Cowichan Region
State of the Environment Report
Update 2014

Air Quality

Contents

The 2014 State of Environment Update Report has been prepared by the Cowichan Valley Environment Commission's State of Environmental Reporting Subcommittee, chaired by Scott Akenhead.

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Figures and Tables

Introduction

Poorer air quality stresses natural ecosystems and impairs their capacity to provide ecological goods and services. Poorer air quality can also impact human health in a number of ways, including breathing problems (especially in children), the aggravation of existing respiratory and cardiac conditions, reduced lung function, and premature death.

In addition, air pollution negatively affects our economy: economic losses for resource-based industries such as forestry, fishing and agriculture can occur when the functioning of plants, animals and aquatic life are inhibited by poorer air quality.[1]

Some of the main sources of air pollution in the Cowichan Region include the pulp and paper sector, the petroleum product storage sector, open burning, agricultural activities, on-road vehicles, and marine activities.[2] The Cowichan Region's valley topography and airflow patterns can cause pollutants to become concentrated at higher levels where more negative impacts will occur.[3]

Local air quality is also compromised by what goes on outside the boundaries of the region: Cowichan's airshed is part of the much larger Georgia Basin–Puget Sound airshed (Figure 1). Weather patterns within this larger airshed may circulate air pollution from surrounding jurisdictions into the Cowichan Region and vice versa.

Modelling studies conducted in the Georgia Basin/Puget Sound airshed indicate that these impacts will be highly variable and entirely dependent on location. Climate change is expected to increase the occurrence of wildfires, which can also have important air pollution implications on a regional basis. These studies also suggest that air quality degradation due to climate change would be offset or reversed through emission reduction initiatives.[4]

Global change is yet another contributor to air quality. Climate warming, changes in pollution emissions from humans, and changes in land use and land cover due to climate effects, urbanization and land management decisions each have the potential to change air pollution levels on local to regional scales.

Figure 1: The Georgia Basin-Puget Sound airshed

Source: Environment Canada.

1 Page 310 – 312 - Georgia Basin Puget Sound ACR 2012.

2 Emissions Inventory Compilation and Forecast for the Cowichan Valley Regional District. Levelton Consultants. June 2014. http://www.bcairquality.ca/reports/pdfs/ei_cowichan_valley.pdf Accessed November 25, 2014.

3 Page 1 in Nephelometer report and B.C. Air Quality FAQ doc (http://www.bcairquality.ca/reports/pdfs/faqs_new_pm25_monitoring_june2012.pdf). Also page 28 in Georgia Basin – Puget Sound Airshed Characterization Report, 2014.

4 GB-PS Airshed Characterization Report, 2012 Pages 258, 280, 282, 296.

Measuring Air Quality

Reliable ways of measuring air quality in the Cowichan Region include monitoring Air Quality Health Index (AQHI) readings, levels of particulate matter and ground-level ozone, and prevalence of respiratory diseases.[5]

The AQHI is a national health initiative that reports out every three hours on the health risks posed by a complex mixture of air pollutants using three representative pollutants: ozone (O_3), nitrogen dioxide (NO^2) and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$). The Cairnsmore station in Duncan collects AQHI data.

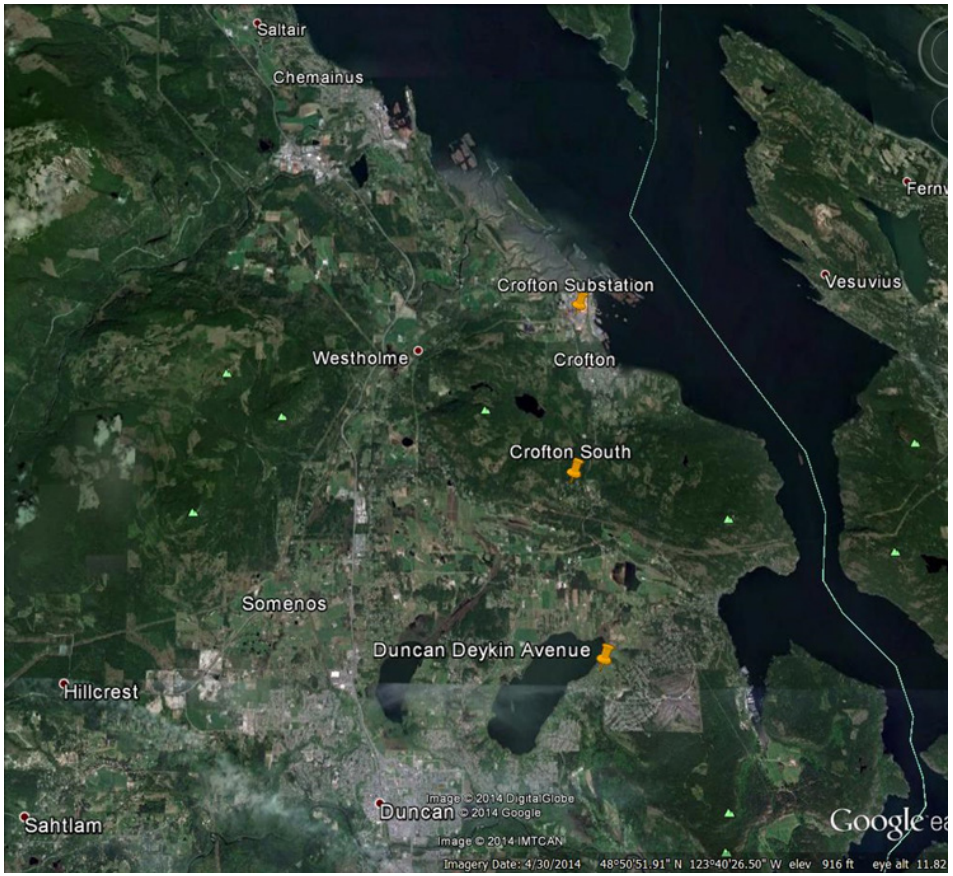
Crofton's Catalyst Paper mill operates three ambient air monitoring stations in the Crofton/Maple Bay area as part of their emission permit: Crofton Substation, Deykin Avenue and Escarpment Way (replaced in 2014 by Georgia Park Heights). The Ministry of Environment operates a fourth station on Cairnsmore Street in Duncan (Figure 2). These stations record emissions such as fine particulate matter, ground-level ozone, nitrogen dioxide and sulphur dioxide.

The Vancouver Island Health Authority tracks common respiratory diseases affected by air pollution: hospital admissions for children with respiratory problems (0-14 years), prevalence and incidence of asthma (5-54 years) and prevalence of chronic obstructive pulmonary disease (5-54 years) using data from B.C. Stats and the Ministry of Health.

Indicators included in this report are:

- Air Quality Health Index (AQHI)
- Fine particulate matter ($PM_{2.5}$)
- Ground-level ozone (Cairnsmore) – this information is new in the 2014 report
- Respiratory diseases

Figure 2: Air quality monitoring station locations in the Cowichan Region



Source: Ministry of Environment: http://www.bcairquality.ca/assessment/network-description.html

5 Ozone is considered to be a very good indicator of respiratory health, while fine particulate matter, or $PM_{2.5}$, is a good measure of cardiovascular health. Glen Okrainetz, Director of Air, Health Protection Branch, B.C. Ministry of Healthy Living and Sport, personal communication, 2010.

Air Quality Health Index

Data Sources and Reliability

In November 2009, the Ministry of Environment installed a station on Cairnsmore Avenue in Duncan to collect urban air quality data, including Air Quality Health Index (AQHI) data.

The AQHI rating system is based the overall health risk associated with multiple pollutants as measured using the three commonly measured pollutants in the index: $PM_{2.5}$, ground-level ozone (O_3) and nitrogen dioxide (NO_2). This method differs from the older Air Quality Index (AQI) that determined air quality based on the highest value of only one pollutant, using a 24-hour time frame. The AQHI might provide more timely information for people with respiratory problems, but is not without its limitations. The blended AQHI does not always communicate poorer air quality during events caused only by increased levels of $PM_{2.5}$ that may result in the issuance of an air quality advisory.[6]

The AQHI rating system is comprised four Health Risk Categories:

- Low Health Risk – AQHI values from 1–3
- Moderate Health Risk – AQHI values from 4–6
- High Health Risk – AQHI values from 7–10
- Very High Health Risk – above 10. (A very rare occurrence, usually connected to wildfire smoke).

6 $PM_{2.5}$ represents only about 10% of the AQHI. If $PM_{2.5}$ is high, but 0_3 and NO_2 are low, the AQHI may not capture this elevated $PM_{2.5}$ reading. An example is a day when the AQHI reading is "low risk" (based on a cumulative assessment of three pollutants) and yet an Air Quality Advisory (based on a single pollutant) is issued. This situation occurred most recently on December 3, 2014; the AQHI value was 2 and an air quality advisory and open burning restriction notice was jointly issued by the B.C. Ministry of Environment and Island Health. B.C. Air Quality Data accessed December 3, 2014. Efforts are currently being trialed in other provinces to clear up confusion that could be caused by such events. Personal communication with Dr Paul Hasselback, Medical Health Officer, Central Island. November 20, 2014. Also personal communication with Earle Plain and Eric Taylor, Air Quality Meteorologists, B.C. Ministry of Environment. December 2014.

The AQHI data is reliable and repeatable, and will be enhanced by findings of the Ambient Air Quality Report being conducted by the B.C. Ministry of Environment (expected completion 2015).

Findings

Hourly data for the Cairnsmore monitoring station for the year 2013 indicates Air Quality Index (AQHI) levels are "low risk" (values from 1-3) 99.8% of the time – with 1 (or less) as the most likely value (Table 1). "Moderate" air quality readings (of 4 on a possible scale of 4–6) were found in January, November and December 2013 (15 out of 7,866 hourly readings[7]).

These findings are supported anecdotally by Air Quality Meteorologists from the B.C. Ministry of the Environment who indicate AQHI levels are "low risk" for the vast majority of the time, and can move slightly into the "moderate" category during air quality advisory periods.[8] Ground-level ozone (O_3) and nitrogen dioxide (NO_2) are the dominant pollutants measured by the AQHI; $PM_{2.5}$ makes up about 10% of the index. There have been no exceedances of NO_2 between 2005 and 2013, and no 8-hour exceedances of the ground-level ozone Canada-wide Standard since monitoring began in November 2009.[9]

Table 1: The frequency of occurrence of each AQHI value at Cairnsmore, 2013.

AQHI	Number (hours)	Frequency
Less than 1	1,255	15.9%
1	4,255	54%
2	2,180	27.7%
3	161	2%
4	15	0.19%

Source: Environment Canada.

7 Note that a small number of hourly readings were not available.

8 Personal communication with Earle Plain and Eric Taylor, Air Quality Meteorologists, B.C. Ministry of Environment. December 2014.

9 Data provided by Earle Plain.

Fine Particulate Matter ($PM_{2.5}$)

Data Sources and Reliability

Fine particulate matter (also called $PM_{2.5}$ due to the size of the particles[10]) is one of the most important outdoor air pollutants in B.C. from a human health perspective. $PM_{2.5}$ exposure is linked to a range of health impacts including inflammation of the airways, more frequent use of medications, increased emergency room visits, hospitalizations and premature mortality.[11] People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure.[12]

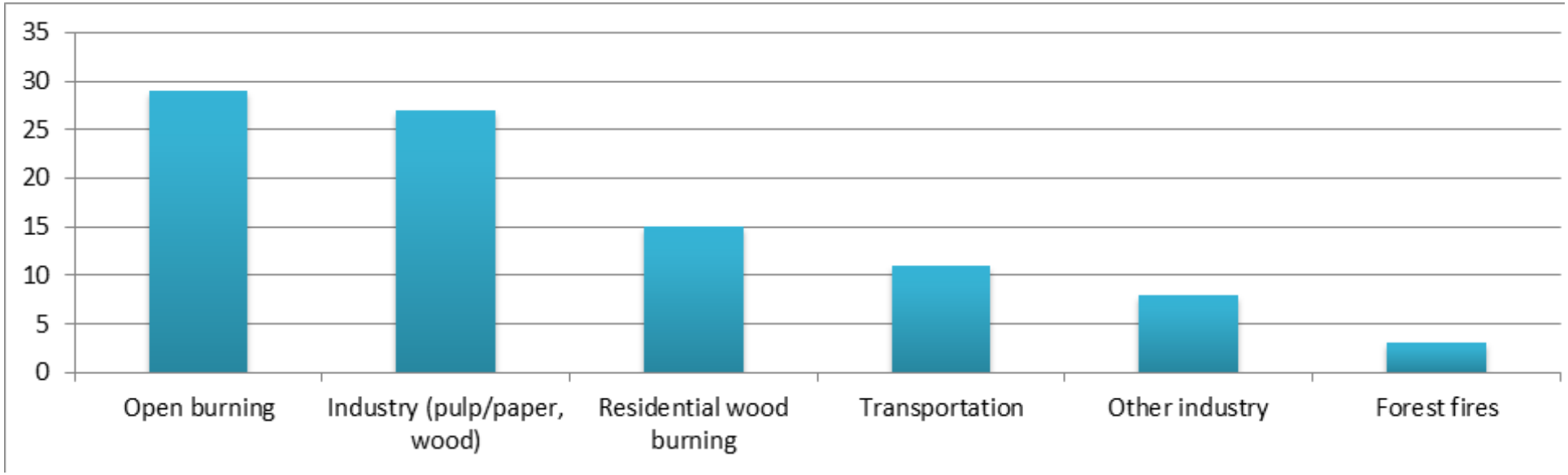
$PM_{2.5}$ comes primarily from combustion sources. Examples include exhaust from vehicles (cars, trucks, buses), dust from gravel roads, emissions from industrial and commercial sources, smoke from residential heating with wood stoves/furnaces, open burning of land-clearing debris and logging slash, and back-yard burning of yard waste and garbage. Fine particulates also come from the reactions that transform some pollutant gases into particles (Figure 3).

$PM_{2.5}$ data has been gathered at different locations in the Cowichan Region since the mid-1990s. Currently four monitoring stations measure $PM_{2.5}$: three in Crofton (Crofton Substation, Deykin Avenue and Escarpment Way - replaced in 2014 by Georgia Park Heights), and one in Duncan (Cairnsmore). Only data from the Cairnsmore Station are documented in this 2014 update; the other three stations were converted to FEM monitors (see below) at the end of 2013 and will provide data useful for the next State of the Environment update.

$PM_{2.5}$ is measured using units of micrograms per cubic metre and hourly readings are rolled up into a 24-hour average in order to compare to daily criteria. In 2012 the Province introduced new FEM (Federal Equivalent Method) air quality monitors to monitor $PM_{2.5}$ in real time. FEM monitors

10 The size of PM2.5 particles is about 1/20th the width of a human hair.
11 B.C. Ministry for Healthy Living and Sport, June 2009.
12 US Environmental Protection Agency, accessed December 2009.

Figure 3: Main sources of $PM_{2.5}$ emissions in BC, 2012



Source: BC Air Quality: http://www.bcairquality.ca/reports/pdfs/faqs_new_pm25_monitoring_june2012.pdf

are the accepted standard in the US and Canada. These new monitors provide a more complete measure of $PM_{2.5}$ by accounting for loss due to evaporation,[13] and as a result may increase $PM_{2.5}$ measurements. Differences between old and new monitor results will be better understood with the ongoing collection of data.[14]

While no safe health thresholds for $PM_{2.5}$ have been identified,[15] the provincial and federal governments have established $PM_{2.5}$ air quality objectives (Table 2).

The FEM $PM_{2.5}$ data is accurate and reliable.

Table 2: $PM_{2.5}$ objectives

	Daily (24-hour period)	Annual mean	Annual voluntary planning goal
British Columbia standards	25 µg/m3	8 µg/m3	6 µg/m3
Canada-wide standards	30 µg/m3*		
World Health Organization guidelines	25 µg/m3	10 µg/m3**	

Note: The Canada-wide standards are based on the 98th percentile annual ambient measurement over 3 consecutive years.

* The Federal Government will reduce this objective to 28 in 2015 and 27 in 2020, and add in an annual mean of 10 in 2015.

** The World Health Organization will reduce this objective to 8.8 in 2020.

Source: B.C. Ministry of Environment, Environment Canada, World Health Organization.

13 The old monitors heat the air sample to remove moisture. Heating the air causes part of the sample to evaporate, which results in lower PM2.5 measurement. The new monitors provide a more complete PM2.5 measure by accounting for the particulate matter that wasn't being measured by the older instruments due to evaporation.

14 BC Lung Assn 2013 State of the Air report. B.C. Government June 2012 FAQs: http://www.bcairquality.ca/reports/pdfs/faqs_new_pm25_monitoring_june2012.pdf

15 B.C. Ministry for Health Living and Sport, June 2009.

Findings

Daily (24-hour) $PM_{2.5}$ levels

Daily levels of fine particulate matter ($PM_{2.5}$) at the Cairnsmore monitoring station exceed the provincial ambient air quality objective more often during the fall and winter months (Figure 4 and Table 4). Between January 2010 and October 2014, daily $PM_{2.5}$ levels exceeded the daily provincial objective 70 times. The highest daily level recorded in this time period was 46.2 µg/m3 (November 2011).

These daily findings are consistent within the Georgia Basin/Puget Sound airshed where $PM_{2.5}$ concentrations have been found to peak and air quality to diminish significantly in the fall and winter months when additional sources of combustion are present (e.g., forest harvesting and land-clearing open-burning activities, woodstove use and backyard burning) and air inversions trap pollution at lower altitudes (i.e., in the region's valleys).[16]

Annual and monthly mean $PM_{2.5}$ levels

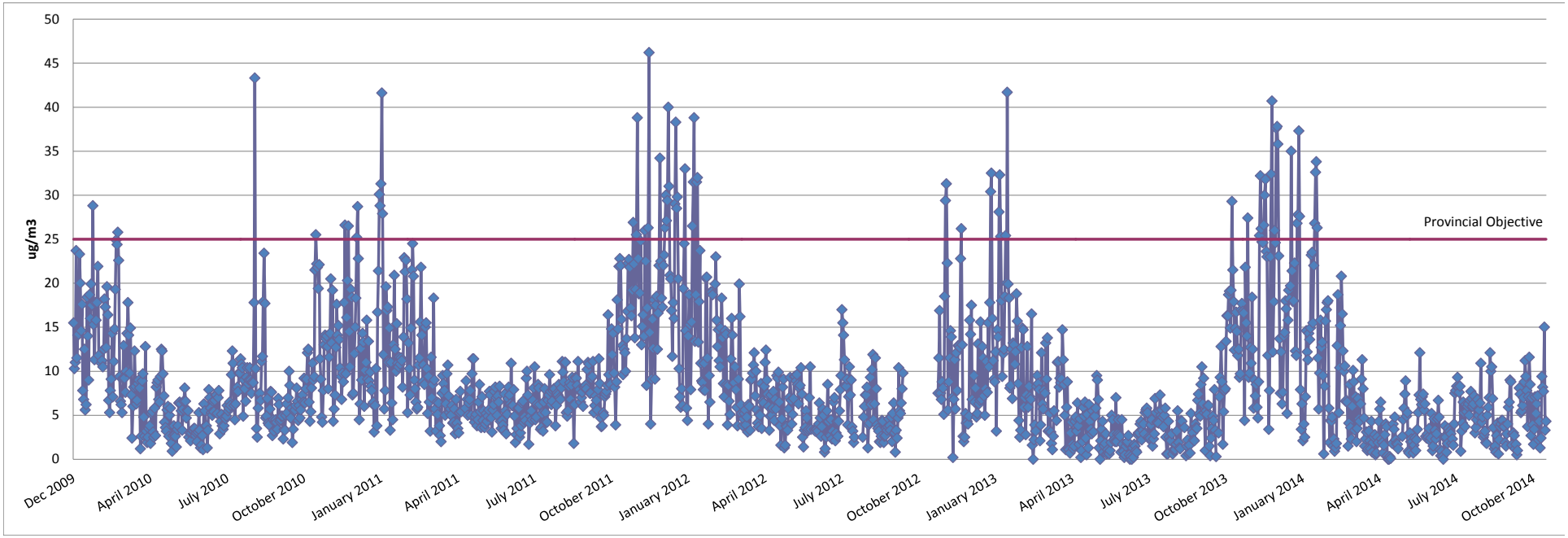
Overall levels (annual averages) of $PM_{2.5}$ are consistently above the provincial annual objective at the Cairnsmore Station for the years 2010 to 2013[17] and have exceeded the Canada-wide standard two years out of four (Figure 5 and Table 3). Monthly averages demonstrate the seasonal variation in $PM_{2.5}$ levels: higher in the fall and winter, and lower in the spring and summer months (Table 5).

Note: The 2010 State of the Environment report did not contain $PM_{2.5}$ data for Cairnsmore as this station had just been installed in November 2009. A more complete picture of $PM_{2.5}$ will be available for the airshed once FEM monitors have been generating ongoing data from all four stations.

16 Georgia Basin Puget Sounds Air Characterization Report, 2014. US Environmental Protection Agency and Environment Canada. Page 31.

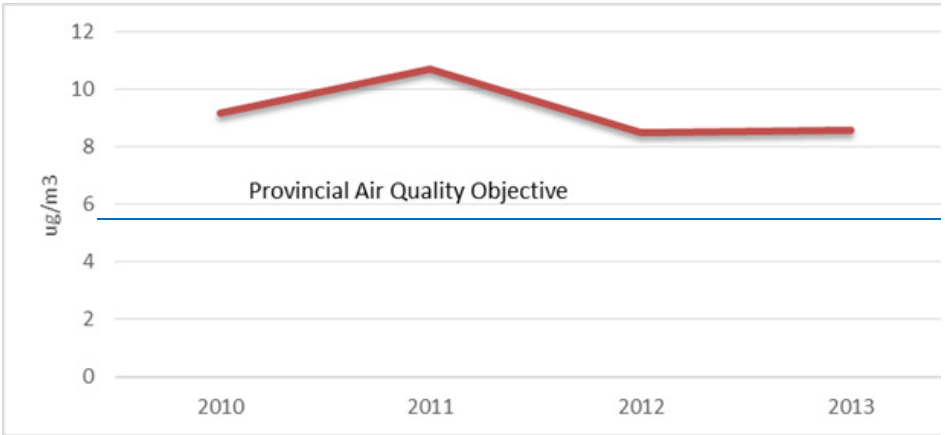
17 Annual data for 2014 unavailable at time of publication.

Figure 4: Cairnsmore daily $PM_{2.5}$ readings (January 2010 to October 2014)



Source: Ministry of Environment, 2014.

Figure 5: Annual Average $PM_{2.5}$ at Duncan Cairnsmore 2009-2013



Source: Ministry of Environment, 2014

Table 4: Annual data summary – Cairnsmore Station (2010 to 2013, ug/m3)

Year	Annual Mean	24 hour average (98th percentile)	Number of values exceeding 25 ug/m3 (BC daily objective)	% of time	Rolling 3-year average (98th Percentile)*
2010	9.2	25.2	6	1.7	34
2011	10.7	31	21	5.8	33
2012	8.5	29.4	9	2.9	29
2013	8.6	32.4	19	5.3	31

*This 3-year average appears much higher than the annual average because it is the 3-year average of the annual 98th percentile of the daily 24-hour average concentrations. Canada-wide standard is 30 ug/m^3)

Source: Ministry of Environment, 2014

Table 3: Exceedances of 24-hour provincial $PM_{2.5}$ objective – Cairnsmore Station (January 2010 to October 2014)

Date	$PM_{2.5}$
23/01/2010	28.8
22/02/2010	25.8
05/08/2010	43.3
17/10/2010	25.5
21/11/2010	26.6
25/11/2010	26.5
05/12/2010	25.2
06/12/2010	28.7
01/01/2011	30.1
02/01/2011	28.8
03/01/2011	31.3
04/01/2011	41.6
05/01/2011	27.9
01/11/2011	26.9
05/11/2011	25.5
06/11/2011	38.8
15/11/2011	26

Date	$PM_{2.5}$
19/11/2011	26.3
20/11/2011	46.2
03/12/2011	34.2
09/12/2011	26.3
10/12/2011	30
11/12/2011	27.1
12/12/2011	29.4
13/12/2011	40
14/12/2011	31
21/12/2011	29
22/12/2011	38.3
23/12/2011	28.5
24/12/2011	29.8
02/01/2012	33
11/01/2012	26.5
12/01/2012	31.5
13/01/2012	38.8

Date	$PM_{2.5}$
16/01/2012	31.5
17/01/2012	32
09/11/2012	29.4
10/11/2012	31.3
28/11/2012	26.2
02/01/2013	30.4
03/01/2013	32.5
12/01/2013	28.1
13/01/2013	32.3
14/01/2013	25.3
20/01/2013	25.4
22/01/2013	41.7
18/10/2013	29.3
06/11/2013	27.4
20/11/2013	25.4
21/11/2013	32.2
22/11/2013	26.2

Date	$PM_{2.5}$
25/11/2013	26.6
26/11/2013	30
27/11/2013	31.8
04/12/2013	32.4
05/12/2013	40.7
08/12/2013	26
10/12/2013	37.6
11/12/2013	37.8
12/12/2013	35.8
28/12/2013	35
04/01/2014	26.8
05/01/2014	27.8
06/01/2014	37.3
07/01/2014	27.6
25/01/2014	26.8
26/01/2014	32.6
27/01/2014	33.8
28/01/2014	26.3

Table 5: Monthly average means - Cairnsmore Station (2010 to 2013, ug/m^3)

	2010	2011	2012	2013
January	14.61	15.26	16.85	16.9
February	12.82	12.95	11.90	8.05
March	7.98	6.82	7.3	7.28
April	5.52	5.27	6.62	3.34
May	4.14	5.59	6.08	3.24
June	4.77	5.53	3.92	1.95

	2010	2011	2012	2013
July	8.08	6.25	7.72	4.22
August	9.04	7.79	5.10	1.98
September	5.38	7.55	4.91	4.64
October	11.68	14.38	n/a	13.46
November	13.65	18.95	12.48	16.77
December	11.74	21.50	8.16	19.46

Source: Ministry of Environment, 2014

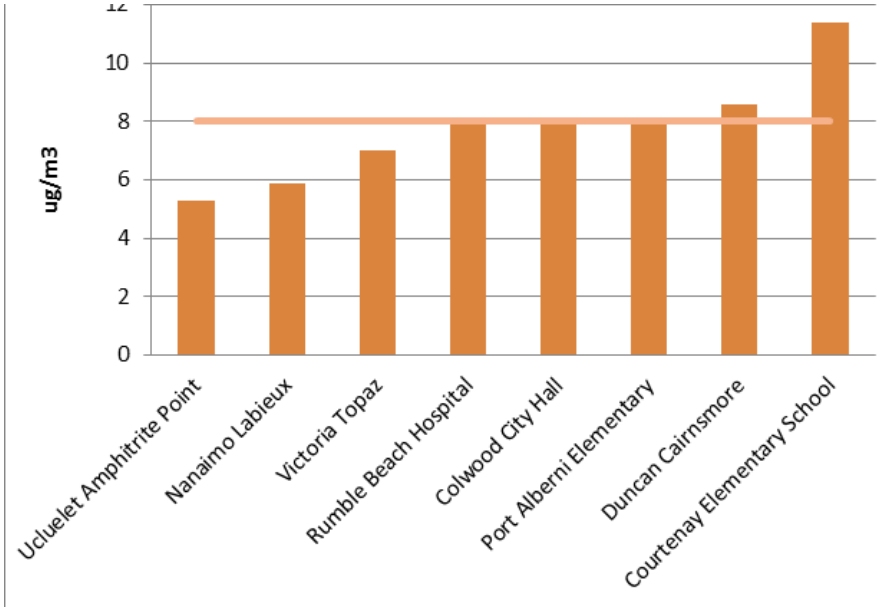
Canada Wide Standards

The numerical target for the CWS for $PM_{2.5}$ is 30 µg/m3 (24-hr averaging time), based on the annual 98th percentile ambient measurement, averaged over three consecutive years. The Cairnsmore Station exceeded the Canada-Wide Standards' $PM_{2.5}$ objective (30 µg/m3) three out of four years (34 µg/m3 in 2010, 33 µg/m3 in 2011 and 31 µg/m3 in 2013), with the non-exceeding year coming close to the objective (29 µg/m3 in 2010) (see Table 4).

Benchmarking – Annual average mean

It is difficult to compare the Cowichan Region's air quality to other parts of the province until all B.C. monitoring sites generate data using the new FEM technology. Figures 6 and 7 offer some preliminary comparison for annual average mean.

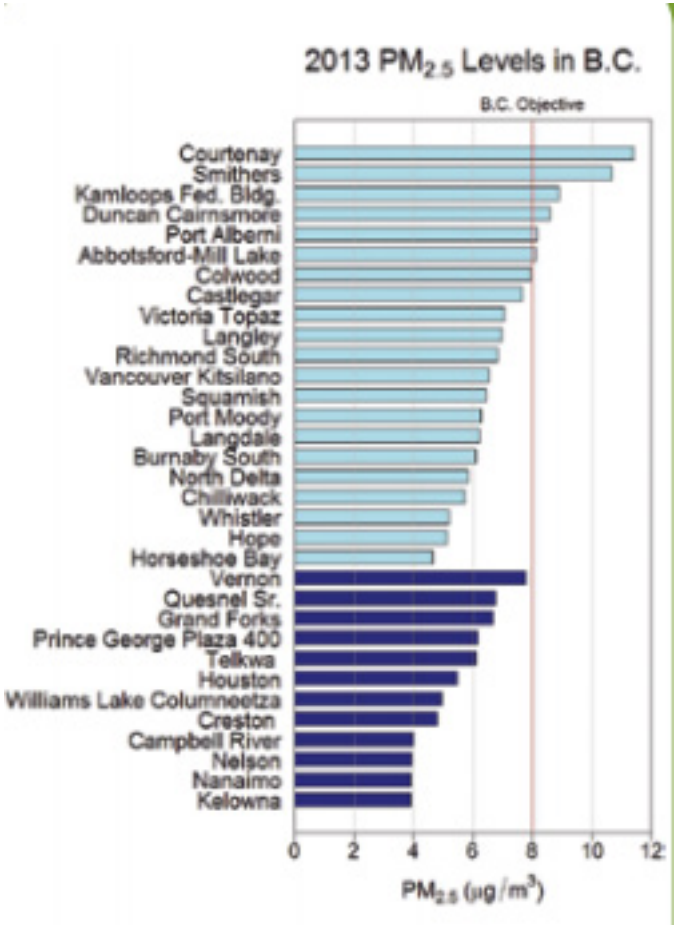
Figure 6: Annual average $PM_{2.5}$ for all Vancouver Island sites operating FEM monitors, 2013.



Orange line is B.C. Annual Objective (8 ug/m^3).

Source: Ministry of Environment, 2014

Figure 7: Annual average $PM_{2.5}$ levels in BC, 2013



Source: BC Lung Association's 2014 State of the Air Report.

This chart shows data abnormalities attributed to the ongoing transition from the old monitoring technology (dark blue bars) to the new FEM monitors (light blue bars) that provide a more complete measure of $PM_{2.5}$.

The BC Lung Association's 2014 State of the Air report analyzed air quality trends over the past ten years. It found that "annual mean $PM_{2.5}$ levels have generally declined over the past decade, owing to improved motor vehicle emission standards, local restrictions on open burning and other local actions." (BC State of the Air 2014 page 12). This trend also noted in the Georgia Basin – Puget Sound 2014 Airshed Characterization Report.

Benchmarking – Canada-Wide Standards

The Canadian Council of Ministers of the Environment (CCME) $PM_{2.5}$ 3-year averages for reporting locations are presented in Figure 8. The 3-year averages ranged from 10 to 20 µg/m^3 at the majority of locations.[18] Three locations in British Columbia and five in Alberta recorded 3-year averages above the $PM_{2.5}$ target of 30 µg/m^3 (indicated by red line). These above-target concentrations may have been influenced by smoke from forest fires. One location in Alberta and two in British Columbia (Duncan and Prince George) recorded 3-year averages within 10% of the target (indicated by the yellow band).

Ground level ozone

Data Sources and Reliability

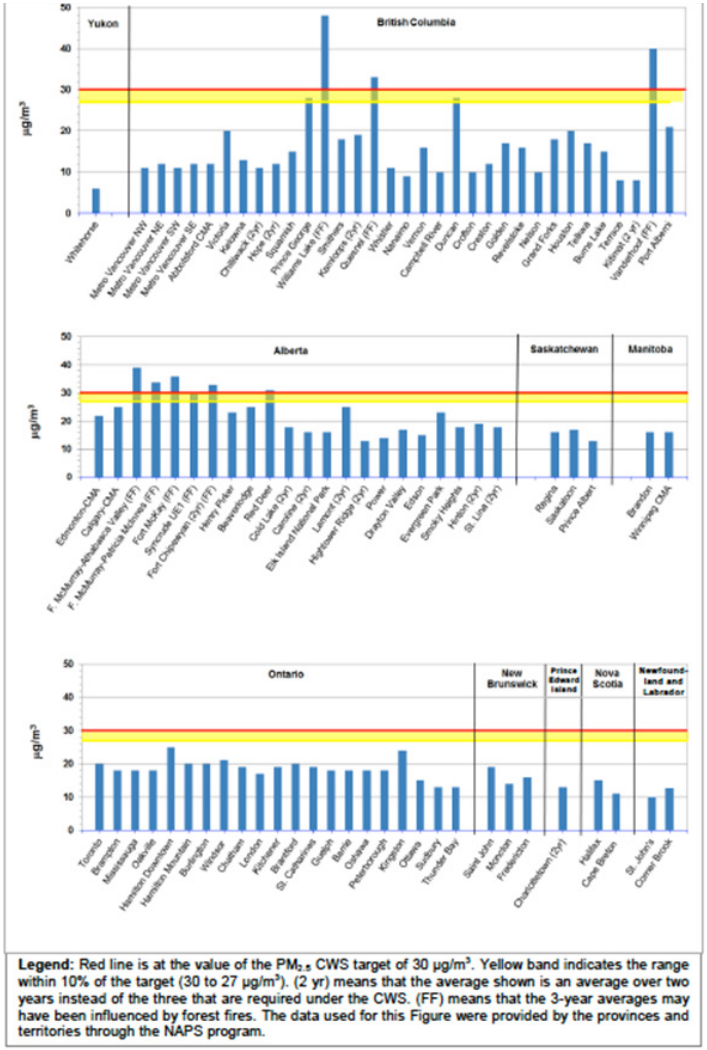
Ground-level ozone is a key determinant of human and ecosystem health. It can induce breathing problems, reduce lung function, and aggravate asthma and other lung diseases. It can also have devastating impacts on local economies, including significant crop damage. Elevated concentrations of ground level ozone is the most significant air quality issue affecting agricultural production.[19]

There is no known lowest effect level for ozone and minimization is the best objective.[20]

Ground-level ozone levels are at their worst during the summer months, when strong sunlight and hot weather trigger a chemical reaction that results in harmful concentrations.

Canada-Wide Standards for ground level ozone use a peak 8-hour value based on the 4th-highest daily maximum 8-hour average concentration, averaged over three years. This peak indicator calculation is aligned with the Canadian Ambient Air Quality Standards (CAAQS) (Table 6).

Figure 8: $PM_{2.5}$ average values for reporting locations 2010- 2012



Legend: Red line is at the value of the $PM_{2.5}$ CWS target of 30 µg/m^3. Yellow band indicates the range within 10% of the target (30 to 27 µg/m^3). (2 yr) means that the average shown is an average over two years instead of the three that are required under the CWS. (FF) means that the 3-year averages may have been influenced by forest fires. The data used for this Figure were provided by the provinces and territories through the NAPS program.

The CCME 2010 to 2012 comparison study contains the caveat "*since the 3-year averages … may be based on a mix of newer and older monitors, caution is recommended when comparing the 3-year averages between locations and to the Canada-Wide Standards target.*"

18 The 3 year average appears much higher than the annual average because it is the 3-year average of the annual 98th percentile of the daily 24-hour average concentrations.

19 Page 310 of GB-PS Air Characterization Report 2012

20 Dr Paul Hasselback, Medical Health Officer, Central Island. Email communication November 25, 2014.

Table 6: CWS for ground level ozone

	Old Standards	New Standards	
		2015	2020
Ozone for 8-hour	65 parts per billion	63 parts per billion	62 parts per billion

Source: Environment Canada, Backgrounder, Canadian Ambient Air Quality Standards http://www.ec.gc.ca/default.asp?lang=En&n=56D4043B-1&news=A4B2C28A-2DFB-4BF4-8777-ADF29B4360BD Accessed on October 20, 2014.

Until recently, ground-level ozone had not been monitored in the Cowichan Region. Duncan's Cairnsmore Street monitoring station started measuring ground-level ozone in November 2009.

Findings

There have been no 8-hour exceedances of the ground-level ozone CWS target since monitoring began in November 2009 (Table 7). The annual average mean concentrations were also below standard (Table 8) with a slight increase in 2012 attributed to long-range transport of pollution from massive forest fires in Siberia.[21]

Table 7: Ground level ozone, Cairnsmore 2009 - 2013

Year	Peak 8-hr exceedances	Peak 8-hr exceedances	Rolling 3-year average
	>65 ppb	4th highest peak	4th highest 8-hr average
2009	0	48	-
2010	0	47.7	48
2011	0	46.9	48
2012	0	50.8	48
2013	0	49.3	49

Source: Ministry of Environment, 2014.

Table 8: Annual average mean concentrations, Cairnsmore 2009-2013

Year	Average Mean
2009	14.2
2010	17.4
2011	17.9
2012	20.2
2013	16.2

Source: Ministry of Environment, 2014.

Benchmarking

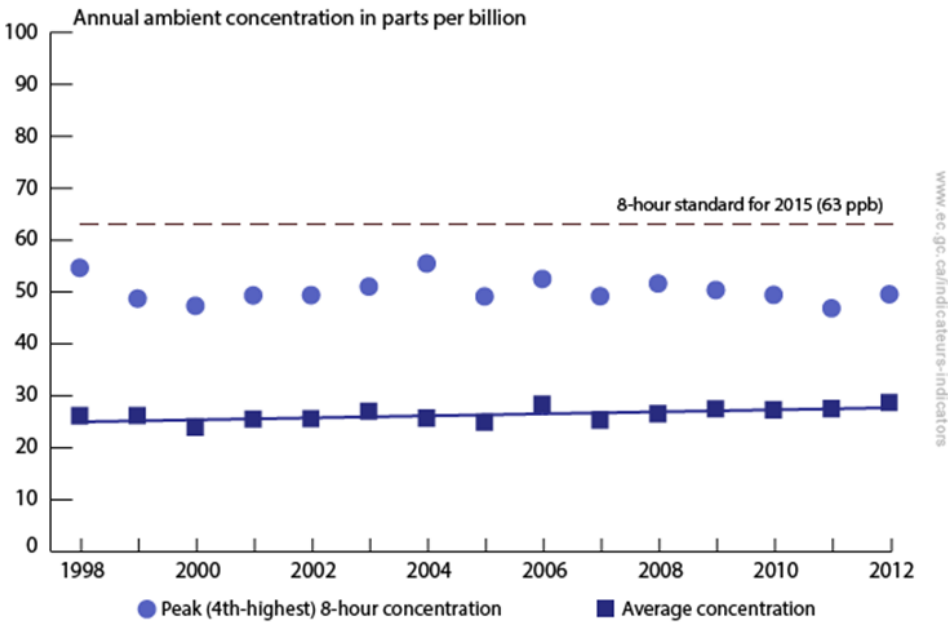
Ground level ozone levels in most areas of the Georgia Basin – Puget Sound airshed are below national standards and regional objectives. The highest ozone concentrations are generally observed downwind of urban centers and at high elevation sites. Regional ozone episodes remain a problem in certain hot spots, such as Enumclaw, WA, and in the central and eastern portions of the Canadian Lower Fraser Valley, where national ambient standards have been periodically exceeded in the past decade.[22]

In British Columbia, the annual peak (4th-highest) 8-hour concentration of O_3 was 50 ppb, or 6% higher than in 2011. The annual peak concentrations were below the 2015 standard for the period 1998 to 2012 (Figure 9).

21 Earle Plain, Air Quality Meteorologist, Ministry of Environment. Personal communication, November 14, 2014.

22 Page 30, GBPS Airshed Characterization Report 2014.

Figure 9: Ozone concentrations, British Columbia, 1998 to 2012



Source: Environment Canada (2014) National Air Pollution Surveillance program (NAPS) and the Canadian Air and Precipitation Monitoring Network (CAPMoN).

Respiratory diseases

Data Sources and Reliability

The human respiratory system is particularly sensitive to air pollution. Air pollutants, such as ground-level ozone and particulate matter, can injure the lungs directly. These pollutants may also trigger inflammation in the lungs that can affect the heart and blood vessels.[23]

Poor air quality causes measurable increases in the rates of hospitalization for people with respiratory and cardiovascular diseases and for others who are considered more vulnerable to airborne pollutants, including children and seniors.[24] There remain questions as to whether poorer air quality causes these illnesses or aggravates existing conditions.[25]

For these reasons, it is useful to assess air pollution levels by looking at the prevalence of common respiratory diseases affected by air pollution. The Vancouver Island Health Authority (Island Health) tracks common respiratory diseases affected by air pollution: hospital admissions for children with respiratory problems (0-14 years), prevalence and incidence of asthma (5-54 years) and prevalence of chronic obstructive pulmonary disease (45+-years).[26]

This data is accurate and reliable, and is intended to be enhanced by a more in-depth study by Island Health, and Health Canada studies looking at the AQHI and air quality in rural areas. Findings from the Health Canada study are unlikely prior to 2017.

23 Health Canada. Respiratory Effects of Air Pollution. Accessed November 14, 2014. http://www.hc-sc.gc.ca/ewh-semt/air/out-ext/health-sante/respir-eng.php

24 Health Canada website: http://www.hc-sc.gc.ca/ewh-semt/air/out-ext/health-sante/respir-eng.php - accessed October 27, 2014. Children respond to air pollution in different ways than adults, mainly because they take in more air—and thus more air pollution—per unit body weight when exercising than adults (20–50% more), and generally spend more time outside than adults. The impacts of poor air quality on children include aggravated respiratory problems such as airway irritation, coughing, and pain when taking a deep breath; wheezing and breathing difficulties during exercise or outdoor activities; aggravation of asthma and increased susceptibility to respiratory illnesses like pneumonia and bronchitis; and suppressed lung growth. (Sources: US Environmental Protection Agency www.epa.gov/groundlevelozone/health.html. See also: Outdoor Air Quality—A Primer for Physicians (and Appendix), 2009. Prepared by the UBC School of Environmental Health and Centre for Health and Environment Research; B.C. Centre for Disease Control; BC Lung Association; and Ministry of Healthy Living and Sport. www.bc.lung.ca/airquality/airquality_primer.html)

25 Health Canada website: http://www.hc-sc.gc.ca/ewh-semt/air/out-ext/health-sante/respir-eng.php - accessed October 27, 2014

26 Local Health Authority profiles created yearly by Island Health's Planning and Community Engagement Department. Find profiles here. http://www.viha.ca/mho/stats/lha_profiles.htm. There are three LHAs that cover the Cowichan region, LHA 65, 66 and 67 (Cowichan, Lake Cowichan, and Ladysmith respectively). Section 4.6 Child Health contains the rate of respiratory disease hospitalizations for children aged 0-14. Island Health obtains this data from Stats Canada at this website, http://www.bcstats.gov.bc.ca/StatisticsBySubject/SocialStatistics/SocioEconomicProfilesIndices/Profiles.aspx, by selecting Local Health Area (LHA) as the region type and then the LHA (e.g. 065-Cowichan) as the region.

Note: The 2010 State of the Environment Report recommended further disaggregation of the hospital admissions data (e.g., by month, by respiratory disorder) to enable a more direct comparison with seasonal fluctuations in air quality (higher $PM_{2.5}$ in the fall and winter, potentially higher ground-level ozone in the summer). This 2014 update rescinds this recommendation; the Medical Officer of Health for the Central Island indicates that disaggregated data would have limited value for a number of reasons, including that there is a 1–3 day time lag in health impacts from air pollution, and that winter hospital admissions go up everywhere—not just in our region, questioning the value of comparisons based on monthly information.[27]

Findings

Hospital admission rates for children with respiratory problems vary through the region. In the Cowichan health area (Cowichan District Hospital catchment area), admissions rates are higher than the provincial average—at times by a significant amount, and have been consistently increased for over a decade[28] (Figure 10). Admissions rates are slightly less elevated in the Ladysmith health area, and are at or below the B.C. average for the Lake Cowichan health area.

The incidence of asthma (rate of new cases in the population each year) in persons aged 5-54 and the prevalence (proportion of the population having ever been diagnosed) are elevated in Ladysmith, and closer to average for the island and province for Cowichan and Lake Cowichan[29] (Figures 11 and 12).

Asthma incidence and respiratory disease hospitalization may be reflective of a variety of issues including increased environmental exposure, exposure to smoke in the household, genetic susceptibility and physician practices.[30]

27 Dr Paul Hasselback, Medical Health Officer, Central Island. Personal communication, October 27, 2014.

28 Dr Paul Hasselback, Medical Health Officer, Central Island. Email communication November 12, 2014.

29 Dr Paul Hasselback, Medical Health Officer, Central Island. Email communication November 12, 2014.

30 Dr Paul Hasselback, Medical Health Officer, Central Island. Email communication November 12, 2014.

Chronic Obstructive Pulmonary Disease (COPD) in persons over the age of 45 is increased in all areas of the region. COPD is often caused by smoking, but may reflect long-term occupational exposures or environmental exposures. The prevalence rates of COPD in Ladysmith and Cowichan areas are 1.67 times that of the island and B.C. average[31] (Figure 13).

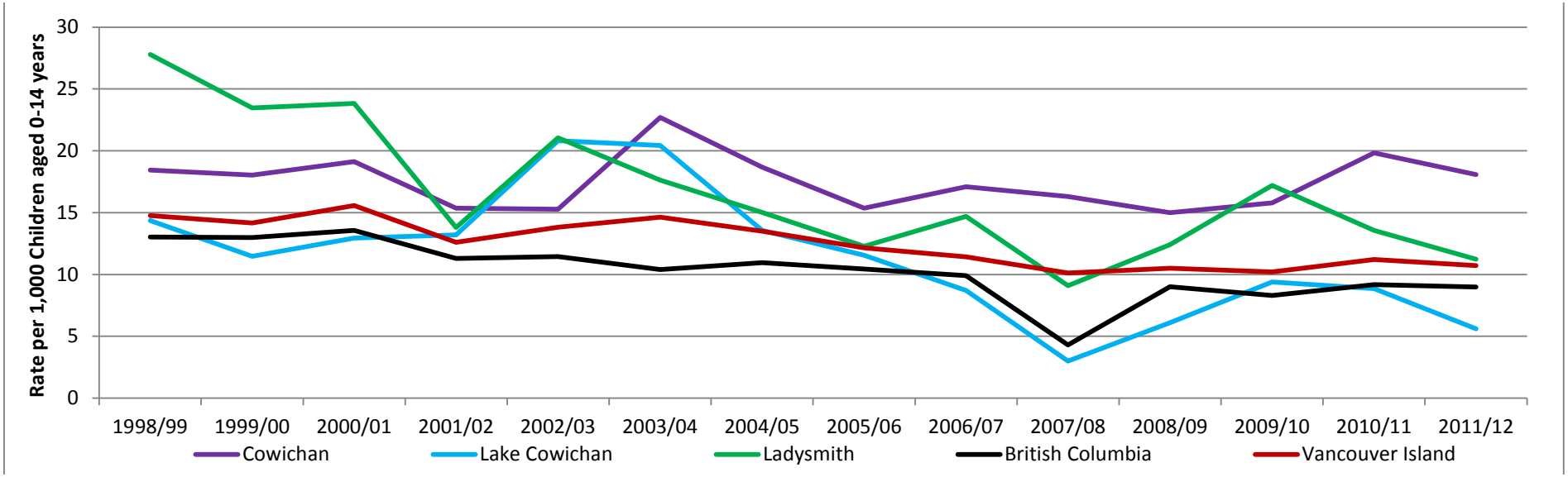
Data Gaps

Existing air quality monitoring stations only show information from a limited area: currently three are clustered around industrial activities in the Crofton area and one is located in downtown Duncan. Additional monitoring may be useful, particularly in areas where topography and airflow patterns can cause pollutants to become concentrated at higher levels.

The impacts of air pollution on Cowichan's ecosystem health have not been examined in any detail, although two known studies suggest it is unlikely that currently air pollution levels are impacting the natural environment. Similarly, the impacts of air pollution on Cowichan's economy have yet to be explored.

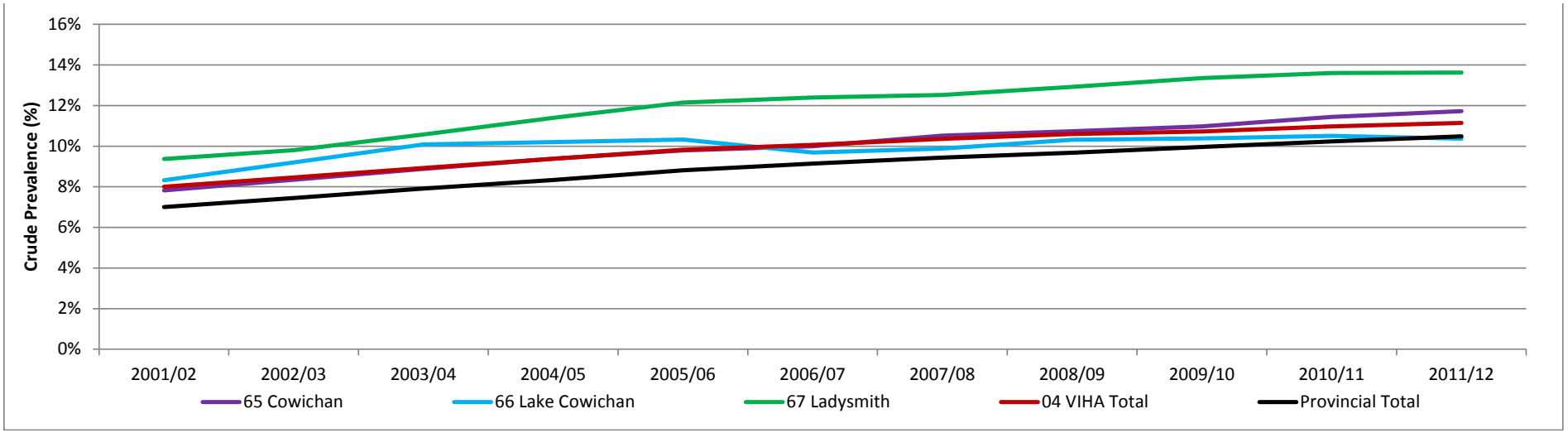
31 Dr Paul Hasselback, Medical Health Officer, Central Island. Email communication November 12, 2014.

Figure 10: Annual number of admissions per 1,000 people (case rate), by local health area, 1998 to 2012



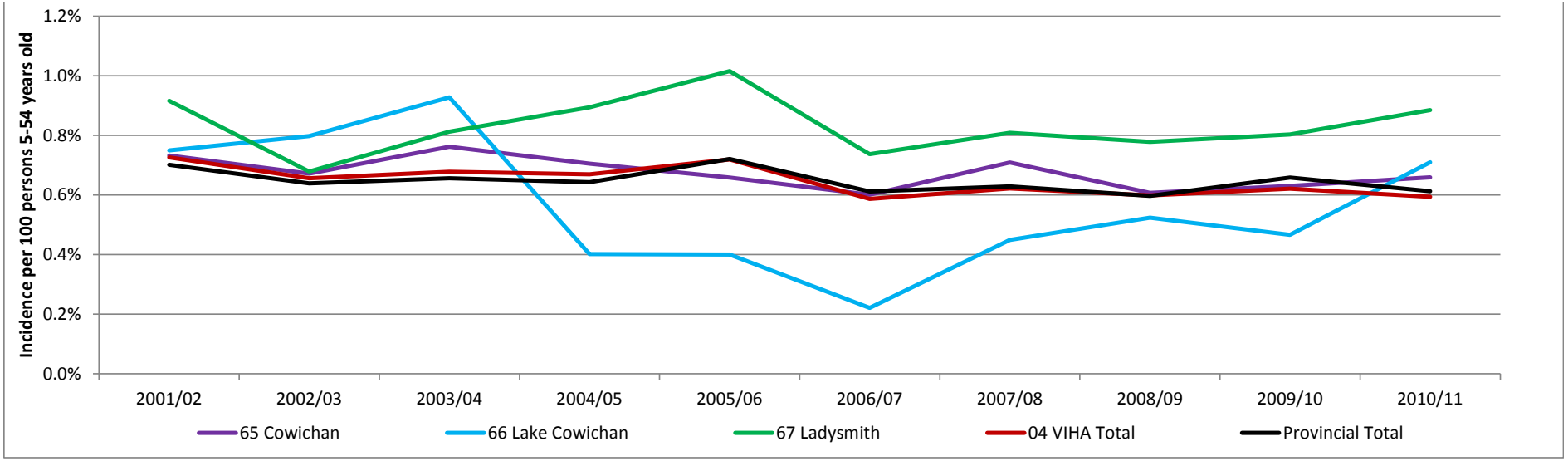
Note: Some case rates in 2007/08 were lower than the scale of this chart (meaning less than 1,000 people admitted). *Source: Vancouver Island Health Authority, 2014.*

Figure 11: Incidence and prevalence of asthma, 5-54 year olds, by local health area, 2001 to 2012



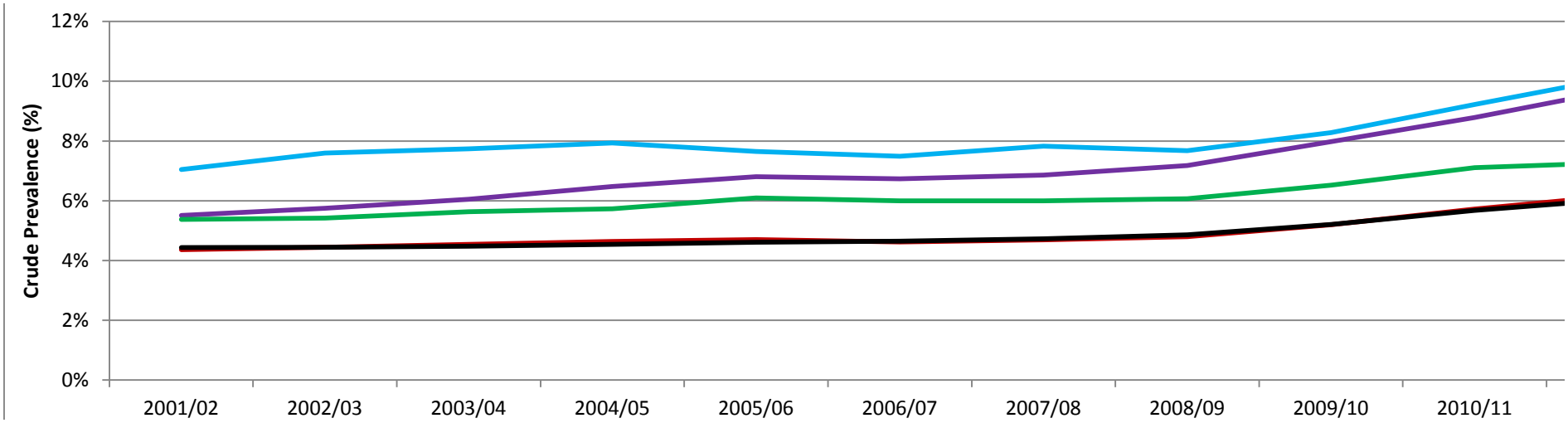
Source: Vancouver Island Health Authority, 2014

Figure 12: Prevalence of Asthma among 5-54 year olds, Cowichan Valley, by local health area, 2001 to 2012



Source: Vancouver Island Health Authority, 2014

Figure 13: Prevalence of COPD among population 45+, by local health area, 2001 to 2012



Source: Vancouver Island Health Authority, 2014