



## Cowichan's Regional Airshed Protection Strategy

*DRAFT for Discussion Purposes*



*<Insert additional logos here for participating organizations as appropriate>*

**A partnership of** *[All potential participants include: Cowichan Valley Regional District, Municipality of North Cowichan, Town of Ladysmith, City of Duncan, Town of Lake Cowichan, Ministry of Environment, Island Health, Our Cowichan - Communities Health Network, School District 79, University of Victoria, Cowichan Tribes, Ditidaht First Nation, Halalt First Nation, Lake Cowichan First Nation, Lyackson First Nation, Malahat First Nation, Pauquachin First Nation, Pacheedaht First Nation, Stz'uminus First Nation, Cowichan Bay VFD, Shawnigan Lake VFD, Mill Bay VFD, Thetis Island VFD, First Nations Health Authority, Timberwest, Island Timberlands, Fresh Air Team, Catalyst Paper, BC Transit, Pacific Pilotage Authority, Ministry of Forests Lands and Natural Resource Operations, Agricultural Community, Sea to Sky Clean Air Society, Managed Forest Council, Saltspring Island Air Quality protection initiatives]*



## Table of contents

What is the air quality problem in our Region?	05
Our History	06
Why are we concerned about air quality?	07
What is an airshed?	07
Addressing Air Quality Concerns by Airshed Planning	08
Why pursue a Community Based Approach?	08
Participants	09
Our Vision	10
Our Goals, Objectives and Targets	11
Key Actions	13
Our Supporting Actions	20
Appendix A - Emissions Inventory	24
Appendix B - Air Quality Study	28
Appendix C - Our Indicators and Targets	40
Appendix D - Contaminant Prioritization	42
Appendix E - References	43

This strategy has formally been tabled for review at the following organizations and accepted and will be included in future programming for action as per the identified roles and responsibilities laid out.

*[organization names to be inserted here]*



*This report outlines a Regional Airshed Strategy for the Cowichan Valley Regional District (CVRD). It identifies the necessary steps to be undertaken in order to develop an effective response to growing air quality concerns in the region. This work is consistent with and taken based on direction in the CVRD Corporate Strategic Plan which specifically directs that an airshed protection strategy be developed. Given this is an area in which many players are involved the CVRD has taken the lead role in the development of the strategy in coordination with MOE, however the implementation will require a broad and coordinated response from many.*

*Jon Lefebure – Chair Cowichan Valley Regional District*

## What is the air quality problem in our Region?

In the Cowichan, the air contaminant of greatest concern is PM2.5, which refers to particulate matter that is less than 2.5 microns in length. This is the particulate matter of greatest concern because it can travel deep into the lungs and become lodged there, causing heart and lung disease, and premature death. Fine particles that comprise PM2.5 are also efficient at scattering light, resulting in degradation of visibility.

A 2014 Air Quality Study for the Cowichan region indicated that there are occasional exceedances of the provincial PM2.5 objectives from 2009 to 2013. The Study also indicated that the exceedances were primarily due to local open burning and wood burning appliances (winter), and forest fires located in other regions (summer). An emission inventory completed in 2014 revealed that 77% of the total PM2.5 in the Region is coming from area sources. Open burning accounted for 53% of the total PM2.5 and wood burning appliances accounted for 23% of the total PM2.5.

## Our History

Air quality concerns in our Region are rooted in local history. The primary sources for PM2.5 include open burning and wood burning appliances. However, the burning of wood debris for clearing land and the use of wood stoves for residential heating has been happening for generations.



*There is something about the smell of wood smoke and the warmth of heat from a fire that is comforting for people. In our region, it is part of our history of living off the land. People will say: "My parents burned wood and my grandparents burned wood, why wouldn't I?" Today, we know about the health effects of wood smoke. And today, the technology and practices exist to do it better.*

*TW Paterson – local historian and author of over 26 books on BC History*

Wild fires have also been contributing to air quality concerns throughout our history. In 1938, a cloud of smoke one mile high covered two-thirds of Vancouver Island and was reported as far south – 640 km – as Portland Oregon. Its fly-ash was so thick that two ships collided off Port Angeles. This was the product of Vancouver Island's worst forest fire ever, the Great Fire (so-called) of 77 years ago which burned an area of approximately 350 square kilometers.



*Image mcr020399-7 courtesy of the Museum at Campbell River*



*Image mcr020399-16 courtesy of the Museum at Campbell River*

## Why are we concerned about air quality?

There is solid scientific evidence at a national level of a strong link between air pollution levels and impacts on human health. Locally, data from Island Health indicates that **in the Cowichan Local Health Area, admissions rates for children with respiratory diseases averaged 70% higher than provincial rates** for the period 1998 to 2012. In 2012 the **proportion of persons aged 5-54 diagnosed with asthma was 14% higher** and the **prevalence of chronic respiratory illness for all persons aged 45 and over was 50% higher in Cowichan Valley Regional District than the province.**



In our region, air emissions originate from a wide range of sources including mobile vehicle emissions, stationary industrial point sources, residential or commercial area sources and natural sources. There is also a wide range of types of contaminants being emitted. For common air contaminants (CAC) such as particulate matter (PM) and ground-level ozone, health impacts have been found even at low concentrations, indicating that there may be no safe level. The elderly, the young, those with lowered immunity, and/or existing heart and lung ailments are especially vulnerable.

Air pollution also affects the integrity of natural ecosystems and agricultural crops, increases greenhouse gas emissions and degrades the visibility of scenic vistas. Together with the health costs, these impacts and their consequences for tourism and other industries have implications for economic activity throughout the region.

## What is an airshed?

The term “airshed” is used to describe an area where the movement of air tends to be hindered by the local geography and by weather conditions. The most obvious examples of an airshed would be the Cowichan, the Shawnigan, Chemainus Basins or even the larger Georgia Basin. Airsheds are not confined to political boundaries and they can be at multiple scales depending on a variety of variables such as geography, dominant wind patterns or weather.

During temperature inversions, a common event in our region, the cooler air near the ground is trapped by warmer air aloft. The effects and duration can be much different depending on the season. The types of emissions that accumulate in the surface layer will vary according to seasonally related activities such as summer traffic, winter home heating with woodstove or open burning in the fall.

In contrast, when the air is well mixed and winds are moderate, pollutants are quickly dispersed. In some cases, the pollutants and their by-products may be transported long distances beyond the airshed. This is a reminder that everyone and their activities are globally interconnected and that our local conditions are to some extent affected by issues elsewhere. The region experiences impacts to air quality from a wide variety of events including fires in Europe, central BC and other areas, dust storms in Asia and the combustion of fossil fuels by mobile sources and large facilities in neighboring regions.

For the above reasons, many of our communities are prone to periods of poor air quality. As global and regional emissions increase and local ground temperatures increase, air quality is expected to continue to worsen over time. This can have numerous impacts on the community, including adversely affecting human health, the environment and visibility. It can also limit a community's ability to attract or accommodate desirable and potential growth. Fortunately, action at the local level can be taken to reduce local consequences.

## Addressing Air Quality Concerns by Airshed Planning

Local, regional and provincial governments have developed and applied various approaches to combat and control air pollution. Among these, airshed planning has emerged as an important tool for dealing with multiple pollution sources that involve numerous stakeholders and, in some cases, cross political boundaries. Airshed planning is a stakeholder-driven process to coordinate the abatement of activities affecting air quality in a defined area or airshed. It recognizes that local air quality is influenced by a myriad of activities and sources, including industry, transportation, commercial and residential development, wood smoke, road dust, and natural circumstances. Since no one jurisdiction controls all these sources, a collective approach to air quality protection is needed that engages a variety of organizations and individuals and, where necessary, encourages partnerships with neighbouring communities in developing and implementing local solutions.

To date, all such efforts in BC have been voluntary in nature, in keeping with a shared stewardship approach. Currently, there are 14 airshed plans that have been completed for various airsheds in the province, with some variation in key areas, objectives, and mechanisms. The issues and ability of key players in the region will affect the level and speed of implementation of a regional strategy. As such it is important that the development of such a strategy include the participation of a broad range of participants working in a coordinated fashion.

## Why pursue a Community Based Approach?

Because the impacts of poor air quality affect such a broad spectrum of the community and originate from a variety of sources a multi stakeholder process is necessary in order to address sources effectively. This will require that all affected organizations and entities are

aligned and coordinated so that policies, actions and ongoing monitoring is effective and strategic in nature. No one entity is charged with the issue nor can any individual action address its effects in a meaningful way.

Existing programs and policies in the region are already contributing towards air quality management objectives (e.g., energy and climate action planning, transportation planning, open burning bylaws, wood burning appliance programs). As such, the emphasis of the proposed strategic process will be on supporting and expanding these existing initiatives.

The value of partnerships for airshed protection is illustrated by successes already achieved in the Region including:

- backyard burning regulations in 5 electoral areas and 4 municipalities,
- a woodstove exchange program that has supported the upgrades of 635 woodstoves
- the *clear the air cowichan* communications materials
- a series of 5 articles on wood smoke in the local newspaper
- partnership with UVIC researchers to undertake initial nephelometer study
- partnership with MOE that allowed for the technical background required to backstop this (emissions inventory, air quality study for the CVRD)
- current partnership for installation of additional regional monitoring stations across region (total now 4)

These programs were all delivered through a collaboration of several provincial government, local government, academic and stewardship organizations. If it is possible to achieve a coordinated alignment it will be possible to ensure that future planning and programming builds effectively on the overall goals and identified actions. And enforcing the philosophy of collective impact, shared interests and shared responsibility which will be a keystone for long term and stable policy development and community health objectives.

## Participants

Contributions from the various organizations involved in local air quality management are key to the successful design and implementation of an Airshed protection strategy. To date a number of ongoing discussions have occurred in the region and most recently planning discussions were hosted by the MOE and the CVRD in 2014 and 2015 to bring together a focused Round Table group to develop a collaborative Airshed Protection Strategy for the region and its affected populations. Each organization has interest in moving forward on the development of a Regional Airshed Strategy as a sub component of the Regional Sustainability and Health Strategies. This strong message provided the impetus to MOE and the CVRD to partner on the development of the necessary background studies (attached as appendices A and B).

The Round Table gathered over a number of meetings in 2014 and 2015 and discussed the overall issues affecting air quality in the region. Based on the insights gathered through these discussions, the CVRD and the MOE partnered to develop additional background material and identification of specific contaminants, appropriate indicators and draft targets for the groups discussion (see appendices C and D).

Based on a structured process the group then identified specific goals, actions and the identification of key leaders and supporting organizations. The following Action Plan is the result of that work and will form the combined efforts of the collaborative in achieving *our vision*.

## Our Vision



***Working together for clean air to support our health, our environment and our communities***

## Our goals, targets and objectives

Airshed planning and implementation will be an ongoing effort of many. While a number of high priority goals have been identified, it is recognized that this will be an ongoing process of refinement over time. Short term and long term actions are summarized below then in more detailed tabular format. Key targets have also been included. The complete set of indicators and targets is provided in Appendix C.

### **1. GOAL – Protecting Human Health**

We will protect and improve regional air quality so our communities are as healthy as possible.

#### **Key Targets**

- Zero exceedance of 24 hour BC AAQO for PM2.5 (25 ug/m<sup>3</sup>)
- Zero exceedance of annual BC AAQO for PM2.5 (8 ug/m<sup>3</sup>)

#### **Objectives**

- Reduce PM2.5 emissions from local open burning including land clearing burning and backyard burning
- Reduce PM2.5 emissions from wood burning appliances
- Support programs that reduce emissions from mobile and point sources of all targeted pollutants (PM10, PM2.5, SO2, Nox, CO and VOC)

#### **Key Actions – High Priority**

- Raise public awareness on the health impacts of wood smoke, the alternatives, the best practices and the rules.
- Develop consistent airshed wide regulatory approach for open burning
- Contribute to provincial efforts to control wood smoke through participation in wood smoke strategy discussions
- Explore options for a curbside pickup of yard and garden materials to overcome barriers to open burning alternatives.
- Develop airshed wide regulatory approach for wood burning appliances
- Develop incentives for wood burning appliance upgrades to overcome financial barriers for upgrading and replacing appliances
- Promote use of alternative energy sources and systems

#### **Supporting Actions – Medium Priority**

- Reduce vehicle idling through policies and education
- Support alternative modes of transportation
- Reduce stop and go traffic on the Trans-Canada Highway

- Reduce dust emissions in communities adjacent to dirt roads
- Compliance with federal and provincial regulatory requirements by point source emitters.

#### **Participants**

- Lead roles for the Ministry of Environment, Island Health, First Nations, Our Cowichan - Communities Health Network, Municipalities, the CVRD and other local governments.
- Support from all Airshed Protection Roundtable participants

## **2. GOAL – Building Strong and Collaborative Partnerships:**

We recognize that many players are critical to true partnerships and we will work towards coordinating our efforts to achieve the objectives and benefits clean air provides our community.

#### **Key Targets**

- Formation of an Airshed Protection Roundtable with Terms of Reference and Annual Reporting

#### **Objectives**

- Develop Terms of Reference for the Airshed Protection Roundtable
- Implement the actions in this strategy
- Annual monitoring and reporting of progress towards the goals, targets and objectives of the strategy

#### **Key Actions – High Priority**

- Develop Terms of Reference for the Airshed Protection Roundtable
- Collaborative development of work plans for the actions identified in this strategy.
- Periodic reporting by the Roundtable on progress towards meeting the objective in the Strategy
- Periodic assessment of whether the strategy should focus on other pollutants of interest
- Develop existing and new linkages to climate change, wildfire (bc *firesmart*), transportation and solid waste planning processes.

#### **Participants**

- All Round Table participants and other organizations that can improve air quality in the Region.

## Key Actions

### Goal #1: Protecting human health

**We will protect and improve regional air quality so our communities are as healthy as possible.**

The following actions related to goal #1 are considered **high priority** as they could lead to a relatively large reduction in PM2.5. The tables provide details of the initiatives and tasks that will help us achieve our goals.

<b>Emission Sources: Open Burning and Wood Burning Appliances, the 1<sup>st</sup> and 2<sup>nd</sup> largest sources of PM2.5.</b>					
<b>Objectives:</b>					
<ul style="list-style-type: none"> <li>• Reduce emissions from local open burning including land clearing burning and backyard burning</li> <li>• Reduce emissions from wood burning appliances</li> </ul>					
<b>#</b>	<b>Action</b>	<b>Initiative</b>	<b>Who?</b>	<b>Status</b>	<b>Proposed Future Tasks</b>
1	Raise public awareness on the health impacts of wood smoke, the best practices, the alternatives and the rules.	Deliver a regionally coordinated public awareness campaign to educate the public on the health impacts of wood smoke, the best practices, the alternatives and the rules. Tools to include: <ul style="list-style-type: none"> <li>• Website</li> <li>• Printed media (newspaper and newsletters)</li> <li>• Social Media</li> <li>• Community Outreach</li> <li>• Agriculture focused media and content</li> </ul>	Our Cowichan - Communities Health Network, Island Health, MoE, UVic, the CVRD, municipalities, School District	<b>Initiative is in progress.</b> <i>Tasks Completed:</i> <ul style="list-style-type: none"> <li>• Clear the Air Cowichan website includes information on the rules and best practices (burn it smart).</li> <li>• Released 5 newspaper articles in the Fall of 2014 on the impacts of wood smoke.</li> <li>• Air quality advisories for the region are released by the MoE.</li> </ul>	<ul style="list-style-type: none"> <li>• 2016 late summer/fall - Run article series again. <b>Lead:</b> <u>MoE and CVRD</u></li> <li>• 2016 - Turn articles into series of digital info documents. <b>Lead:</b> _____</li> <li>• 2016 - Develop a public interface for air quality issues and alerts that can be delivered effectively using a variety of media routes. <b>Lead:</b> _____</li> </ul>

**Emission Sources: Open Burning.**

*Open Burning is the largest source of PM2.5*

**Objective:** Reduce emissions from local open burning including land clearing burning and backyard burning

#	Action	Initiative	Who?	Status	Proposed Future Tasks
2	Develop consistent airshed wide regulatory approach for open burning	2a. Develop, implement and review backyard burning bylaws across the region.	CVRD, Municipalities, Fire Improvement Districts,	<p><b>Initiative is in progress.</b></p> <p><i>Tasks Complete:</i></p> <ul style="list-style-type: none"> <li>Open burning bylaws Implemented in the Municipality of North Cowichan, City of Duncan, Town of Ladysmith, Town of Lake Cowichan and some CVRD electoral areas</li> </ul>	<ul style="list-style-type: none"> <li>Spring 2016 - Review bylaws on a rolling 3 year basis. <b>Lead:</b> <u>CVRD, Municipalities and _____.</u></li> <li>Spring 2016 - Identify issues and barriers for implementation of bylaws across whole of region, including improvement districts and additional electoral areas. <b>Lead:</b> <u>CVRD, Municipalities and _____.</u></li> <li>Explore expansion of burning timelines to take advantage of better venting in some areas and reduce the number of days with people burning. <b>Lead:</b> <u>CVRD, Municipalities and _____.</u></li> </ul>
		2b. Explore an update to open burning bylaw(s) in the Region to include prohibition of any open burning on zoned agricultural land and ALR land as long as it is not 'a normal farm practice'.	Ministry of Agriculture, CVRD, Agricultural Community, Municipalities	<p><b>Initiative is pending</b></p>	<ul style="list-style-type: none"> <li>Spring 2016 - Preliminary discussion with CVRD agriculture commission. <b>Lead:</b> <u>MAL, CVRD and _____.</u></li> <li>Spring 2016 - Focused stakeholder meeting with local agricultural producers. <b>Lead:</b> <u>MAL, CVRD and _____.</u></li> <li>Spring 2016 - Develop and clarify the role of burning on agricultural</li> </ul>

					properties in an educational way. <b>Lead: MAL CVRD and</b> _____.
		2c. Explore complete ban on backyard burning for additional high density areas in the Region	All Airshed Roundtable participants	<b>Initiative is Pending.</b> <i>Background:</i> Backyard burning is banned in the City of Duncan, Town of Ladysmith and the Town of Lake Cowichan.	<ul style="list-style-type: none"> <li>Fall 2015 - Review of Official Community Plan (OCP) issues, explore area E as a starting point given the current OCP cycle and public consultation. <b>Lead: CVRD, Ministry of Agriculture and Agricultural Community.</b></li> <li>Spring 2016 - Explore the development of metrics to track the number of burns that follow best practices and those that don't. <b>Lead: CVRD and</b> _____.</li> </ul>
3	Contribute to provincial efforts to control wood smoke	Monitor or participate in Open Burning Smoke Control Regulation (OBSCR) planning discussions and other wood smoke strategy discussions	Forest Industry, MFC, Min of Ag, Agricultural Community, Island Health, CVRD, MoE, Municipalities	<b>Initiative is in Progress</b> Provincial OBSCR discussions are ongoing.	<ul style="list-style-type: none"> <li>Ongoing for 3 to 5 years – Participation by MoE and Island Health in OBSCR discussions. <b>Lead: MoE.</b></li> <li>Spring 2016 - Report progress to Airshed Roundtable on periodic basis. <b>Lead: MoE.</b></li> </ul>
4	Explore options for a curbside pickup of yard and garden materials to overcome financial barriers to the alternative.	Study the potential benefits and costs for curbside pickup of yard and garden materials and options for the receiving facility (District Energy System or compost facility)	CVRD, Municipalities, Agricultural Community,	<b>Initiative is in Progress.</b> CVRD has already gathered information on costs and benefits.	<ul style="list-style-type: none"> <li>2016 - Explore costs and benefits for a yard and garden pickup including: <ul style="list-style-type: none"> <li>o Include options for commercial or multi-family residential organics</li> <li>o Consider breaking up the two waste streams for more specific management objectives.</li> </ul> <b>Lead: CVRD and</b> _____.</li> </ul>

					<p>Seek direction from the Board and Report back to task force by 2016.  <b>Lead: CVRD and</b>  _____.</p> <ul style="list-style-type: none"> <li>• 2017 - explore the pilot use of a fee for service air curtain burner.  <b>Lead: CVRD and</b>  _____.</li> </ul>
--	--	--	--	--	---

**Emission Sources: Wood Burning Appliances**

Wood burning appliances is the 2<sup>nd</sup> largest source of PM2.5

**Objective:** Reduce emissions from local open burning including land clearing burning and backyard burning

#	Action	Initiative	Who?	Status	Proposed Future Tasks
5	Develop airshed wide regulatory approach for wood burning appliances	<p>Develop and implement a model wood burning appliance bylaw to be available for the region.</p> <p>Explore options including:</p> <ul style="list-style-type: none"> <li>• During air quality advisory, no woodstoves may be used.</li> <li>• Upon sale of house, woodstove must be removed.</li> <li>• No woodstoves in new homes being constructed.</li> </ul>	CVRD, Municipalities, Ministry of Environment	<p><b>Initiative is in Progress.</b></p> <p><i>Tasks Complete:</i></p> <ul style="list-style-type: none"> <li>• Wood burning appliance bylaw implemented in the City of Duncan</li> </ul>	<ul style="list-style-type: none"> <li>• Develop and implement a model wood burning appliance bylaw <ul style="list-style-type: none"> <li>○ 2016 - Estimate the number of woodstoves there are in the region by spatial locations and age.</li> <li>○ 2016- Further develop an understanding of the use of woodstoves in economically challenged households</li> <li>○ 2016 - Request an update from the province regarding the changes to legislation required for real estate transactions</li> <li>○ 2017 - Expand and support the burn it right program</li> <li>○ 2017- Explore and make recommendations on the</li> </ul> </li> </ul>

					<p>expansion of wood burning bylaws in other high density areas</p> <ul style="list-style-type: none"> <li>○ 2017 - Legal review of woodstove ban in new homes.</li> </ul> <p><b>Lead:</b> <u>CVRD</u></p>
6	Develop incentive programs for wood burning appliance upgrades.	Develop and implement a wood burning appliance rebate program for the region	Ministry of Environment, CVRD, Municipalities,	<p><b>Initiative is in Progress.</b></p> <p><i>Tasks Complete:</i></p> <ul style="list-style-type: none"> <li>• Rebate program implemented in North Cowichan and CVRD electoral areas</li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing - Continue wood burning appliance upgrades at a pace of established in action 5 above.</li> </ul> <p><b>Lead:</b> <u>CVRD</u></p> <ul style="list-style-type: none"> <li>• 2017 - Expand woodstove switch out program to include incentives for transition to alternative modes of heating.</li> </ul> <p><b>Lead:</b> <u>CVRD</u></p>
7	Promote use of alternative energy sources and systems	Promote alternative energy pilot programs and grant programs.	School District, Local Solar Energy Stewardship Community, CVRD, Municipalities,	<p><b>Initiative is in Progress.</b></p> <p><i>Tasks Complete:</i></p> <ul style="list-style-type: none"> <li>• Solar panel demonstration project being explored for the Region</li> <li>• Events in the community to promote clean energy forms have been coordinated by local stewards and co-ops.</li> <li>• Potential for exploring District Energy Systems</li> </ul>	<p>2016 – Include information on alternative energy source and systems in public awareness campaign.</p> <p><b>Lead:</b> _____.</p> <ul style="list-style-type: none"> <li>• 2016 – Contribute air quality information to solar energy stewardship community as they engage to the community.</li> </ul> <ul style="list-style-type: none"> <li>• <b>Lead:</b> _____.</li> </ul>

**Goal #2: Building strong and collaborative partnerships**

**We recognize that many players are critical to true partnerships and we will work towards coordinating our efforts to achieve the objectives and benefits clean air provides our community.**

The following actions are considered to be **high priority** as they support the reduction of PM2.5 and other targeted contaminants.

<b>Emission Sources: All</b>					
<b>Objectives:</b>					
<ul style="list-style-type: none"> <li>• Develop Terms of Reference for the Airshed Protection Roundtable</li> <li>• Implement the actions in this strategy</li> <li>• Annual monitoring and reporting of progress towards the goals, targets and objectives of the strategy</li> </ul>					
<b>#</b>	<b>Action</b>	<b>Initiative</b>	<b>Who?</b>	<b>Status</b>	<b>Proposed Future Tasks</b>
1	Formation of an Airshed Protection Roundtable	Develop Terms of Reference Formation for an Airshed Protection Roundtable that will implement the actions in this Strategy.	All Round Table participants and other organizations that can improve air quality in the Region.	<b>Initiative is in progress.</b> <i>Tasks complete:</i> <ul style="list-style-type: none"> <li>• The Airshed Roundtable has begun the process of building partnerships through gathering at 3 workshops from 2013 to 2015 to develop this strategy.</li> </ul>	<ul style="list-style-type: none"> <li>• Strategy to be reviewed and approved in principle by partnering organizations in the Fall of 2015. <b>Lead:_____</b></li> <li>• TOR to be developed by Dec 2015. <b>Lead:_____</b></li> </ul>
2	Develop Work Plans	Develop work plans for the <u>high priority</u> actions identified in this strategy. Identify supporting processes for the <u>medium priority</u> actions identified in this strategy	All Round Table participants	<b>Initiative is in progress</b>	<ul style="list-style-type: none"> <li>• January 2016 and ongoing - Task force to meet annually to report out and develop 2 year work plans <b>Lead:_____</b></li> <li>• January 2016 - Invitation to participate to be extended to fire departments. <b>Lead:_____</b></li> </ul>
3	Periodic Reporting and	Annual reporting by the	All Round Table	<b>Initiative is pending</b>	<ul style="list-style-type: none"> <li>• Dec 2015 - Decision and</li> </ul>

	Monitoring	Roundtable on progress towards meeting the objectives in the Strategy.	participants		<p>recommendations on monitoring framework and reporting to be developed with recommendations  <b>Lead:</b>_____</p> <ul style="list-style-type: none"> <li>December 2015 - Annual reporting and task force meeting and communications schedule to be discussed for recommendations  <b>Lead:</b>_____</li> </ul>
		Periodic assessment of whether the strategy should focus on other pollutants of interest.	All Round Table participants	<b>Initiative is pending</b>	<ul style="list-style-type: none"> <li>Fall 2016 – Review whether strategy should focus on other pollutants of interest  <b>Lead:</b>_____</li> <li>Establish review cycle and process  <b>Lead:</b>_____</li> </ul>
		Regional Air Quality Monitoring	MoE and CVRD	<b>Initiative is in progress</b>	<ul style="list-style-type: none"> <li>Spring 2016 - MOE will provide air monitoring stations and technical support via a MOU with the CVRD  <b>Lead:</b> <u>MoE and CVRD</u></li> </ul>
4	Develop existing and new linkages to climate change, transportation, wildfire and solid waste planning processes.	Participate in climate change strategy, transportation planning, wildfire (bc firesmart) and solid waste planning discussions.	All Round Table participants	<b>Initiative is pending</b>	<ul style="list-style-type: none"> <li>Spring 2016 - Preliminary presentations to task force with proposed issues and linkages by invited representatives  <b>Lead:</b>_____</li> </ul>

## Supporting Actions

The following actions are considered to be **medium priority** for the following reasons:

- they could lead to a relatively large reduction in targeted contaminants including Nitrogen Oxides (NOx), Carbon Monoxide (CO) and Volatile Organic Compounds (VOCs); and/or
- they could lead to a relatively small reduction in PM2.5; and/or
- the actions are beyond the direct control of representatives of the Airshed Protection Roundtable

<b>Emission Sources: On-Road Vehicles</b>					
<i>On-road vehicles are the second largest source of Nitrogen Oxides (NOx) and Carbon Monoxide (CO) emissions in our region.</i>					
<b>Objective:</b> Support programs that reduce emissions from mobile and point sources of all targeted pollutants (PM10, PM2.5, SO2, NOx, CO and VOC)					
#	Action	Initiative	Who?	Timing	Proposed Future Tasks
1	Reduce vehicle Idling through policies and education	<ul style="list-style-type: none"> <li>• Identify organizations and companies with/without policies. Extend invitations to support anti-idling policies for companies that do not have one</li> <li>• Provide anti-idling resources to organizations (e.g. free anti-idling signs for store parking lots)</li> </ul>	Stewardship Community, CVRD, Municipalities, Island Health	<p><b>Initiative is in progress.</b></p> <p><i>Tasks complete</i></p> <ul style="list-style-type: none"> <li>• Anti-idling policy under exploration for the CVRD vehicle fleet</li> <li>• Municipal anti-idling bylaws have been implemented</li> </ul>	<ul style="list-style-type: none"> <li>• Report to task force spring 2016</li> </ul> <p><b>Lead:</b> _____</p>
2	Support alternative modes of transportation	Support programs that overcome barriers to bicycling as a commuting option	CVRD, Municipalities, Ministry of Transportation and Highways,	<b>Initiative is in progress.</b>	<ul style="list-style-type: none"> <li>• Local governments to report out issues and recommendations regarding active transportation in Summer 2016.</li> </ul> <p><b>Lead:</b> _____</p>

			Stewardship Community, Island Health		
		Support programs that overcome barriers to electric vehicle use as a commuting option	Electric vehicle community, CVRD, Municipalities	<b>Initiative is in progress.</b> <i>Tasks Complete</i> 10 publicly accessible Electric Vehicle charge stations installed across 4 municipalities (Ladysmith, North Cowichan, Lake Cowichan and Duncan) and 2 electoral area (Mill Bay, and Shawnigan Lake)	<ul style="list-style-type: none"> <li>By 2017 - task force and collaborative group to provide support letters to electric vehicle associations <b>Lead:</b> _____</li> <li>By 2017 - local partners (where possible) to explore installing EVI stations in their facilities <b>Lead:</b> _____</li> </ul>
		Raise awareness for public transit and promote ridership	BC Transit Municipalities All Round Table participants	<b>Initiative is in progress.</b> <i>Tasks Complete</i> The Cowichan Valley Future Transit Plan is complete and ridership targets are included in the plan. The plan envisions what the network should look like 25 years from now. Implementation is underway.	<ul style="list-style-type: none"> <li>By 2017 - Task force partners to review how their organizations can support internally and externally the use of public transportation in their programs and public messaging <b>Lead:</b> _____</li> <li>By 2017 - Report to be brought back to the task force <b>Lead:</b> _____</li> </ul>
		Road Improvements to improve walkability	Municipalities, Ministry of Transportation and Highways, CVRD	<b>Initiative is in progress.</b> <i>Tasks Complete</i> CVRD Parks and Trails Master Plans include active transportation and have	By 2017 - Task force members to consider how to support the collection of this information from their user groups <b>Lead:</b> _____

				<p>been developed for some electoral areas of the region. Transportation planning as part of the CVRD's Regional Integrated Strategy is underway.</p> <p>City of Duncan's active transportation plan is being developed.</p>	<ul style="list-style-type: none"> <li>By 2017 - Local governments to review OCP's and provide recommendations on improvements.</li> </ul> <p><b>Lead:</b> <u>CVRD and Municipalities</u></p>
3	Reduce Stop and go traffic on the Trans Canada Highway and other major road systems in area	Implement the TransCanada Highway (TCH) Corridor Management Plan	Ministry of Transportation and Highways, CVRD, Municipalities and Cowichan Tribes.	<p><b>Initiative is in progress.</b></p> <p><i>Tasks Complete</i></p> <p>The Boys Rd to Beverley Rd section of the TCH corridor management plan is being implemented.</p>	<ul style="list-style-type: none"> <li>By Dec 2016 - MOTI be invited to become a partner on the task force or strategy by December 2015.</li> </ul> <p><b>Lead:</b> _____</p>
4	Reduce dust emissions in communities adjacent to dirt roads	Reduce Mud track out onto main roads to through truck wash stations	TimberWest, CVRD, Town of Lake Cowichan, Island Health,	<p><b>Initiative is in progress.</b></p> <p><i>Tasks Complete</i></p> <p>The Youbou truck wash station has been built and is expected to be in use in the Fall of 2015.</p>	<ul style="list-style-type: none"> <li>By Dec 2016 - MOTI be invited to become a partner on the task force or strategy by December 2015.</li> </ul> <p><b>Lead:</b> _____</p> <ul style="list-style-type: none"> <li>A representative of the Managed Forest Council to be invited to sit on as an industrial representative by December 2015.</li> </ul> <ul style="list-style-type: none"> <li><b>Lead:</b> _____</li> </ul>

**Emission Sources: Point Sources**

*Point Sources are the largest contributor of Sulphur Dioxide and Total Reduced Sulfur. And the second largest contributor of VOCs.*

**Objective:** Support programs that reduce emissions from mobile and point sources of all targeted pollutants (PM10, PM2.5, SO2, NOx, CO and VOC)

#	Action	Initiative	Who?	Timing	Proposed Future Tasks
1	Compliance with provincial and federal regulatory requirements for reporting of PM10, PM2.5, SO2, CO, NOx, VOCs and TRS.	Annual air quality monitoring and reporting	Large point source facilities. Ministry of Environment	<b>Initiative is in progress.</b> <i>Ongoing tasks underway</i> Many of the large facilities in our region are reporting for compliance with provincial and federal permitting requirements for facilities.	<ul style="list-style-type: none"><li>Spring 2016 - Catalyst to provide annual data and issues identification</li></ul> <b>Lead:</b> <u>Catalyst</u>

## Appendix A - Emissions Inventory for the Cowichan Region

### Background

Levelton Consultants Ltd. (Levelton) was retained by BC Ministry of Environment (MoE) and for the Cowichan Valley Regional District (CVRD) to compile an emissions inventory for the region. The main purpose of the 2014 analysis was to provide background information regarding which pollutants/emission sources may be of greatest concern and identify and individual sectors/subsectors will be key to future management actions. The regional inventory was compiled for 2011 as the base year and forecasted at five-year intervals for 2016, 2021, 2026 and 2031.

### Scope

The emissions inventory was compiled for the following key pollutants of interest:

- Particulate Matter (PM), including the following size fractions:
  - Particulate matter less than 2.5 microns in equivalent diameter (PM<sub>2.5</sub>);
  - Particulate matter less than 10 microns in equivalent diameter (PM<sub>10</sub>);
  - Total particulate matter (TPM);
- Carbon Monoxide (CO);
- Sulphur Oxides (SO<sub>x</sub>);
- Nitrogen Oxides (NO<sub>x</sub>);
- Ammonia (NH<sub>3</sub>); and
- Volatile Organic Compounds (VOCs)

No specific analysis of carbon dioxide or other Greenhouse Gases (GHG's) was undertaken as it was outside of the parameters of this study and have been calculated as a component of the Community Energy and Emissions Inventory (CEEI) by the Province.

The emissions inventory identified a number of source categories including: point sources (large industrial facilities), area sources (light industrial, residential, commercial and institutional sources, agricultural activities, miscellaneous sources), mobile sources (on-road motor vehicles and non-road sources including aircraft, marine vessels, and others such as construction and lawn and garden equipment), and road dust. A summary of the emission inventory is provided below.

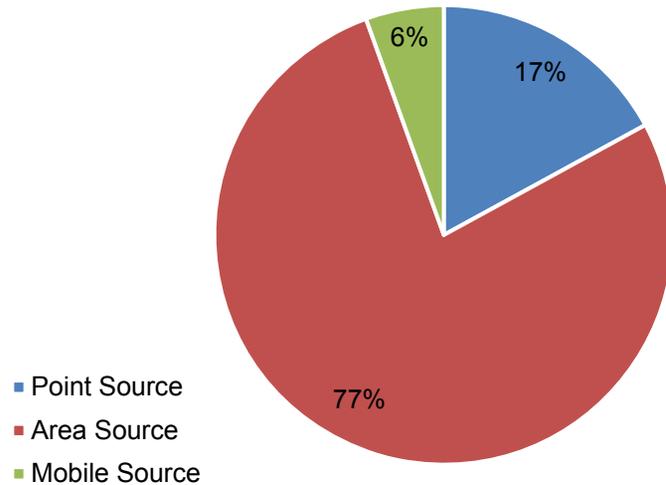
## Results – where are the emissions coming from?

The majority of TPM, PM10, PM2.5, VOC and NH3 emissions were from area sources. Mobile sources, excluding road dust, were the largest contributor of CO and NOx. The largest emitters for SO2 were point sources.

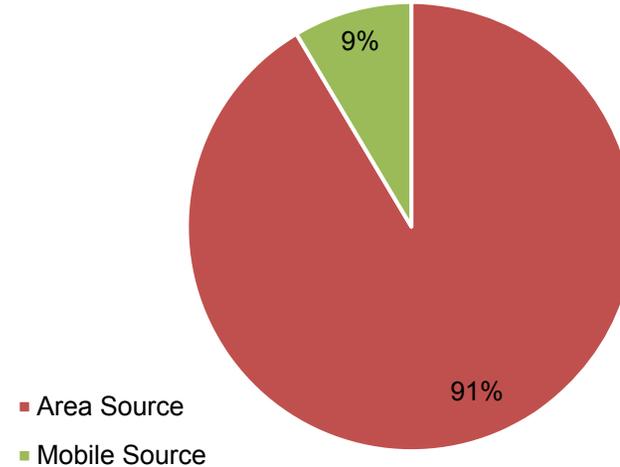
### Area Sources

Overall, the majority of TPM, PM10, PM2.5, VOC and NH3 emissions were from area sources. Open burning was the largest contributor of CO, NOx, TPM, PM10 and PM2.5. VOC emissions from gasoline marketing including the distribution and sales of petroleum products at service stations and solvent evaporation accounted for approximately half of the total VOC emissions from area sources. Agricultural activities were the largest source for the regional NH3 emissions. Space heating was the largest contributor of SO2 emissions and second largest contributor of CO, NOx, TPM, PM10 and PM2.5 emissions.

**Distribution of PM2.5 Emissions**



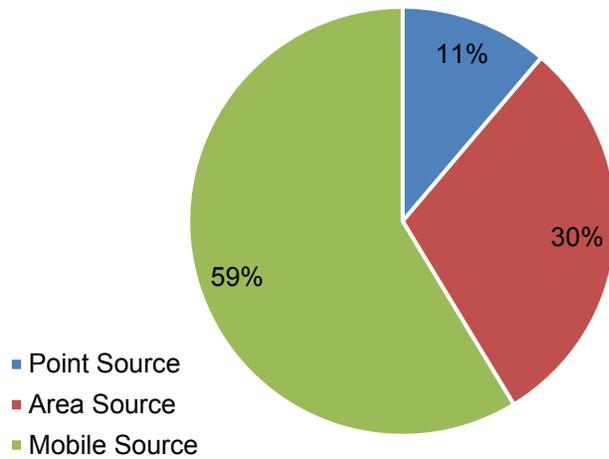
**Distribution of NH3 Emissions**



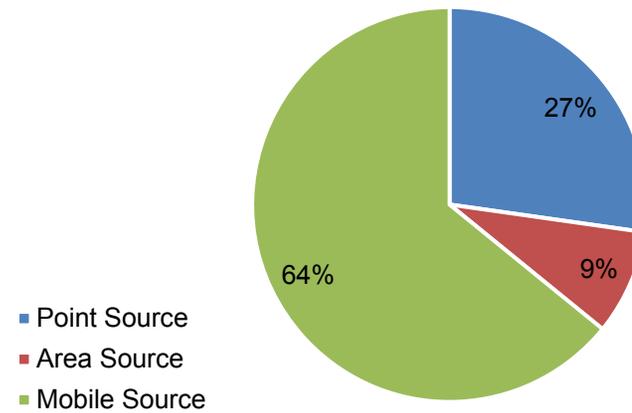
### Mobile Sources

Overall, mobile sources, excluding road dust, were the largest contributor of CO and NOx. Data analyses indicated that emissions from on-road vehicles were the largest contributor of all CACs from mobile sources with the exception of NOx. Marine vessels were the largest contributor of NOx emissions from mobile sources. The second largest emission contributor to CO, TPM, PM10, PM2.5 and VOC emissions from mobile sources was non-road equipment/vehicles. CAC emissions due to aircraft activity were insignificant.

**Distribution of CO Emissions**



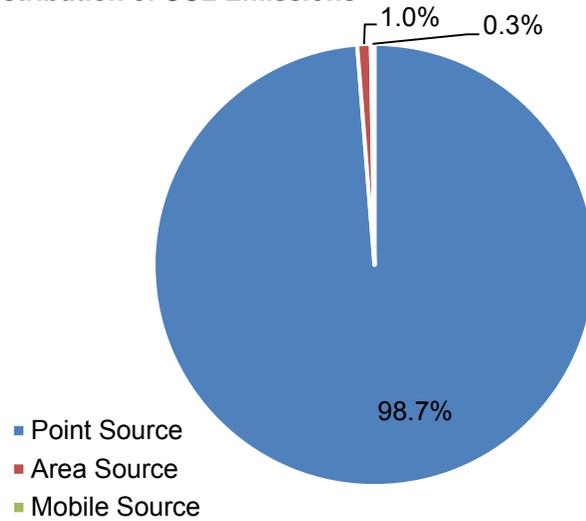
**Distribution of NOx Emissions**



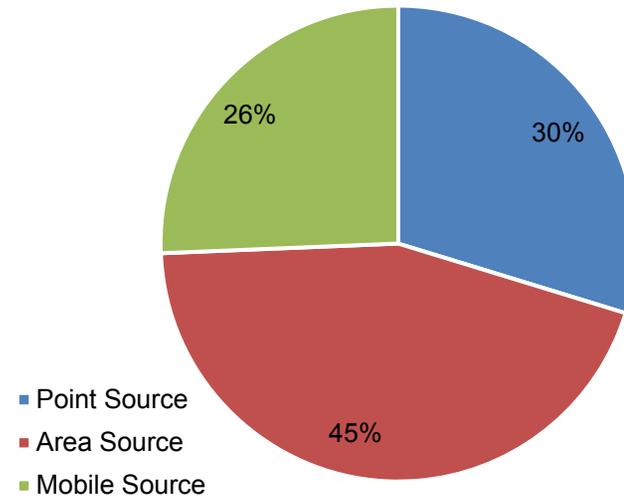
### Point Sources

Overall, the largest emitters for SO<sub>2</sub> were point sources. The majority of point source industry emissions were from the pulp and paper sector, which accounted for 87% of CO, 95% of NO<sub>x</sub>, 62% of TPM, 77% of PM<sub>10</sub>, 86% of PM<sub>2.5</sub>, 67% of VOC, and 99.7% of SO<sub>x</sub> emissions from point sources. The petroleum product storage sector was the second largest contributor at 29% in terms of total VOC emissions.

Distribution of SO<sub>2</sub> Emissions



Distribution of VOC Emissions



## Appendix B - Air Quality Study for the Cowichan Region

### Background

The BC Ministry of Environment and the Cowichan Valley Regional District engaged Stantec Consulting Inc. in 2014 to analyze the meteorological and air quality datasets for the region to develop a more comprehensive analysis of the impact of emission on air quality. The study considered the 11- year period 2003 through 2013 to consolidate the most recent air quality information in support of future airshed management efforts. Statistical summaries, graphics, and case studies were used to characterize patterns in the observed air quality conditions.

### Scope

Air quality datasets from four monitoring stations in the CVRD were analyzed. These include Crofton Substation, Crofton Escarpment Way, Duncan Deykin Avenue, and Duncan Cairnsmore. The Crofton Substation and Duncan Deykin Avenue stations were operational prior to 2003. Observations at Crofton Escarpment Way and Duncan Cairnsmore stations began in October 2008 and July 2009, respectively.

The five substances that were measured and analyzed are: sulphur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), particulate matter (PM), total reduced sulphur (TRS), and ozone (O<sub>3</sub>). Particulate matter is further categorized by diameter into inhalable (PM<sub>10</sub>) and respirable (PM<sub>2.5</sub>) fractions. These substances are known collectively as criteria air contaminants (CACs). Air quality is determined by a comparison of the measured CAC concentrations with the national and provincial ambient air quality objectives (AAQO).



## Results of baseline analysis

### **Respirable Particulate Matter - PM2.5 (particulate size is small enough to be absorbed and distributed into organs of body)**

There were sporadic exceedances of the PM2.5 objectives (Figures 1 and 2). The study revealed that the exceedances were episodic and not systemic in nature. The Crofton Substation, Crofton Escarpment Way, and Duncan Deykin Avenue stations had very few exceedances of the 24-hour AAQO for PM2.5 while Duncan Cairnsmore had a greater frequency in winter (Figure 3). **The meteorological data analysis revealed that these sporadic exceedances may be due to local burning and space heating (winter), and long range transport from forest fires located in other regions (summer).**

### ***Impact of pollutant***

PM2.5 refers to particulate matter that is less than 2.5 microns in length. This is the particulate matter of greatest concern because it can travel deep into the lungs and become lodged there, causing heart and lung disease, and premature death. Fine particles that comprise PM2.5 are also efficient at scattering light, resulting in a degradation in visibility.

The following figures illustrate the exceedance of PM2.5 objectives and the daily pattern observed at the Duncan Cairnsmore location.

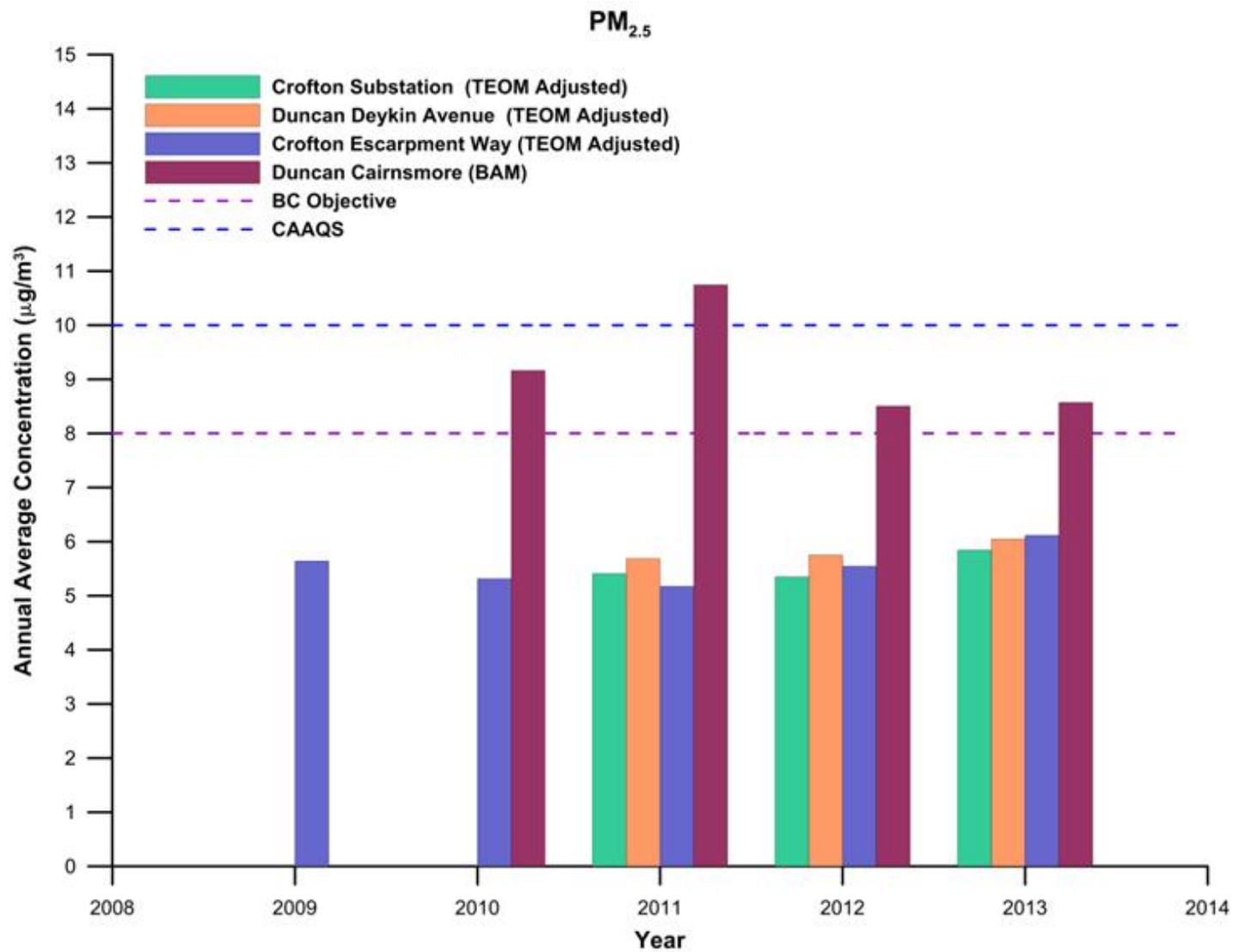


Figure 1. Annual Average PM<sub>2.5</sub> Concentrations in the CVRD

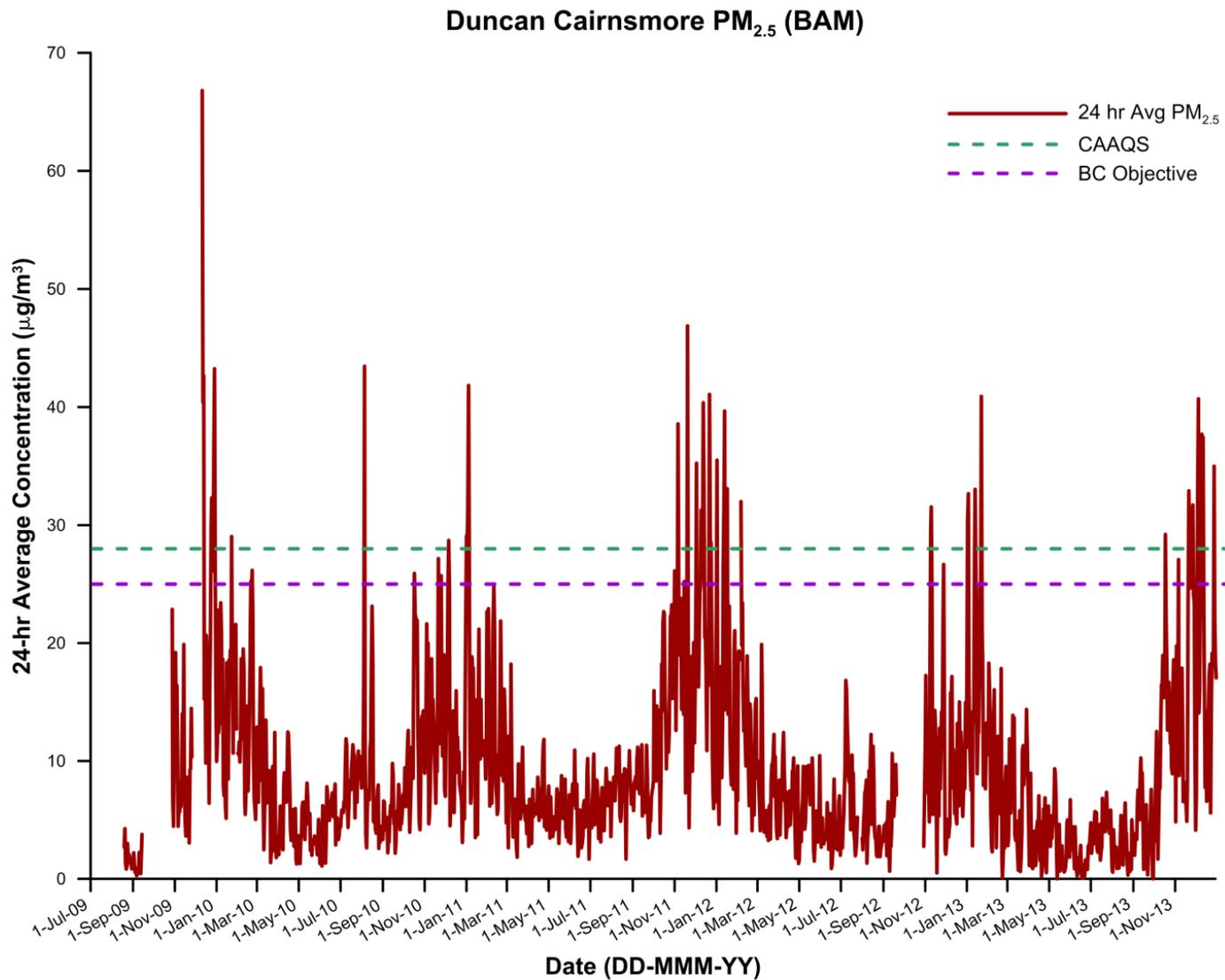


Figure 2. 24 Hour Average PM<sub>2.5</sub> at Duncan Cairnsmore

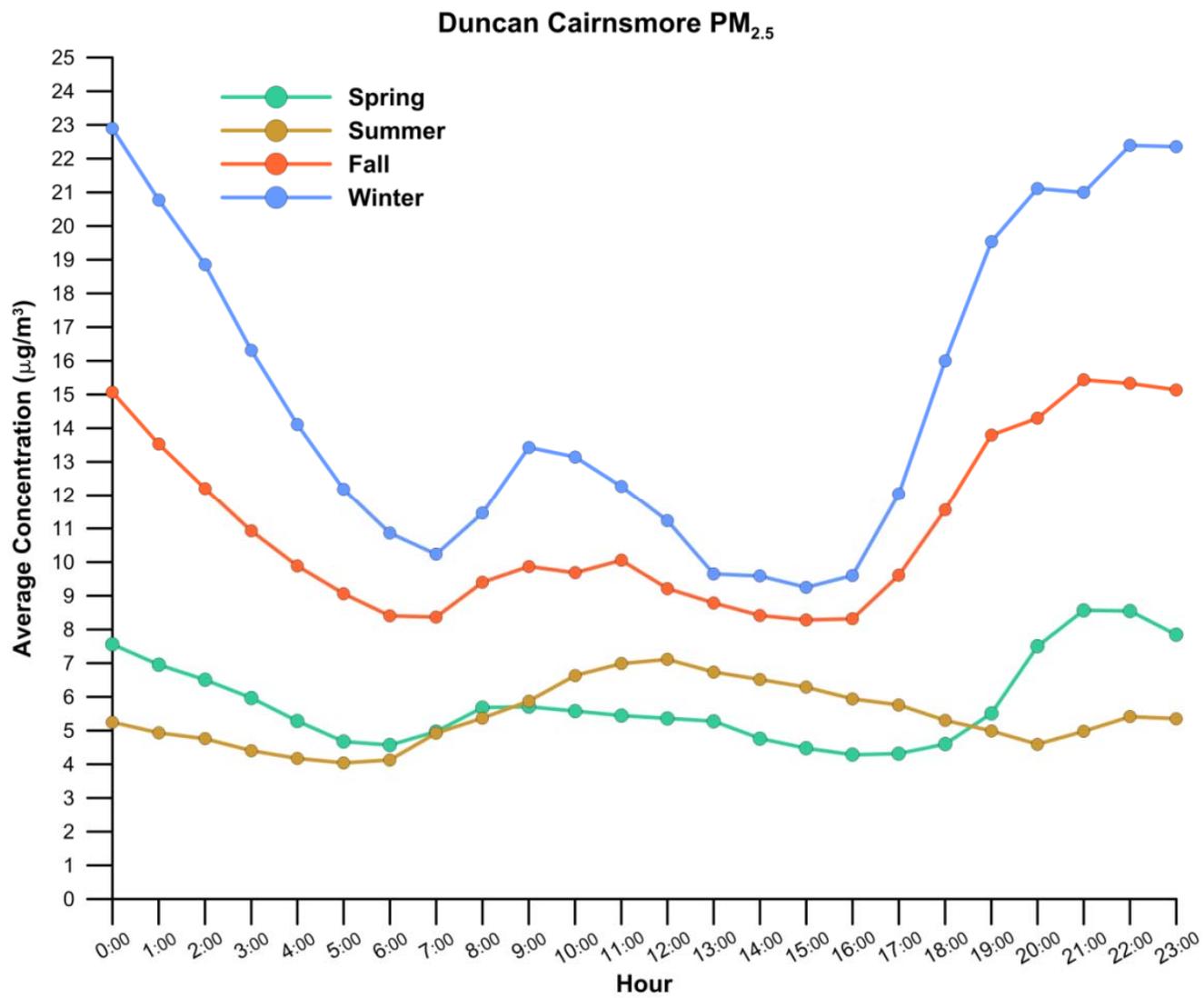


Figure 3. Diurnal Trends in PM<sub>2.5</sub> Concentration at Duncan Cairnsmore by Season.

## Inhalable Particulate Matter – PM10 (particulate size will irritate and cause coughing, become lodged in respiration system)

At Crofton Substation, there was just one day when the 24 hour average PM10 concentration exceeded the BC AAQO (Figure 4). There were no exceedances of the provincial objective at Duncan Deykin Avenue from 2003 to 2010 (Figure 5). At Crofton substation, there is minimal seasonal trend with slightly higher concentrations in the spring and summer compared to the fall and winter. At Duncan Deykin Avenue, there were higher concentrations in the late fall and early winter due to activities such as space heating and open burning.

### Impact of pollutant

PM10 refers to particulate matter that is less than 10 microns in length. These particles can irritate the nose and throat, but do not normally penetrate deep into the lungs. Particulate matter is the main source of haze that reduces visibility. These particles can also make lakes and other sensitive areas more acidic, causing changes to the nutrient balance and harming aquatic life.

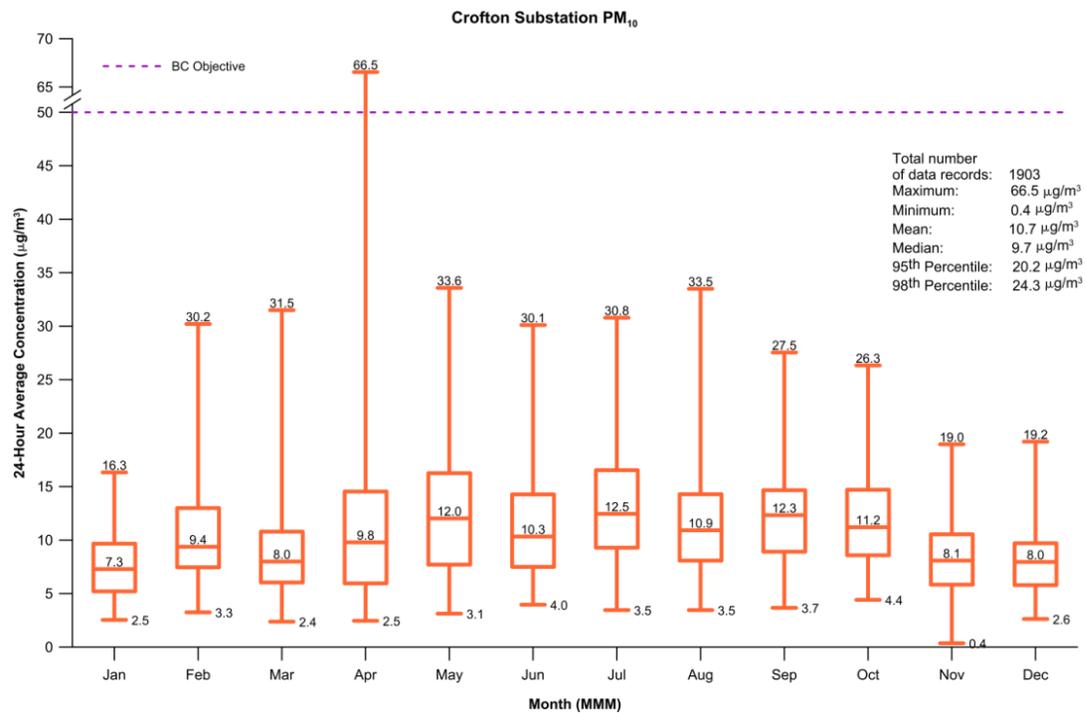
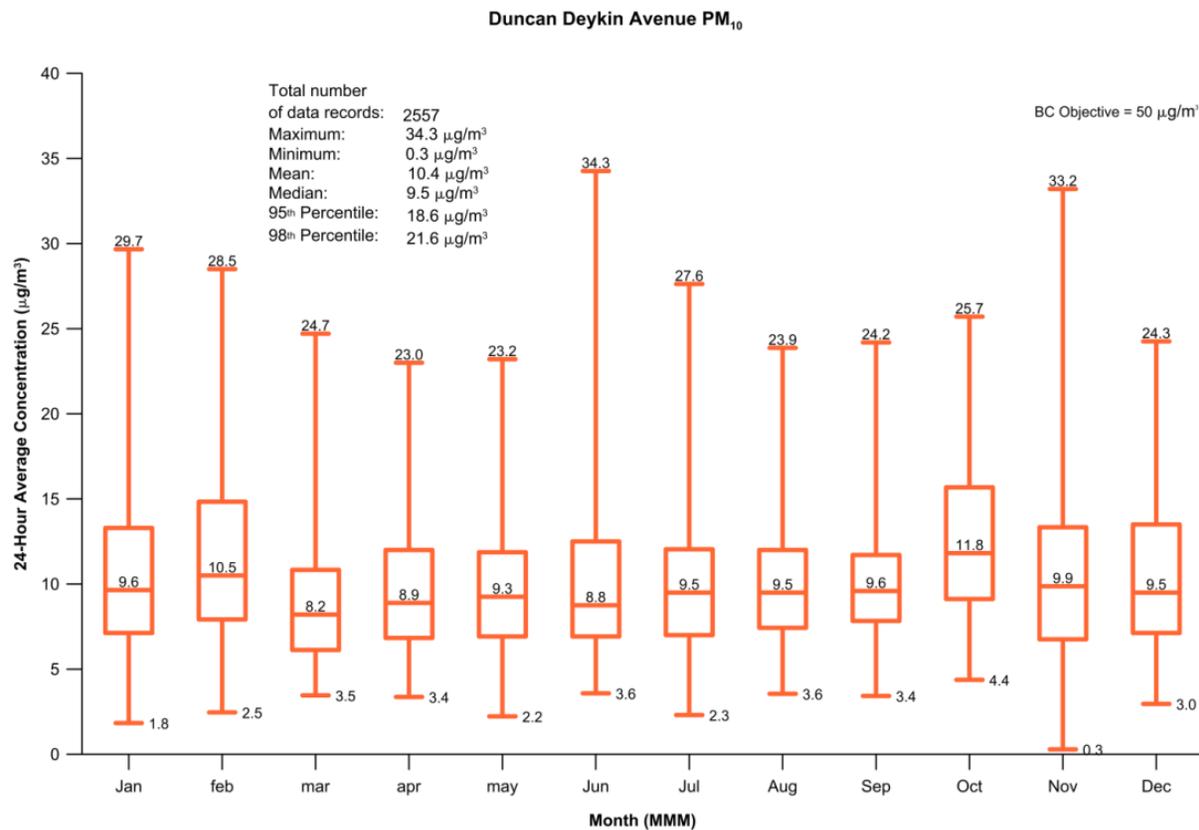


Figure 4. Monthly Variation of 24-Hour Average PM10 Concentration at Crofton Substation Based on 2005–2010 Data



**Figure 5. Monthly Variation of 24-Hour Average PM<sub>10</sub> Concentration at Duncan Deykin Avenue Based on 2003–2010 Data**

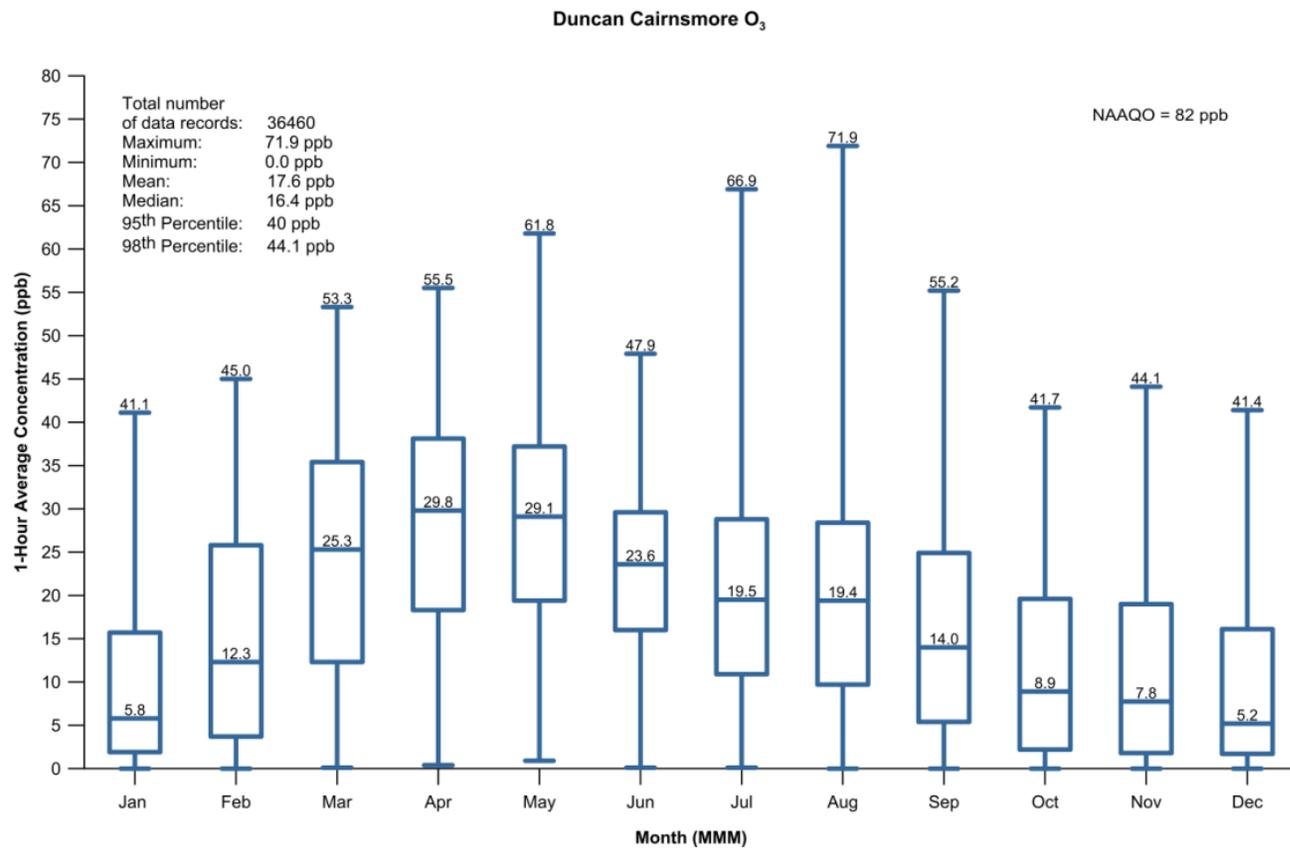
### Ozone

Ozone was measured at the Duncan Cairnsmore station starting in mid-2009. Ozone is more prevalent during summertime high pressure systems, as its formation is dependent on sunlight and warm temperatures. Average monthly concentrations exhibited a springtime peak, but the highest 1-hour average concentrations occurred in August. A well-defined daily cycle in O<sub>3</sub> concentration with a late afternoon maximum was observed for all seasons, indicating some local photochemical production – entirely consistent with the small urban setting. Analysis of two high-concentration episodes found these patterns were associated with periods of hot, sunny weather not usually observed in the region.

Analysis of O3 into regimes suggests that transport of O3 from the Lower Fraser Valley (or most distant sources) is not an important factor. There were no exceedances of the national AAQO for O3.

**Impact of Pollutant**

Low concentrations of ground-level ozone can irritate the eyes, nose and throat. Ozone can also irritate the lung airways, and make them red and swollen (inflammation). People with lung problems are most at risk, but even healthy people who are active outdoors can be affected when ozone levels are high. Ozone can also damage and plants and trees when levels are high.



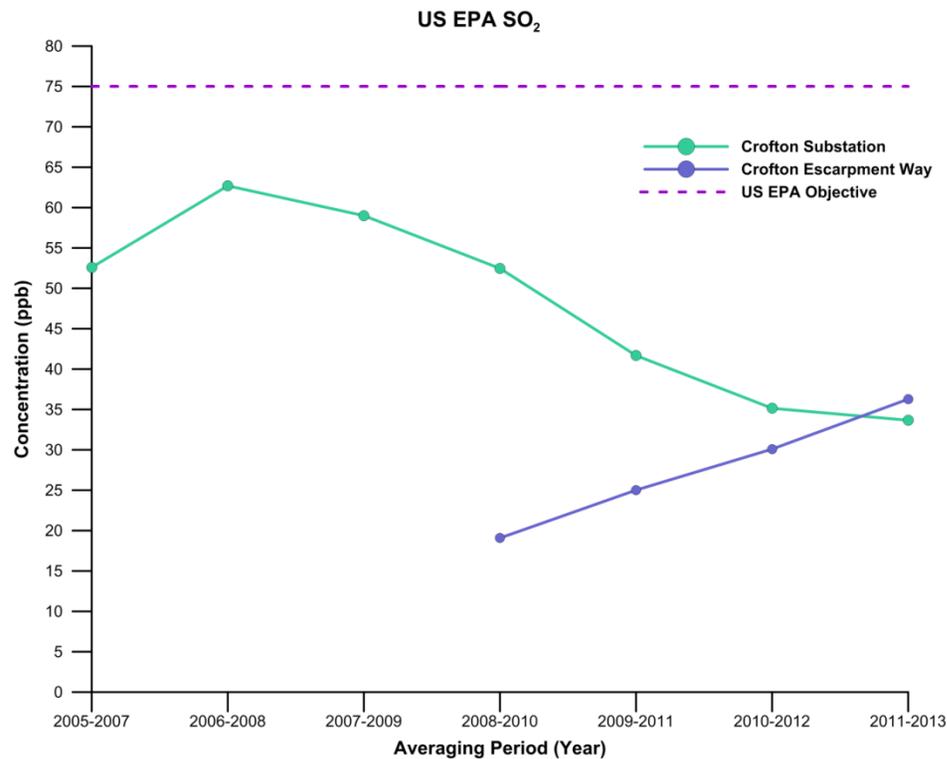
**Figure 6. Monthly Variation of 1-Hour Average O3 Concentration at Duncan Cairnsmore based on 2009–2013 Data**

## Sulphur Dioxide

A daily pattern was found for SO<sub>2</sub> concentrations in which average values peaked in late morning and decreased through the night. This pattern was likely due to shoreline fumigation (clearing of air) after the onset of onshore (easterly) wind flow. No day of week pattern was apparent for SO<sub>2</sub>. There were no exceedances of national or provincial AAQO for SO<sub>2</sub> (Figure 7).

### Impact of Pollutant

Sulphur dioxide can transform in the atmosphere to sulphuric acid, a major component of acid rain. Inhalation of high levels of sulfur dioxide is associated with increased respiratory symptoms and disease, difficulty in breathing and premature death.



**Figure 7. 1-Hour Average SO<sub>2</sub> Results for the US EPA Supplemental Objective at the Crofton Substation and Crofton Escarpment Way Monitoring Stations**

## Nitrogen Dioxide

A daily pattern was found for NO<sub>2</sub> concentrations as well. The pattern for NO<sub>2</sub> showed two peaks, one in the morning and one in the evening, corresponding to times of peak motor vehicle traffic. A weekly pattern was found for NO<sub>2</sub>, with lower concentrations on weekends than during the week. There were no exceedances of national or provincial AAQO for NO<sub>2</sub> (Figure 8).

### Impact of Pollutant

High levels of Nitrogen dioxide can irritate the lungs and lower resistance to respiratory infections such as influenza. Nitrogen oxides in the air can significantly contribute to acid rain and eutrophication in coastal waters.

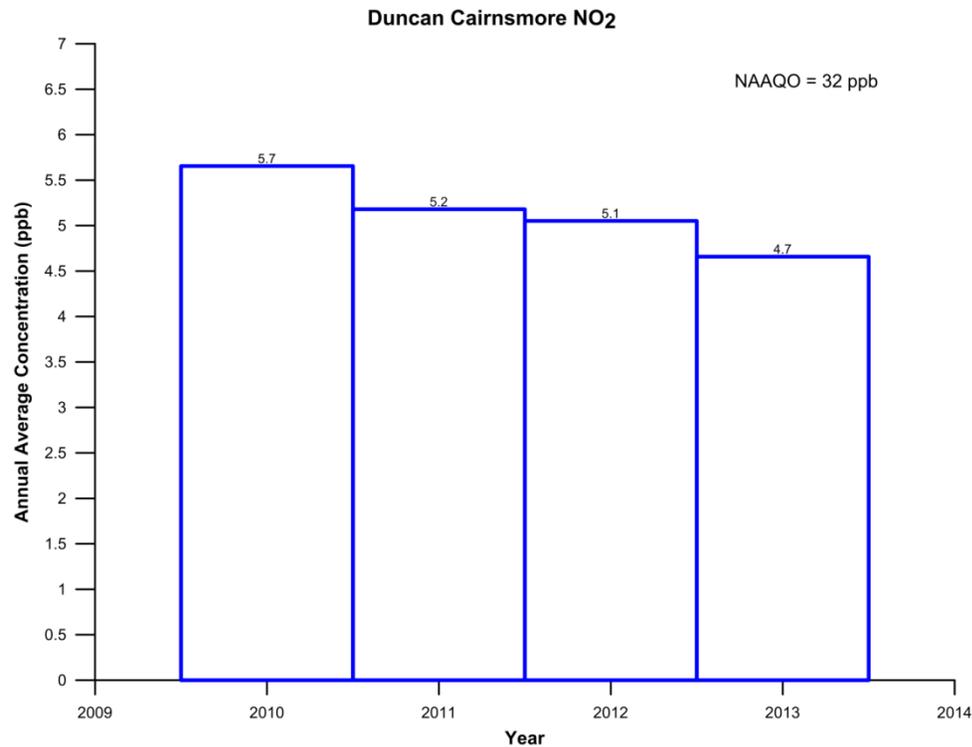


Figure 8. Annual Average NO<sub>2</sub> Concentrations at Duncan Cairnsmore for 2010–2013

## Total Reduced Sulphur

Total reduced sulphur exhibited low average concentrations with short-term peaks that exceeded the most stringent BC AAQO for the 1-hour and 24-hour averaging periods (Figure 9). These episodes of higher TRS concentration are most likely associated with emissions from the Pulp Mill in Crofton. Exceedance of the TRS AAQO for the 24-hour averaging period occurred up to 30% of the time on an annual basis at Crofton Substation which is 250 m south of the Pulp Mill, but only up to 1.5% of the time at Duncan Deykin Avenue which is more than 8 km away from the Pulp Mill. The meteorological data analysis revealed that these sporadic exceedances may be due to the Crofton Mill emissions.

## Impact of Pollutant

TRS is a mixture of compounds including hydrogen sulphide, mercaptan, dimethyl sulphide and dimethyl disulphide. TRS compounds are not considered a health hazard at typical environmental levels. They are however, a primary cause of odours. Exposure to high concentrations of hydrogen sulphide can lead to respiratory distress or arrest.

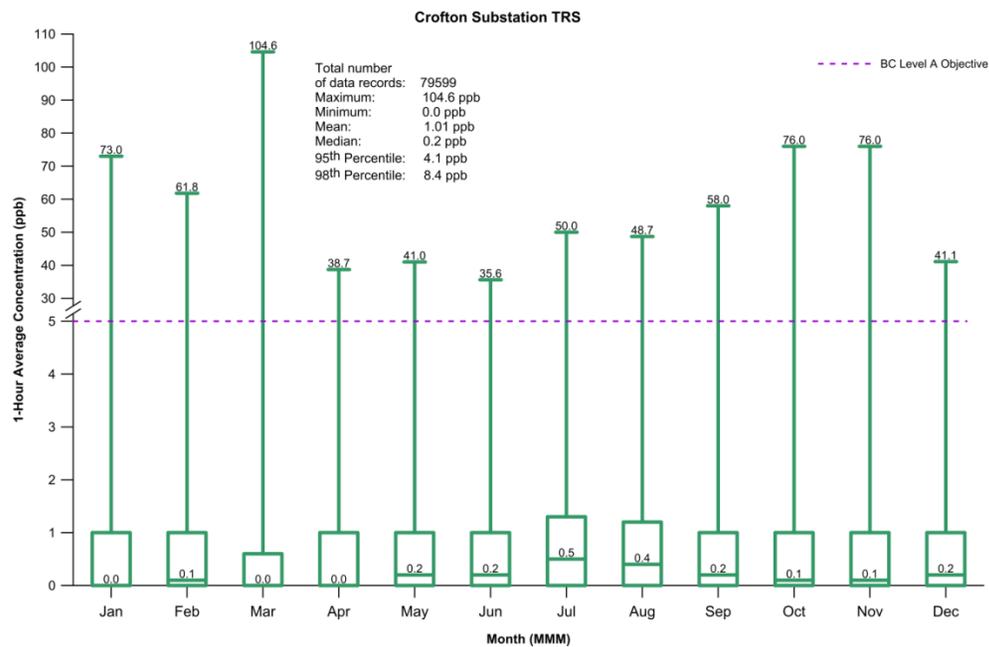


Figure 9. Monthly Variation of 1-Hour Average TRS Concentration at Crofton Substation Based on 2003–2013 Data

## Appendix C – Our Indicators and Targets

The following indicators and targets were developed to help us understand whether we are achieving our goals

Parameter	Indicator	Sources	Rationale	Targets ⇒ Denotes key target	Units	Monitoring
<b>Health</b>	a) Childhood respiratory illness		a) Health effects	Zero	# of people	Island Health
<b>Population</b>	b) Resident population c) Visitors d) By demographic categories		b) Measure of population growth c) Measure of tourism health	N/A	# of people	Census data
<b>Particulate matter</b>	a) Annual average PM <sub>2.5</sub>	Open burning and wood burning appliances	Health effects (respiratory, cardiovascular), vegetation damage, visibility degradation.  Reduce the frequency and duration of episodes that lead to <i>air quality advisories</i> .	⇒ a) <b>Zero exceedance of BC AAQO (8 µg/m<sup>3</sup>)</b> ⇒ a) <b>Zero exceedance of BC AAQO (25 µg/m<sup>3</sup>)</b> c) Zero exceedance of the BC AAQO of 50 µg/m <sup>3</sup> -Decreasing trend	µg/m <sup>3</sup>	Yes
<b>NOx</b>	a) Provincial and National objectives	industry, mobile sources, wood burning, etc.	Health effects (respiratory), vegetation damage, acidification, secondary particles, O <sub>3</sub> precursor	Decreasing trend		
<b>SO<sub>2</sub></b>	a) Provincial and National objectives	Crofton Pulp Mill; combustion of fossil fuels containing sulphur.	At high concentrations - health effects (respiratory), vegetation	a) WHO 24 h 7.5 ppb		

	guideline of 7.5 ppb	Marine Vessels.	damage, acidification, fine particulate formation, visibility		
<b>Ozone</b>	a) Provincial and National Objectives for 1 hr and 8 hr	A secondary pollutant formed from reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOCs) in the presence of sunlight	Health effects (respiratory and eyes), vegetation damage, visibility (photochemical smog)		
<b>Odour</b>	a) # of odour complaints b) TRS – Provincial Level A odour objective	Point sources Crofton pulp mill; sewage treatment; swamps, bogs and marshes.	Offensive odours	a) Reduction in odour complaints b) Continuous improvement in TRS	
<b>Visibility</b>	a) Visibility complaints b) Good Visibility	Mobile sources Ozone, NOx, VOC and PM	can effect tourism, outdoor recreation and public perception	a) Reduction in visibility complaints b) Visibility index of good	
<b>Partnerships &amp; Leadership</b>	a) Annual reports b) partnerships c) Stewardship programs d) Public Awareness Campaign			⇒ <b>Form an Airshed Protection Roundtable</b> ⇒ <b>Implement Actions in this Strategy</b>	- Website hits. - #of AQ pres. given to others. # of requests for info AQ planning. - # of visitors with a positive perception of air quality and environmental health.

## Appendix D - Contaminant Prioritization

To focus the planning of actions on those that will have the greatest impact on our air quality, high priority pollutants have been determined based on the following criteria:

- Does the pollutant have exceedance(s) of national or provincial air quality objectives?
- Is the pollutant normally considered to be a significant hazard to human health, the environment or the economy?

Pollutant	Exceedance of AQ objective	Hazard		
		Human Health	Environmental	Economic
SO <sub>2</sub>		√	√	√
TRS	√			√
NO <sub>x</sub>		√	√	√
Ozone		√	√	√
PM <sub>10</sub>		√	√	√
PM <sub>2.5</sub>	√	√	√	√

## Appendix E – References

1. Provincial Framework for Airshed Planning – BC Government  
([http://www.bcairquality.ca/reports/pdfs/airshedplan\\_provframework.pdf](http://www.bcairquality.ca/reports/pdfs/airshedplan_provframework.pdf))
2. A Review of Airshed Planning in British Columbia – BC Government - March 31, 2009  
([http://www.bcairquality.ca/reports/pdfs/airshed-planning-review\\_03\\_2009.pdf](http://www.bcairquality.ca/reports/pdfs/airshed-planning-review_03_2009.pdf))
3. A Community-Based Approach to Airshed Management in the Sea to Sky Corridor – Sea to Sky Airshed Society – 2005  
(<http://www.seatoskyairquality.ca/pdf/SharingTheAirMarch2005.pdf>)
4. Sea to Sky Air Quality Management Plan – Sea to Sky Airshed Society – 2007  
(<http://seatoskyairquality.ca/wp-content/uploads/aqmp2007.pdf>)
5. City of Kamloops Air Management Plan – City of Kamloops  
(<http://www.city.kamloops.bc.ca/environment/pdfs/13-05-AirshedManagementPlan.pdf>)
6. National Pollutant Release Inventory Online Data Search – Environment Canada - Facility Reported Data  
(<http://www.ec.gc.ca/inrp-npri/donnees-data/index.cfm?lang=En>)
7. CVRD 2010 State of the Environment Report – Cowichan Valley Regional District's Environment Commission – 2010  
(<http://www.12things.ca/12things/uploads/2010SOEreportsm.pdf>)
8. Agency for Toxic Substances & Disease Registry – Public Health Statement – Hydrogen Sulfide  
<http://www.atsdr.cdc.gov/toxprofiles/tp114-c1-b.pdf>
9. Carlton, A.G., R.W. Pinder, P.V. Bhave and G.A. Pouliot. "To What Extent Can Biogenic SOA be Controlled?", Environmental Science & Technology 44:3376-3380 (2010).