BRITISH COLUMBIA | Ministry of Environment

GEORGIA STRAIT AIR ZONE REPORT

(2011-2013)

OVERVIEW

This is the first air quality report for the Georgia Strait Air Zone, which covers coastal areas of southwestern B.C. outside of the Lower Fraser Valley. 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 ($PM_{2.5}$).

Over the current reporting period of 2011 to 2013, 8-hour ozone concentrations ranged from 44-53 ppb, and were well below the CAAQS of 63 ppb. $PM_{2.5}$ concentrations ranged from 9-32 $\mu g/m^3$ (24-hour) and 3.4 -10.3 $\mu g/m^3$ (annual). Monitoring sites in Courtenay and Duncan exceeded the 24-hour CAAQS for $PM_{2.5}$ of 28 $\mu g/m^3$, and Courtenay exceeded the annual CAAQS of 10 $\mu g/m^3$.

The Air Zone Management Framework defines colour-coded management levels associated with air quality. On this basis, the Georgia Strait Air Zone has been assigned a management level of "yellow" for ozone, indicating actions to prevent further deterioration may be warranted, and a management level of "red" for $PM_{2.5}$, indicating actions are needed in the communities of Courtenay and Duncan to achieve the national standards.

1. Introduction

Fine particulates ($PM_{2.5}$) and ground-level ozone are considered 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. 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 (see Table 1),
- 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, including CAAQS for ozone and $PM_{2.5}$ for 2015 and 2020 achievement. Ozone metric based on annual 4th highest value, averaged over three years. $PM_{2.5}$ 24-hour metric based on annual 98th percentile, averaged over three years. $PM_{2.5}$ annual metric averaged over three years.

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					

Under the AQMS, provinces and territories are expected to annually 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 Georgia Strait 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. Georgia Strait Air Zone

The Georgia Strait Air Zone (see Figure 2) covers coastal areas of southwestern B.C., including eastern Vancouver Island, the Sea to Sky corridor, and the Sunshine Coast.[1] The air zone is characterized by rugged terrain and a cool Mediterranean-type climate of mild, wet winters and warm, relatively dry summers. Major population centres include Victoria, Nanaimo, Courtenay, Campbell River, Powell River, Whistler and Squamish. Four of the fastest growing municipalities in B.C. over the past year (i.e. Langford, Sechelt, Squamish and Whistler) are located in this air zone.

Figure 2 Georgia Strait Air Zone.

Wood combustion, including open burning and residential wood combustion, is a major source of $PM_{2.5}$ emissions in the air zone. Mobile sources, including on- and off-road vehicles, contribute to ground-level ozone formation through emissions of nitrogen oxides (NOx) and volatile organic compounds (VOCs). The largest industrial sources are from the pulp and paper sector, with mills located in Crofton, Harmac, Port Mellon, Powell River and Port Alberni.

[1] Metro Vancouver and the Fraser Valley Regional District are part of the adjacent Lower Fraser Valley Air Zone

3. Ozone Levels

Ozone measurements are reported for eight sites in the Georgia Strait Air Zone. As summarized in Figure 3, all monitoring sites were below the national standard of 63 ppb, based on the annual 4th highest 8-hour maximum, averaged over three years. Ozone levels ranged from 44-53 ppb, with the highest concentrations observed in Whistler.

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

Trends in annual ozone levels, based on the annual 4th highest of the daily 8-hour maximum, are shown in Figure 4. Concentrations have remained below the national standard over this period.

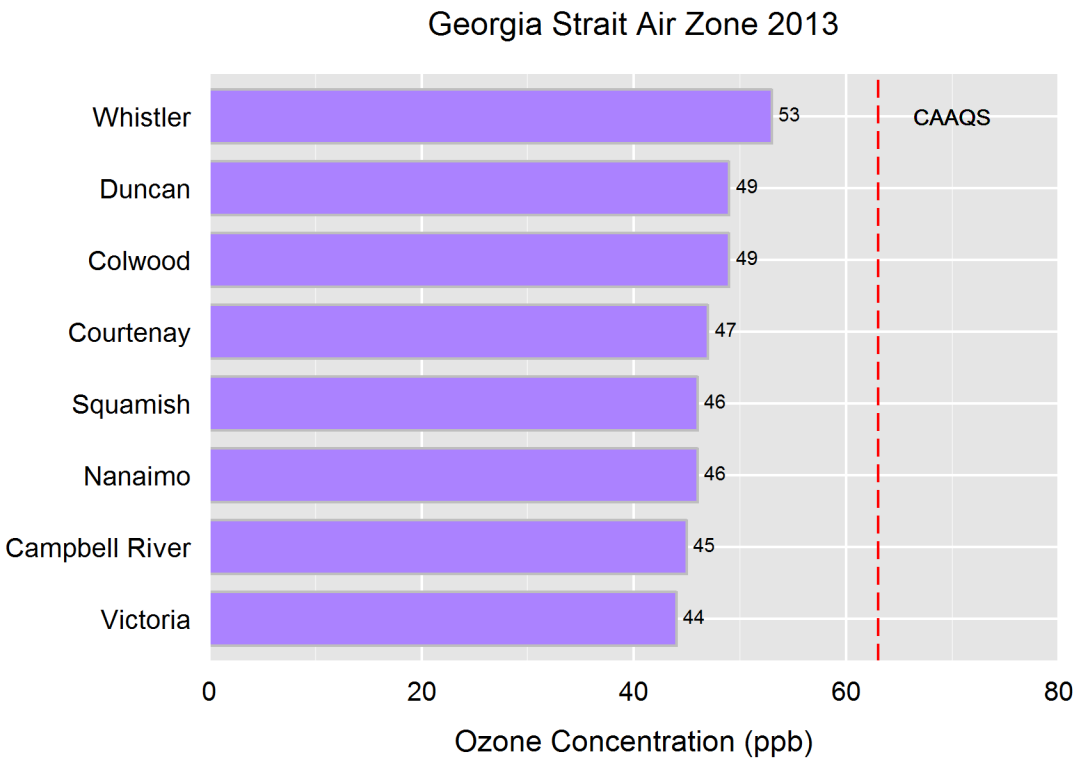

Figure 3. Ozone concentrations in Georgia Strait Air Zone (2011-2013), based on CAAQS metric (i.e. annual 4th highest daily 8-hour maxima, averaged over three consecutive years). Red dashed line identifies CAAQS of 63 ppb.

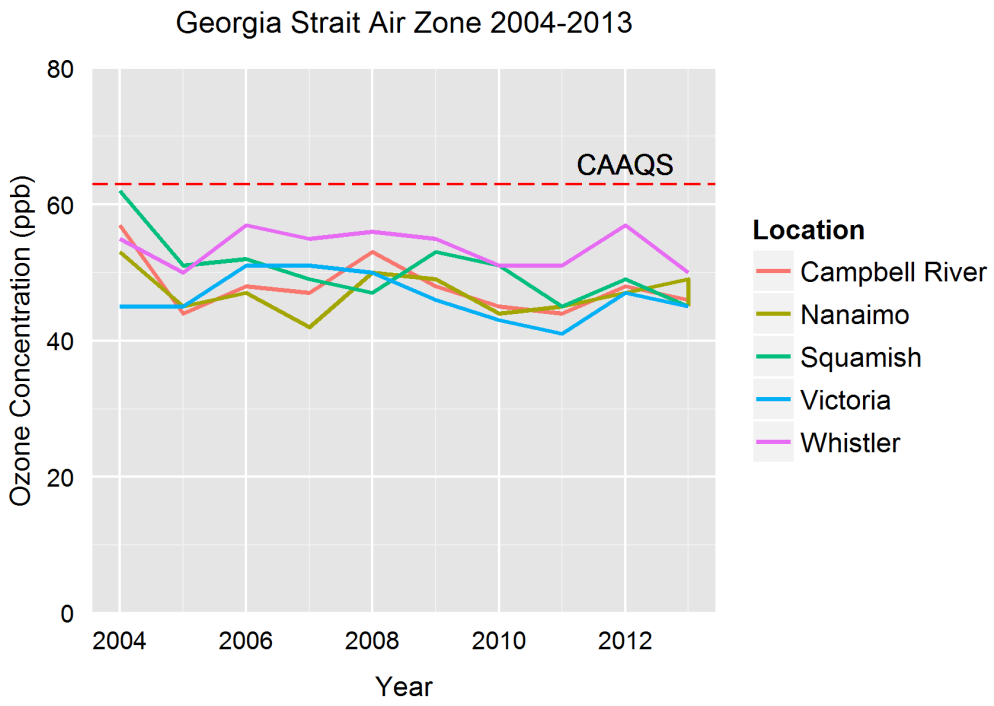

Figure 4. Annual trends in ozone concentrations (2004-2013), based on annual 4th highest daily 8-hour maxima. Red dashed line identifies CAAQS of 63 ppb.

4. $PM_{2.5}$ Levels

$PM_{2.5}$ measurements are reported for 13 sites in the air zone. 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 to 32 $\mu g/m^3$, with monitoring sites in Courtenay and Duncan exceeding the national standard of 28 $\mu g/m^3$. Annual levels ranged from 3.4 to 10.3 $\mu g/m^3$, with Courtenay the only site to exceed the national standard of 10 $\mu g/m^3$.

Ten-year trends in annual mean $PM_{2.5}$ concentrations are shown in Figure 6. A distinction is made between data collected using the new FEM technology (e.g. in Courtenay and Duncan-Cairnsmore) and the older TEOM instruments which are gradually being replaced, as the FEMs generally provide a more complete measure of $PM_{2.5}$.This is reflected in the higher concentrations reported by the FEMs that came online from 2010 onwards.

$PM_{2.5}$ 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") are being introduced that 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 quality has not changed.

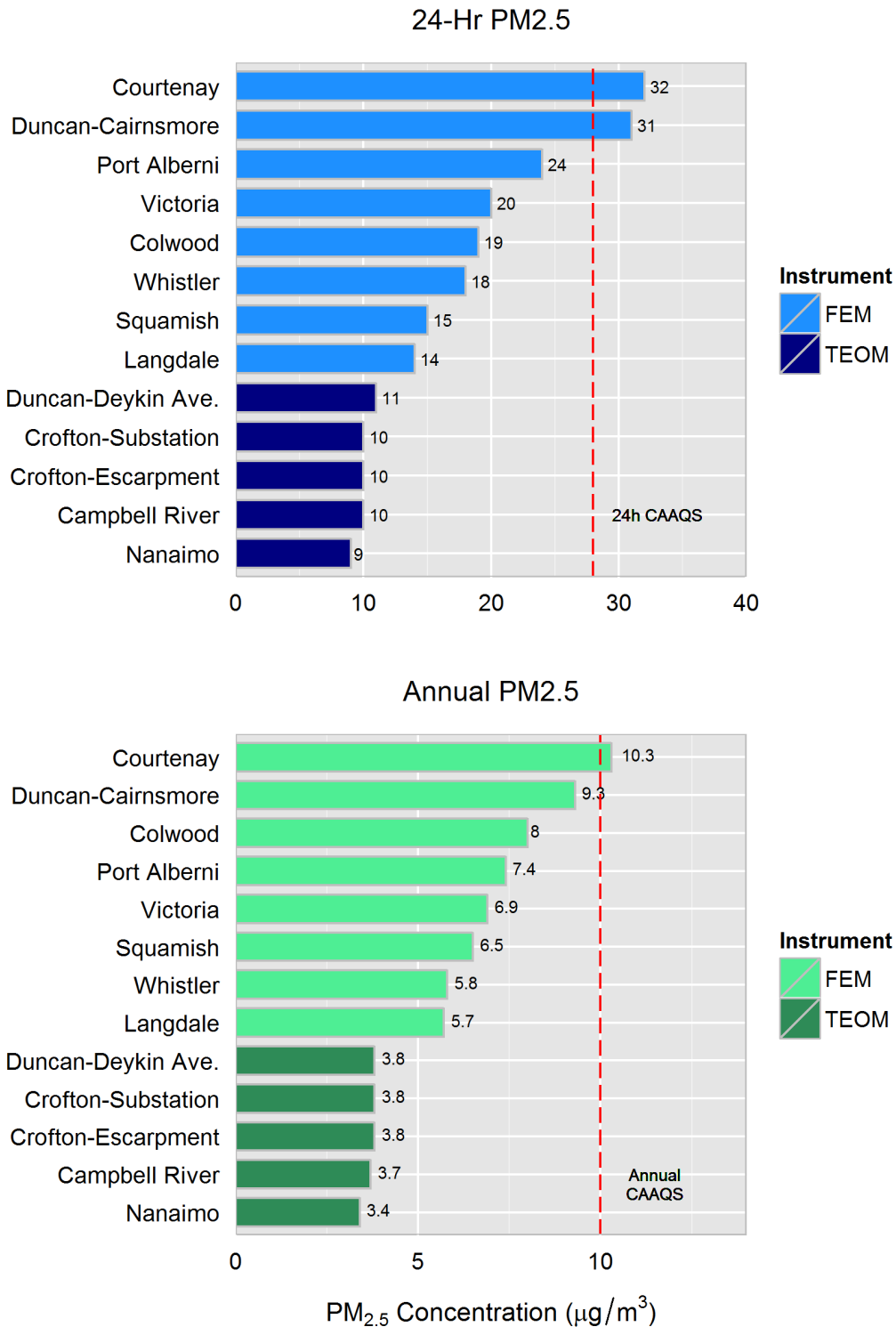

Figure 5. $PM_{2.5}$ concentrations in Georgia Strait Air Zone (2011-2013). Upper plot based on 24-hour concentration (annual 98th percentile, averaged over three years). Lower plot based on annual mean concentration (averaged over three years). Red dashed lines identify CAAQS of 28 µg/m^3 (upper plot) and 10 µg/m^3 (lower plot).

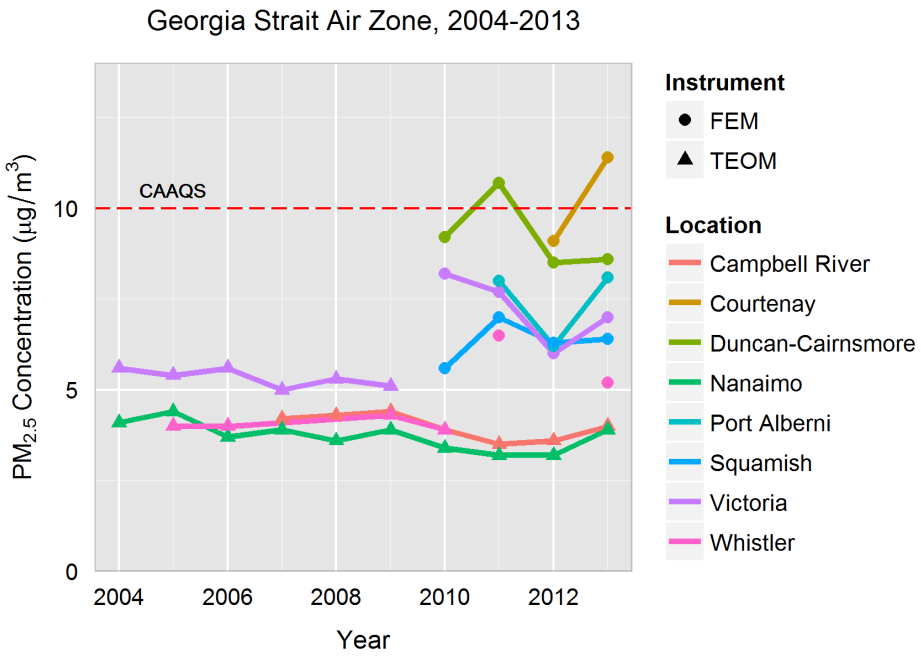

Figure 6. Annual trends in $PM_{2.5}$ concentrations (2004-2013), based on annual mean concentrations. The CAAQS value of 10 µg/m^3 is shown by the red dashed line. $PM_{2.5}$ measurements prior to 2011 are reported at 25°C and 1 atm. From 2011 onward, measurements are reported at local conditions.

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. However, the highest $PM_{2.5}$ levels that were observed in Courtenay and Duncan were found to occur outside of the summer wildfire season that stretches from June to September. Hence, the exceedance of the $PM_{2.5}$ CAAQS in Courtenay and Duncan are not believed to be a result of TF/EE influences.

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. As summarized in Table 2, the Georgia Strait Air Zone is assigned an ozone management level of “yellow”

based on data collected between 2011 and 2013, indicating that ozone-related actions should be focussed on preventing further 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 8-hour Maxima		Air Zone Management Level
		2013	2011-2013	
Colwood	3	49.4	50	Goal: Preventing Further Deterioration
Courtenay	2	46.1	47	
Duncan	3	49.3	49	
Campbell River	3	45.7	45	
Nanaimo	3	45.1	46	
Squamish	3	45.3	46	
Victoria	3	45.3	44	
Whistler	3	50.6	53	

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 "red" level due to high concentrations in Courtenay and Duncan. This means that $PM_{2.5}$-related actions should focus on meeting the standards in these two communities.

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

Location	Monitor Type	No. Valid Years 2011-2013	Annual Mean		Daily Mean (98th Percentile)		Air Zone Management Level
			2013	2011-2013	2013	2011-2013	
Colwood	FEM	3	7.9	8	20.7	19	Goal: Achieving Air Zone CAAQS
Courtenay	FEM	2	11.4	10.3	33.4	32	
Crofton-Escarpment	TEOM	3	4.2	3.8	11.8	10	
Crofton Substation	TEOM	3	4	3.8	9.2	10	
Duncan-Deykin Ave	TEOM	2	-	3.8	-	11	
Duncan-Cairnsmore	FEM	3	8.6	9.3	32.4	31	
Campbell River	TEOM	2	4	3.7	11.6	10	
Langdale	FEM	2	6.2	5.7	14.3	14	
Nanaimo	TEOM	3	3.9	3.4	10.2	9	
Port Alberni	FEM	3	8.1	7.4	30.6	24	
Squamish	FEM	3	6.4	6.5	15.2	15	
Victoria Topaz	FEM	3	7	6.9	22.8	20	
Whistler	FEM	2	5.2	5.8	18.5	18	

7. Actions to Protect Air Quality

The reduction of woodsmoke is an important priority throughout the Georgia Strait Air Zone. Residential wood combustion is a major source of both woodsmoke and $PM_{2.5}$ emissions. The Provincial Wood Stove Exchange Program is designed to encourage residents to change out their older, smoky wood stoves for low-emission appliances including new CSA-/EPA-certified clean-burning wood stoves. Between 2011 and 2013, the provincial government provided almost $180,000 to support local change-out programs in the Sunshine Coast and the Regional Districts of Campbell River, Comox Valley, Nanaimo, and Cowichan Valley, and an additional $38,500 for the Alberni Valley, which overlaps with the Coastal Air Zone. A further $80,000 in funding is being provided by the province for 2014/15.

High childhood hospitalization rates due to air pollution in the Cowichan Valley prompted the local government to initiate the development of an airshed management plan in 2013.[2] These discussions have involved health and environment agencies and various other stakeholders in the Cowichan Valley Regional District. While open burning is already banned within the City of Duncan and the Towns of Ladysmith and Lake Cowichan, a new bylaw was adopted in 2013 to limit open burning in surrounding electoral areas.[3] The City of Duncan also passed a wood stove bylaw in 2013 to regulate wood-burning appliances.[4]

Within the Comox Valley, there are plans to form an air quality working group as a step toward the development of a local air quality plan.[5] Health Canada is currently conducting a study in Courtenay to look at the daily variations in $PM_{2.5}$ due to wood smoke and to compare these findings to health data.

Within the scenic Sea-to-Sky Airshed, stretching along the Highway 99 corridor from Lions Bay through Squamish, Whistler and the Pemberton Valley, concerns over air quality due to projected economic growth led to the development of an air quality management plan.[6] Proactive steps were identified to reduce emissions from transportation sources and wood combustion activities. A review of the plan in 2014 found that good progress has been made on a number of action items.[7] This includes the development of the *Burning and Smoke Control Strategic Framework* in 2013 as a first step toward an airshed-wide smoke control strategy.[8]

[2] http://www.cvrd.bc.ca/index.aspx?NID=1410
[3] http://cvrd.bc.ca/index.aspx?NID=1463
[4] http://www.city.duncan.bc.ca/pdf/3089%20-%20Wood%20Burning.pdf
[5] E. Plain, personal communication
[6] For more information, see: http://www.seatoskyairquality.ca/pdf/2007-October-29-AQMP-Final.pdf.
[7] http://seatoskyairquality.ca/wp-content/uploads/2013/11/Sea-to-Sky-AQMP-Review-Final-Report-April-30-2014.pdf
[8] http://seatoskyairquality.ca/burning-and-smoke-control-strategic-framework/