GEORGIA STRAIT AIR ZONE REPORT (2012-2014)

Introduction

This is the second annual air quality report for the Georgia Strait 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 Georgia Strait 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. Georgia Strait 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 Georgia Strait Air Zone are summarized in Figure 2. Concentrations ranged from 45 ppb in Nanaimo to 53 ppb in Whistler.[1] All sites achieved the national standard of 63 ppb.

Trends in ozone levels are shown in Figure 3.[2] Concentrations have remained below the national standard over the 10-year period.

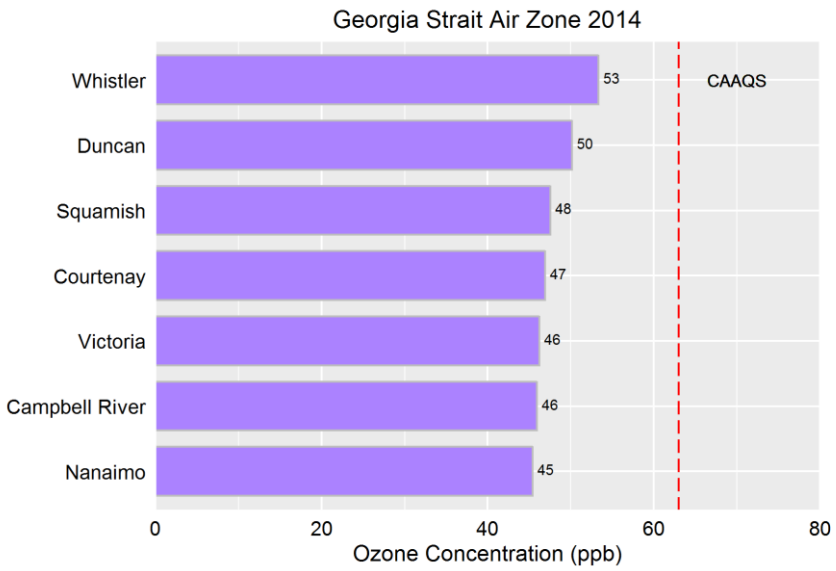

Figure 2. Ozone concentrations in the Georgia Strait Air Zone, based on annual 4th highest daily 8-hour maxima, averaged over 2012-2014. Red dashed line identifies the CAAQS of 63 ppb.

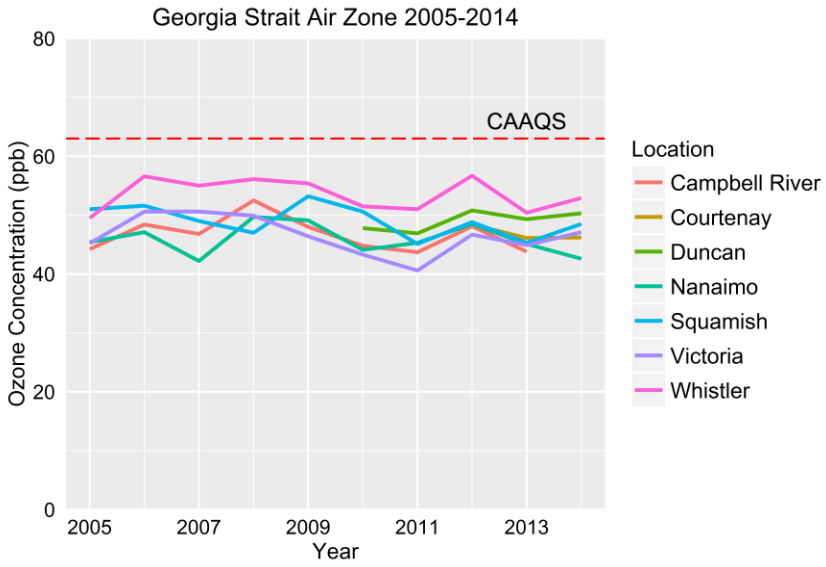

Figure 3. Trends in ozone concentrations (2005-2014), based on annual 4th highest daily 8-hour maxima for a single year. Red dashed line identifies CAAQS of 63 ppb.

[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 are being phased out. The FEMs are the preferred instrument as they provide a more complete measure of $PM_{2.5}$ than the TEOMs.

Daily concentrations (upper plot) ranged from 9 to 31 µg/m^3.[3] The national standard of 28 µg/m^3 was exceeded in Courtenay and Duncan-Cairnsmore, and equalled in Port Alberni. Annual concentrations (lower plot) ranged from 2.7 to 9.9 µg/m^3.[4] All monitoring sites achieved the national standard of 10 µg/m^3.

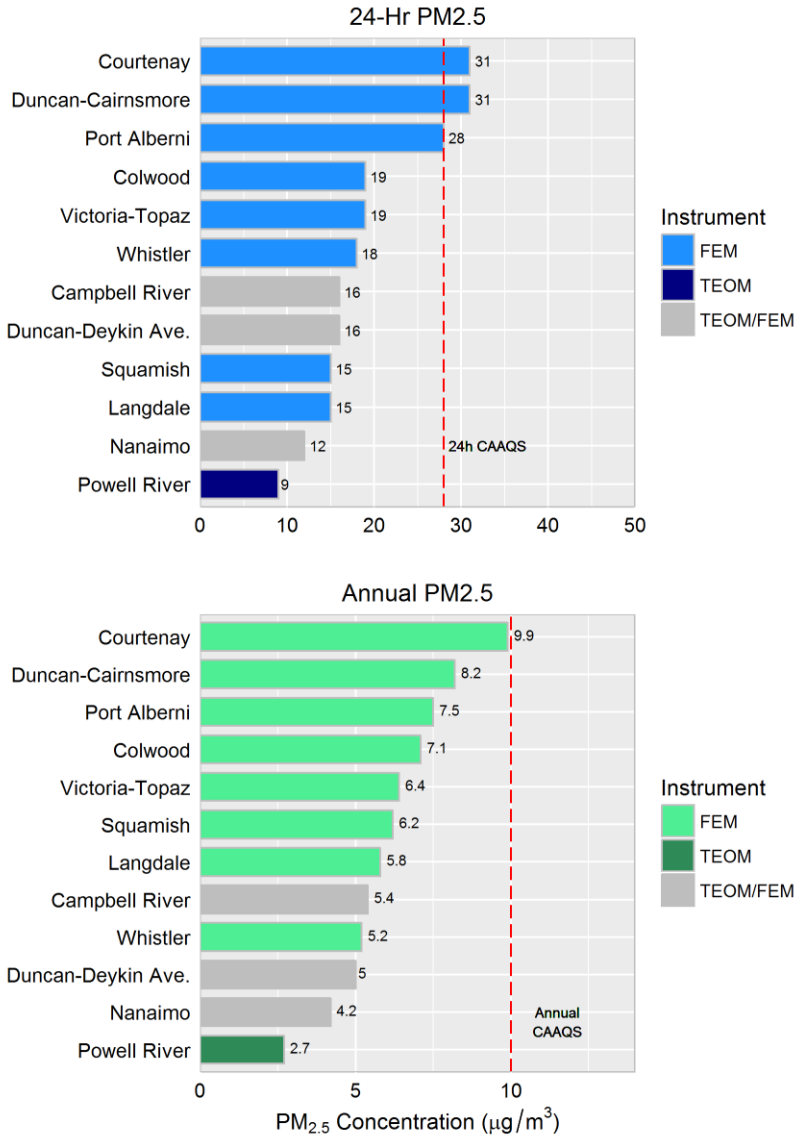

Figure 4. $PM_{2.5}$ concentrations in the Georgia Strait Air Zone. Upper plot based on 24-hour concentration (annual 98th percentile, averaged over 2012-2014). Lower plot based on annual mean concentration (averaged over 2012-2014). Red dashed lines identify CAAQS of 28 µg/m^3 (upper plot) and 10 µg/m^3 (lower plot).

Trends in annual mean concentrations over a single year 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 about 2010 onward.

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

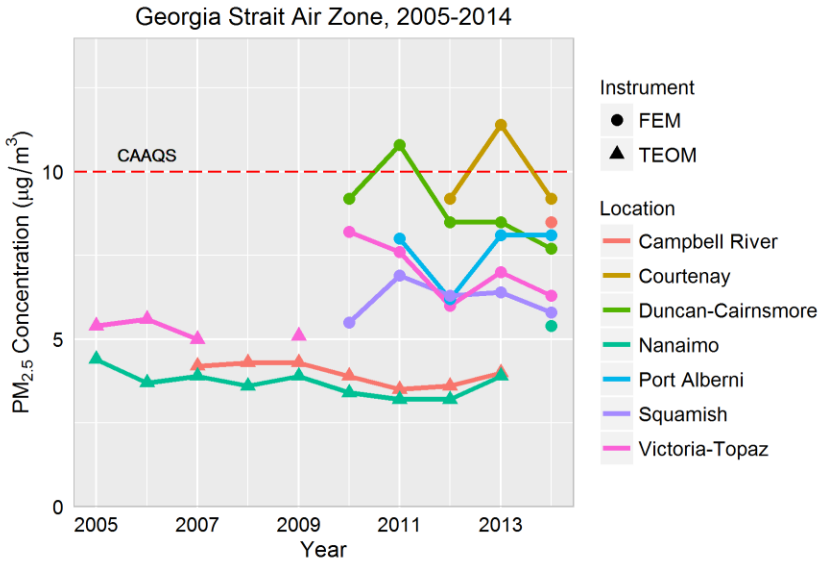

Figure 5. Annual trends in $PM_{2.5}$ concentrations (2005-2014), based on annual mean concentrations from a single year. The CAAQS value of 10 µg/m^3 is shown by the dashed line. $PM_{2.5}$ measurements prior to 2011 are reported at 25°C and 1 atm. From 2011 onward, measurements are reported at local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

Table 2 summarizes the as-measured concentrations for ground-level ozone and the management levels once any TF/EE influences have been considered. No TF/EE influences were identified for ozone. The ozone management level for the Georgia Strait Air Zone remains in the "yellow", based on concentrations in Whistler. This indicates that ozone-related actions should continue to focus on preventing further air quality deterioration.

Table 3 summarizes both as-measured $PM_{2.5}$ concentrations and management levels once any TF/EE influences (particularly wildfires) have been removed. The overall $PM_{2.5}$ management level remains in the "red" based on elevated concentrations in Courtenay and Duncan-Cairnsmore. This indicates that $PM_{2.5}$-related actions in the air zone should continue to focus on achieving the CAAQS, particularly in the Courtenay-Comox and Cowichan Valleys.

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

Location	No. Valid Years	4th Highest Daily 8-hour Maxima		Air Zone Management Level
		As Measured	TF/EE Influences Removed	
Campbell River	2	46	46	Goal: Preventing Further Deterioration
Colwood	3	50	50	
Courtenay	3	47	47	
Duncan-Cairnsmore	3	50	50	
Nanaimo	3	45	45	
Squamish	3	48	48	
Victoria	3	46	46	
Whistler	3	53	53	

Table 3. Summary of $PM_{2.5}$ concentrations as measured and air zone management levels for the Georgia Strait Air Zone (based on 2012-2014 data). All concentrations in $\mu g/m^3$.

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	
Campbell River	TEOM/ FEM	3	16	16	5.4	5.4	Goal: Achieving the CAAQS
Colwood	FEM	3	19	19	7.1	7.1	
Courtenay	FEM	3	31	31	9.9	9.9	
Duncan-Cairnsmore	FEM	3	31	31	8.2	8.2	
Duncan-Deykin Ave.	TEOM/ FEM	2	16	16	5.0	5.0	
Langdale	TEOM	3	15	15	5.8	5.8	
Nanaimo	TEOM/ FEM	3	12	12	4.2	4.2	
Port Alberni	FEM	3	28	28	7.5	7.5	
Powell River	TEOM	2	9	9	2.7	2.7	
Squamish	FEM	3	15	15	6.2	6.2	
Victoria	FEM	3	19	19	6.4	6.4	
Whistler	FEM	2	18	18	5.2	5.2	

Actions to Protect Air Quality

The reduction of $PM_{2.5}$ emissions has been a focus in both the Cowichan and Comox Valleys. The Cowichan Valley recently completed an airshed protection strategy that identifies a number of actions to reduce emissions from open burning, residential wood combustion and other sources (see: http://bc-cowichanvalley2.civicplus.com/DocumentCenter/View/70959). Between 2012-2014, wood stove change-out programs were supported in the Sunshine Coast, the Regional Districts of Campbell River, Comox Valley, Nanaimo, the Alberni Valley and the Cowichan Valley to encourage residents to change out their older, smoky wood stoves for low-emission appliances.

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).

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 $PM_{2.5}$.

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 $\mu g/m^3$ 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,
- 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 on the above criteria, no wildfire-influenced data were identified for the Georgia Strait Air Zone between 2012-2014. As a result, no data were excluded from the determination management levels.