2013	2013	2011-2013	
Abbotsford-Airport	F	1	6.3	.	14.7	.	Goal: Preventing Deterioration
Abbotsford-Mill Lake	T-F	3	8.1	5.3	17.9	14	
Burnaby South	T-F	3	6.1	4.6	13.5	11	
Chilliwack	T-F	3	5.7	4.6	12.7	11	
Hope	T-F	3	5.1	4.1	11.5	11	
Horseshoe Bay	T-F	3	4.6	3.8	10.0	9	
Langley	T-F	3	7	5.2	17.7	14	
North Delta	T-F	2	5.8	5.1	13.8	13	
N. Vancouver-Mahon Park	T-F	2	5.1	4.5	11.5	12	
N. Vancouver-2nd Narrows	T-F	2	6.2	5.3	14.7	12	
Pitt Meadows**	T	2	.	4.0	.	11	
Port Moody	T-F	3	6.3	5.1	13.6	13	
Richmond-Airport**	T	2	-	4.2	-	11	
Richmond South	T-F	2	6.8	5.6	17.1	14	
Surrey	T-F	3	5.6	4.7	15	12	
Tsawwassen	T-F	3	5.7	4.2	14.6	11	
Vancouver Kitsilano	T-F	3	6.5	4.9	15.9	13	

*TEOM data reported for 2011-2012; FEM data reported for 2013. Exceptions noted by **, where TEOM data reported for 2011-2012 and insufficient FEM data available for 2013.

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 adopted its first air quality management plan in 1994, with subsequent plans in 2005 and the current Integrated Air Quality and Greenhouse Gas Management Plan (IAQGGMP) in 2011.[6] The 2014 progress report describes the status of the 12 strategies, 81 actions and 10 performance measures in the current IAQGGMP.[7]

The FVRD has an Air Quality Management Plan that has been in place since 1998.[8] This plan is being revised and is scheduled to be released in 2015.

[6] Metro Vancouver (2011) *Integrated Air Quality and Greenhouse Gas Management Plan*, http://www.metrovancouver.org/services/air-quality/plans-reports/iaqggmp/Pages/default.aspx

[7] Metro Vancouver (2014*) Integrated Air Quality and Greenhouse Gas Management Plan Progress Report*. Ibid.

[8] FVRD (1998) *Air Quality Management Plan.* Fraser Valley Regional District (FVRD). http://www.fvrd.bc.ca/Services/AirQuality/Documents/1998FVRDAQManagementPlan.pdf

Air quality agencies in the LFV collaboratively developed a Regional Ground Level Ozone Strategy in 2014.[9] In 1992 the Province established a light-duty vehicle emissions testing program in the LFV – AirCare. The program ended on December 31, 2014, and the focus has shifted to ensuring no backsliding in the emission reduction benefits that resulted from the AirCare program, and reducing emissions from heavy-duty diesel engines.[10]

Metro Vancouver, FVRD and Environment Canada partner to operate the Lower Fraser Valley Air Quality Monitoring Network – a network of 28 monitoring stations that collect air quality and meteorological data. The data are available to the public in real time, and are used to support planning and regulatory efforts and assessment of compliance with air quality standards and objectives and performance with respect to achievement of air quality management goals.[11]

Other multi-agency committees and groups that exist in the LFV to collaborate air quality initiatives include but are not limited to:

- Agriculture Nutrient and Air Working Group
- Air Quality and Health Steering Committee
- BC Visibility Coordinating Committee[12]
- Lower Fraser Valley Air Quality Coordinating Committee
- Reducing Exposure to Traffic Emissions Committee
- Georgia Basin-Puget Sound International Airshed Coordinating Committee
- BC Marine Vessel Air Quality Working Group.

[9] RGLOSSC (2014) Regional Ground-Level Ozone Strategy for the Canadian Lower Fraser Valley Region. Regional Ground-Level Ozone Strategy Steering Committee (RGLOSSC). Joint committee of the Fraser Valley Regional District, Metro Vancouver, BC Ministry of Environment, Environment Canada and Port Metro Vancouver. http://www.metrovancouver.org/services/air-quality/AirQualityPublications/RGLOS2014.pdf

[10] Lindner, John (2013) Heavy Duty Diesel Vehicle Policy Options Evaluation Study. Final Report. Contract Number: RFP No. 13-122. Prepared by SNC-Lavalin for Greater Vancouver Regional District (Metro Vancouver). Dec. 31, 2013. http://www.metrovancouver.org/services/air-quality/AirQualityPublications/2013HeavyDutyDieselVehiclePolicyOptions.pdf

[11] Metro Vancouver (2012) *Station Information: Lower Fraser Valley Air Quality Monitoring Network*. December 2012. http://www.metrovancouver.org/services/air-quality/AirQualityPublications/LowerFraserValleyAirQualityMonitoringNetwork2012StationInformation.pdf

[12] For more information, see: http://www.clearairbc.ca/Pages/default.aspx