



**SNC • LAVALIN**

**Fraser Valley Regional District Open Burning  
Practices and Policy Options,  
Final Report**

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Project 629027

**Prepared for:**

**Fraser Valley Regional District**

**SNC-LAVALIN INC.**

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## ACRONYMS

|                   |   |
|-------------------|---|
| ALR               | Agricultural Land Reserve                                     |
| AQMP              | air quality management plan                                   |
| BC                | British Columbia  |
| BCMoE             | BC Ministry of Environment                                    |
| BMPs              | best management plans   |
| BFI               | BFI Canada Inc.   |
| BSF               | BlueSky Framework   |
| CARB              | California Air Resources Board                                |
| CBP               | Canadian Bluesky Playground                                   |
| CLFV              | Canadian portion of the Lower Fraser Valley                   |
| CVRD              | Cowichan Valley Regional District                             |
| EIs               | emission inventories  |
| EMA               | BC Environmental Management Act                               |
| FLNRO             | BC Ministry of Forests, Lands and Natural Resource Operations |
| FVRD              | Fraser Valley Regional District                               |
| LFV               | Lower Fraser Valley   |
| M. Ag.            | BC Ministry of Agriculture                                    |
| MV                | Metro Vancouver   |
| NAPS              | National Air Pollution Surveillance                           |
| OFTS              | Open Fire Tracking System                                     |
| OBSCR             | Open Burning Smoke Control Regulation                         |
| PM                | Particulate matter  |
| PM <sub>2.5</sub> | PM of aerodynamic diameter 2.5 microns or less                |
| PM <sub>10</sub>  | PM of aerodynamic diameter 10 microns or less                 |
| PG                | City of Prince George   |
| PG AIR            | PG Air Improvement Roundtable                                 |
| RDCO              | Regional District of Central Okanagan                         |
| RWDI              | Rowan Williams Davies and Irwin Inc.                          |
| SHARP             | Synchronized Hybrid Ambient Real-time Particulate (monitor)   |
| SNC-Lavalin       | SNC-Lavalin Inc.  |
| SLRD              | Squamish-Lillooet Regional District                           |
| TEOM              | Tapered Element Oscillating Microbalance (monitor)            |
| UBC               | University of British Columbia                                |
| UNBC              | University of Northern British Columbia                       |
| USDA              | U.S. Department of Agriculture                                |
| US EPA            | U.S. Environmental Protection Agency                          |



## EXECUTIVE SUMMARY

The Fraser Valley Regional District (FVRD) commissioned SNC-Lavalin to complete a study of open burning activities and emissions within the regional district, including a review of best management practices and policies for the FVRD to consider. The FVRD is responsible for air quality planning functions within the region and reducing pollutants emitted from open burning, especially particulate matter (PM), is a priority.

Open burning in the FVRD is managed through policies at the provincial, regional and municipal government levels. The provincial Open Burning Smoke Control Regulation (OBSCR) is in effect in all parts of the province but does not address all open burning activities. Residential or 'backyard' burning is not addressed in the OBSCR; the province supports development of local bylaws to address residential burning as well as allowing for more stringent requirements for other types of open burning than exist in the OBSCR. Agricultural burning (the burning of crop residues) is also not addressed in the OBSCR. In 2010, agricultural burning was estimated to release almost twice as much fine particulate matter (PM<sub>2.5</sub>) as backyard burning in the FVRD communities.

Open burning emissions in the FVRD were found to be a significant contributor (up to 7%) of the total PM loading to the region. While the ambient PM monitoring data in the FVRD was reviewed as part of this study, no clear relationship could be identified between the open burning activities and ambient PM concentrations. This is not surprising, since the 'burn season' differs by municipality and the potential ambient effects of open burning are expected to be localized in most cases. Monitoring stations tend to be located in urban areas and much of the open burning occurs outside of these higher density locations.

While open burning is controlled to a high degree in the urban areas of the FVRD, burning in rural areas does not typically have the same level of control. In addition, 'illegal' open burning activities occur in all areas. The existing FVRD municipal bylaws address residential, agricultural and land clearing open burns and in this sense the study recommendations associated with open burning policy are associated with reducing open burning through tighter controls, education and provision of alternatives.

At the regional district level, no bylaw with open burning requirements currently exists. Development of a regional district level bylaw for electoral areas is planned for the future. The regional district bylaw would regulate open burning activities in the electoral areas under the management of the FVRD, while the existing municipal bylaws would remain in effect. For this reason, recommendations are expressed for the regional district bylaw and the municipal bylaws separately. The existing municipal bylaws were found to be effective at controlling and reducing open burning in general and therefore the recommendations are largely associated with issues of consistency throughout the regional district as well as progressive actions that have been identified through

recent bylaw developments in other locations. In addition, the implications of the provincial OBSCR policy intentions paper were considered.

- I. Municipal open burning bylaw recommendations include:
- II. Require that all open burning be subject to a permit (exception campfires).
- III. Use of a consistent allowed burn period for all municipalities. While a spring (March-April) and fall (October-November) period (as Chilliwack currently uses) is reasonable to use, shortening the fall period to October only and encouraging more burns to occur in spring than fall would better align with an expectation of good dispersion conditions.
- IV. Require that all open burns be conducted between 9 a.m. and sunset, unless through a special circumstance (i.e., an air curtain incinerator is used or Fire Department staff are on hand).
- V. No open burning be allowed for properties smaller than 1 ha.
- VI. Requirement of mandatory forced air assistance for land clearing burns (possibly extending to all burns greater than a defined threshold).
- VII. Develop an open burning best management practice (BMP) guidance document (or web summary) that is referenced in the open burning bylaws.

These recommendations should be reviewed with the relevant municipal staff to identify how they could be used effectively to facilitate a consistent approach towards open burning in the region over time. The municipal Fire Chiefs in particular have a great deal of experience with the existing 'burners' in their jurisdictions and may be able to help identify strategies for implementing and supporting these initiatives.

Regional District open burning bylaw recommendations include:

- I. Select an existing municipal bylaw (or portion of the bylaw) that addresses open burning to pattern the regional district bylaw. The Abbotsford and Chilliwack bylaws may be suitable examples.
- II. Identify 'high' smoke sensitivity areas of the electoral areas through use of a map, in consultation with the BCMoE (primary or 'high' as well as secondary smoke sensitivity areas are expected to be identified in the next version of the OBSCR).
- III. Require that all open burning be subject to a permit within the high sensitivity areas (exception campfires), and subject to registration within the secondary areas.



- IV. Specifically identify residential, agricultural and land clearing burns in the bylaw so these can be tracked similar to those within the municipalities.
- V. Use of a consistent allowed burn period for all electoral areas (as noted for the municipalities).
- VI. Require that all open burns be conducted between 9 a.m. and sunset within the high sensitivity areas, unless through a special circumstance (i.e., an air curtain incinerator is used or Fire Department staff are on hand)
- VII. No open burning be allowed within the high sensitivity areas for properties smaller than 1 ha.
- VIII. Requirement of mandatory forced air assistance for land clearing burns within the high sensitivity areas (possibly extending to all burns greater than a defined threshold).
- IX. Develop an open burning best management practice (BMP) guidance document (or web summary) that is referenced in the open burning bylaw (also addressed in the municipal bylaw recommendations).

The permit and registration requirements allow for the opportunity to express tighter controls over the open burning activities (such as allowed days to burn, size and number of piles, and use of forced air assistance). Importantly, the use of permits also facilitates a better understanding of the amount of open burning that occurs in the regional district.

As is well understood in other locations in the province that have limited the amount of allowed open burning, alternatives to open burning must be provided so that residents are able to dispose of their wood waste. A ‘culture of burning’ exists in some parts of the FVRD and therefore an aggressive program to shift residents from this mindset is needed in some areas, in step with policy changes that aim to reduce open burning.

The municipalities of the FVRD currently maintain their own collection, diversion and disposal systems for solid waste, with the regional government providing service to most of the electoral areas only. In other regions that have had key initiatives for providing alternatives to open burning (use of low or no transfer station tipping fees, free chipping services), the regional government has had an active role in the administration of transfer stations and landfills. This may present a difficulty in establishing a region-wide program in the FVRD to effectively encourage greater collection and use of wood waste. Ongoing collaboration with the municipalities on this topic is encouraged for the FVRD and there are existing municipal programs that may be feasible to offer in other areas of the FVRD (notably the electoral areas). There may also be end-use markets for wood waste (chipped wood) in the FVRD that could be viable if a region-wide approach is considered. A feasibility study on this topic is suggested.

A successful alternative to agricultural burning is likely region-specific and oriented towards the dominant agricultural practice(s) in the region. It is noted that effective programs of this nature have involved strong collaboration between the agricultural industry and government. Some of this collaboration already exists in the FVRD municipalities with significant agricultural industry and for this reason the management of agriculture burning at the municipal level is already more advanced in the FVRD than in other parts of the province. The FVRD is encouraged to further evaluate the agricultural practices in the electoral areas in particular, to consider alternatives to open burning that may be viable to support.

An additional study goal was to evaluate possible air quality management tools, in effect, predictive tools that may allow greater knowledge of the potential impacts of open burning, before or during the permitting stage. The Canadian Bluesky Playground, a free web-based tool that allows simulation of open burning emissions scenarios, was found to be a very useful resource, effective in the study of very large open burns and their potential impacts within the valley. No simple tool was found (or is recommended) that would be useful to determine the impacts of smaller scale burns and use of a more sophisticated tool would be warranted for such an initiative. The City of Prince George reportedly has used such a tool in the development of open burning policy, leveraging the expertise of the local university there (UNBC). This example provides some context to consider for a tool that may be useful for the FVRD to consider further policy refinements associated with where, when and what size of open burns should be permitted in the future. It is strongly suggested that a tool of this nature should not be used as part of the permitting process but rather to help set specific bylaw requirements.

# 1 INTRODUCTION

This study, the Fraser Valley Regional District (FVRD) Open Burning Practices and Policy Options Study, is directed toward a number of recommendations regarding best management practices and policies for the FVRD to reduce the impact of open burning on air quality. The FVRD is responsible for air quality planning functions within the region and a key principle of its existing Air Quality Management Plan (1998, currently being updated) is continuous air quality improvement. This principle is associated with all air contaminants, although particulate matter (PM), especially fine PM is considered a priority air contaminant by the FVRD, similar to many other regulatory and non-regulatory agencies and groups. Open burning is a key source of PM emissions in the regional district and one with a higher relative uncertainty compared to other source groups such as onroad vehicles. Not all open burning is formally permitted (i.e., registered with a relevant authority) and the type and amount of materials consumed in both permitted and non-permitted open burns must currently be estimated from anecdotal information (average size of piles, etc.).

There are four main tasks associated with this study: identification of the current open burning practices and management actions in the FVRD, an assessment of current open burning emissions estimates and impact on local air quality, a review of open burning policies and practices elsewhere in the province and a number of recommendations or 'solutions' moving forward. It is well understood that there are other active agencies and recent or ongoing assessment initiatives related to open burning in the area; notably, Metro Vancouver (MV) conducts an emissions inventory of the Lower Fraser Valley (LFV) every five years (next inventory for 2015) and the BC Ministry of Agriculture (M. Ag.) has developed a provincial agricultural air emissions inventory (2014) specifically for that sector. Both of these products are relevant to this study and are reviewed in this report.

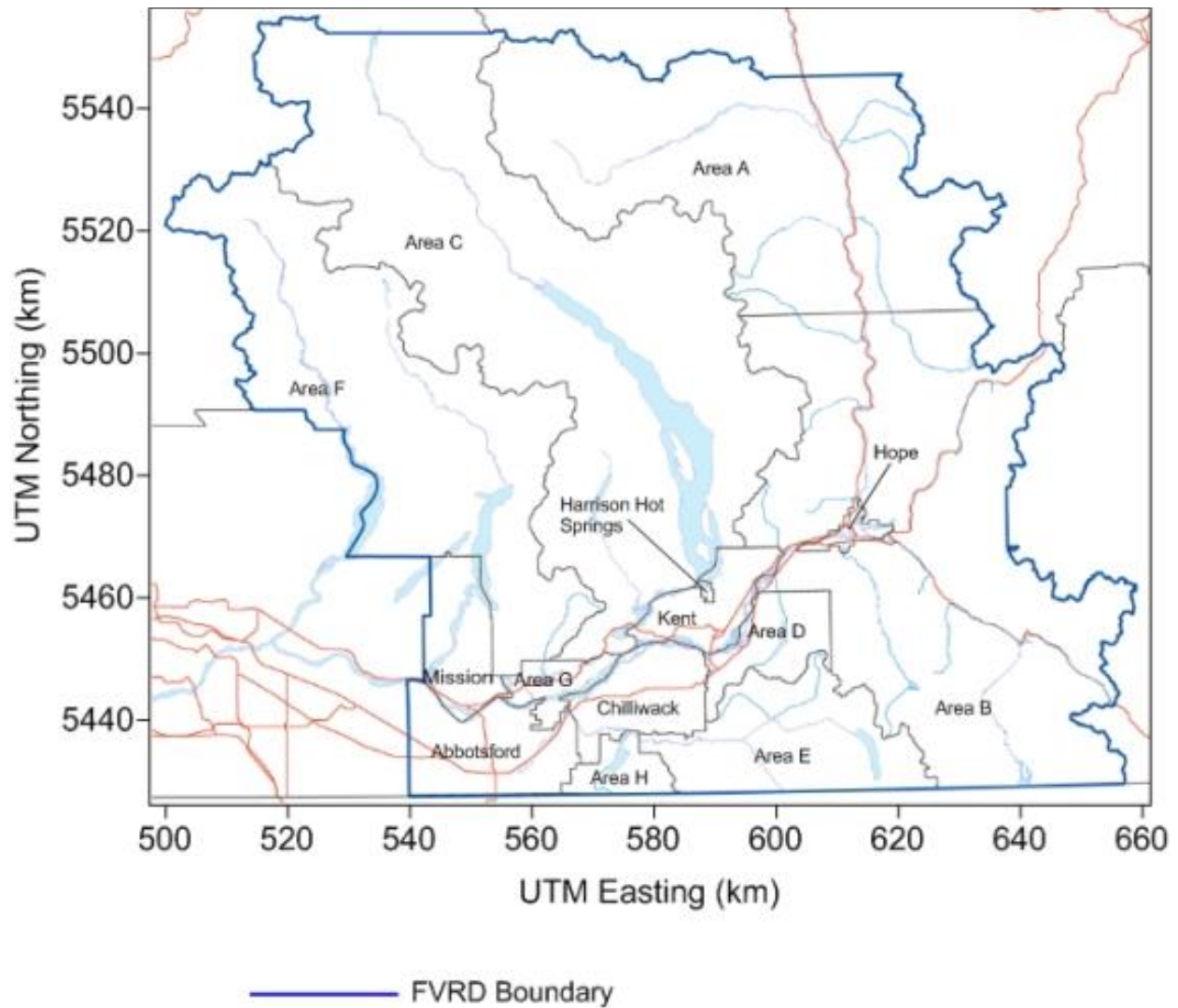
The FVRD is located in the eastern portion of the Lower Fraser Valley (LFV) airshed. The airshed is regularly influenced by emissions originating from the FVRD, Metro Vancouver (MV) to the west as well as Whatcom County to the south, across the international border with the U.S., and infrequently influenced by wildfires in BC, Washington and beyond.

## 1.1 FVRD Municipalities and Electoral Areas

The FVRD is shown in Figure 1.1. The regional district is made up of six municipalities and eight electoral areas, with a total estimated population of 294,000 as of 2015 (BCstats, 2015). Most residents live in the municipalities, as outlined below (2011 Census).

- Abbotsford: 133,497;
- Chilliwack: 77,936;
- Mission: 36,426;

- Hope: 5,969;
- Kent: 5,664; and
- Harrison Hot Springs: 1,468.



**Figure 1-1: FVRD Municipalities and Electoral Areas**

## 1.2 Open Burning

Open burning is often defined as an outdoor fire that *does not* burn within an enclosure with a chimney or stack. It is typically associated with organic material such as wood and leafy debris but may also involve other materials. The open burning activities regulated by government often are categorized to land clearing, prescribed (i.e., forest tenure or silviculture), residential ('backyard') and agricultural, although commercial and recreational fires (i.e., campfires) are also regulated in some jurisdictions. Agricultural burning is associated with removal of plant matter or other crop residues (including trees), potentially to maintain crop health.

Open burning regulations are common at the municipal, regional and provincial levels in Canada as well as in other countries and tend to specify size and content restrictions as well as temporal restrictions (time of day, time of year) and geographical restrictions (specified areas or proximities). However, enforcement of open burning regulations (bylaws) can be sporadic at the municipal level due to lack of staff capacity or jurisdictional authority. As such, enforcement tends to be complaint driven, with fines rarely imposed (Coccola, 2012).

A key element of the policy review portion of this study is directed to case studies to ascertain opportunities for improved management of open burning at the municipal and regional levels.

## 2 CURRENT PRACTICES

### 2.1 *Fraser Valley Regional District Services and Responsibilities*

The FVRD derives its authority to govern from the Local Government Act and the Community Charter of British Columbia. It provides a wide range of services to its member municipalities and electoral areas, two of which include regional air quality and solid waste management. The FVRD received air quality planning authority by a Provincial Order in Council in 1992, although air emissions regulatory authority remains with the BC Ministry of Environment (BCMoE).

The FVRD has a number of divisions, including Regional Programs which provides services on a regional scale. Other divisions include Electoral Area Planning and Development and Electoral Area Community Services, both of which serve the unincorporated electoral areas. The latter divisions include bylaw enforcement, as well as emergency services, such as fire halls. The Environmental Services Department, part of the Regional Programs Division has responsibilities for a number of service areas, including air quality and climate change planning, solid waste management, watershed planning, noxious weed control, mosquito control, and animal control.

#### 2.1.1 Air Quality Responsibilities and Authorities

The FVRD delivers a wide range of air quality services under its planning authority. The FVRD has six air quality monitoring stations in the region, which are operated by MV through a contractual agreement, and form part of the twenty-eight station Canadian Lower Fraser Valley (CLFV) monitoring network. Air discharge permits for the significant industrial sources in the regional district are governed by the BCMoE. Much of the FVRD's air quality work is through interagency committee projects and initiatives. The FVRD is currently in the process of updating its AQMP, expected to be completed in 2016.

#### 2.1.2 Solid Waste Responsibilities and Authorities

The FVRD produced an updated Solid Waste Management Plan (SWMP) in 2014, which was approved by the BCMoE in 2015 (FVRD, 2014). The FVRD's solid waste portfolio entails:

- 1) Obligation to create, implement and maintain long range (10 year) plans for solid waste management for municipalities and electoral areas within the region.
- 2) Authority to:
  - a) manage solid waste and recyclable material within the region;
  - b) make and enforce bylaws regarding waste disposal;
  - c) identify materials banned from disposal;



- d) set or collect fees for disposal;
- e) license and compliance enforcement for waste and recycling handlers and disposal sites; and
- f) issue fines for non-compliance.

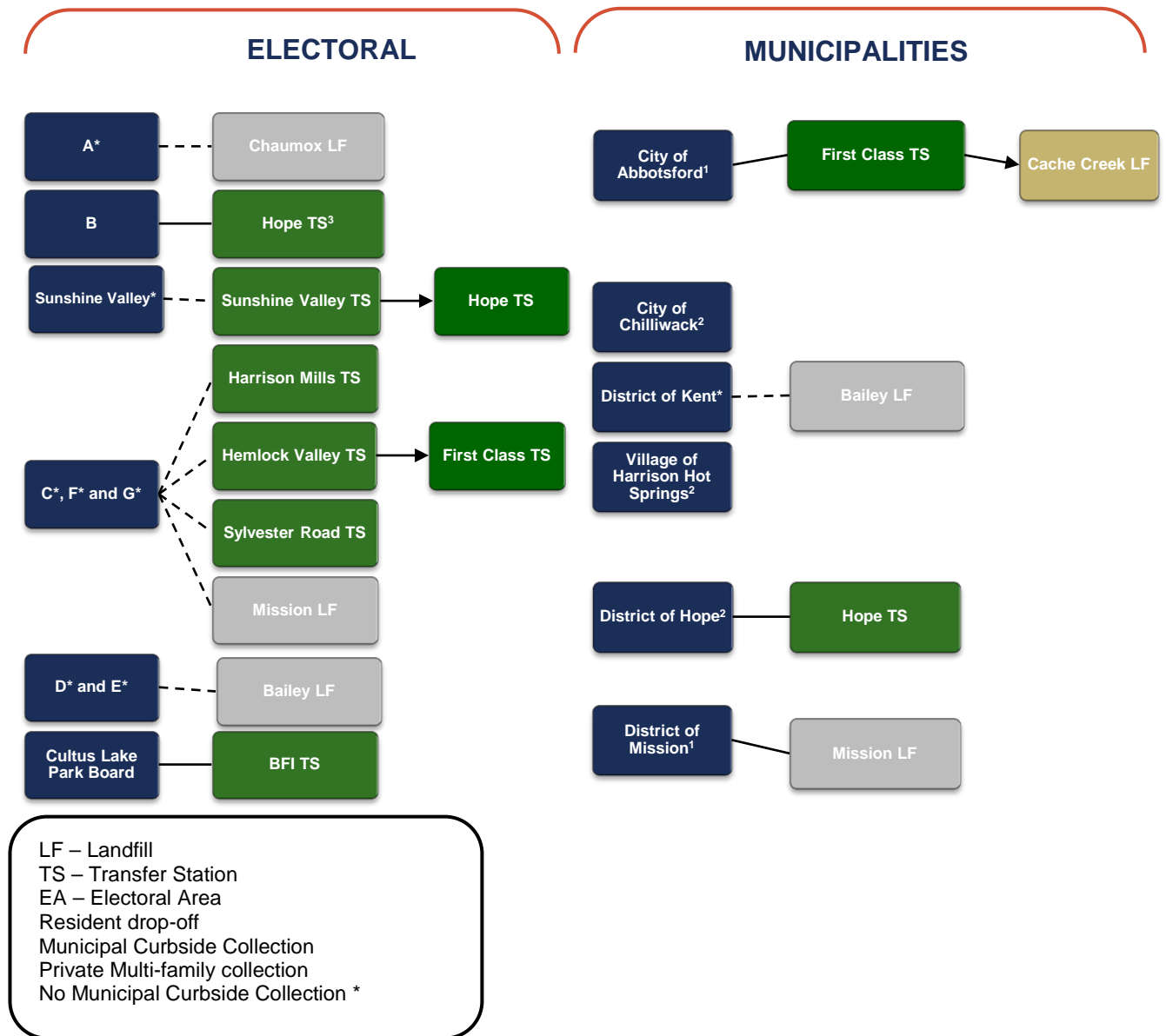
Currently, the FVRD municipalities maintain their own collection, diversion and disposal systems for solid waste, with the FVRD providing service to most of the electoral areas only. The landfills and transfer stations in the FVRD are summarised below (owner in brackets) and in a flow chart representation of the waste streams by municipality/electoral area in Figure 1.2.

#### Landfills:

- Bailey Road Chilliwack (City of Chilliwack) – landfill gas capture being installed;
- Chaumox, Electoral Area A (FVRD) – operated by the Boston Bar ‘Area A’ Landfill Society;
- Mission (District of Mission) – also serves Electoral Areas C, F and G;
- Valley Road Standby Cell, Abbotsford (City of Abbotsford); and
- Several on-Reserve landfills around Harrison Lake and near Boston Bar (managed by the First Nations bands, not subject to FVRD or municipal management).

#### Transfer Stations:

- Harrison Mills, Electoral Area C (FVRD);
- Hemlock Valley, Electoral Area C (FVRD) – upgrade being considered due to potential expansion of local ski resort;
- Parr Road Green Depot, Chilliwack (operated by BioCentral)
- Silver Hope, District of Hope (proposed, not active);
- Sunshine Valley, Electoral Area B (FVRD);
- Sylvester Road, Electoral Area F (FVRD);
- Yale, Electoral Area B (proposed, not active);
- BFI Canada Inc., Abbotsford (private, operated by BFI);
- First Class Waste Services, Abbotsford (private, operated by First Class) – City of Abbotsford has an agreement with Metro Vancouver; waste is transported to Cache Creek Landfill; and
- Several on-Reserve transfer stations, including Valley Tank and Container, Chilliwack, Leq’a:mel Transfer Station, Electoral Area G, potentially others.



<sup>1</sup> Municipal curbside collection service is only provided to single-family homes and duplexes; Multi-family units must make collection arrangements through a private contractor.  
<sup>2</sup> Municipal curbside collection service is provided to single-family homes and duplexes.  
 Multi-family units have the option of participating in the municipal program or contracting the service out to a private hauler.  
 Note: *Parr Road Transfer Station is not included in this diagram. Electoral Area H was created after this figure was produced.*

**Figure 2-1: Waste Collection Flow Chart for District (from FVRD SWMP Update 2016 - 2026).**

The SWMP notes that two out-of-region landfills are currently approved to accept FVRD waste – Cache Creek Landfill and Roosevelt Regional Landfill in Washington State.

The SWMP has a goal of 90% waste diversion by 2025 (65% by 2017 and 80% by 2019). Notably, the SWMP currently identifies that a region-wide, source separated organics program phased in over the next several years for all waste sectors could increase the current waste diversion to 65 – 70% (current diversion estimated to be approximately 50%). A user-pay approach to waste collection is currently favoured.

## 2.2 *FVRD Open Burning Bylaws*

### 2.2.1 **Provincial Open Burning Smoke Control Regulation**

The BC Environmental Management Act (EMA) provides the BCMoE with the authority to set air quality objectives as well as to regulate sources of emissions (BCMoe(a), 2015). The Open Burning Smoke Control Regulation (OBSCR), or BC Reg. 145/93 was passed in 1993 and has had several amendments since that time (BCMoe(b), 2015). The OBSCR does not apply to residential (backyard) burning. However, the province actively supports municipal and regional governments in development of bylaws to regulate residential burning and has provided a bylaw template for this purpose (BCMoe(c), 1997).

The OBSCR also does not apply to ‘the burning of leaves, foliage, weeds, crops or stubble’ for agricultural purposes. For this reason, municipal and regional bylaws may also address agricultural waste and related burning.

The OBSCR authorizes the burning of vegetative matter on the same site it was gathered; identifies prohibited materials; limits burns to days with ‘good’ or ‘fair’<sup>1</sup> venting indices; prescribes the number of hours per burn and requires adherence to local bylaws.

The current OBSCR has several key components that can be identified, as described below:

Prohibited materials:

- Plastics, treated lumber, etc.

Exemptions:

- Leaves, foliage;
- Crops, weeds, stubble for domestic or agricultural purposes or in compliance with the Weed Control Act;

---

<sup>1</sup> If a burn continues for a second consecutive day, the venting index forecast for the second day must be either ‘good’ or ‘fair’, unless the BCMoE has local burn plan/smoke management plan requirements in effect for the area.

- Controlled fires under the authority of a designated forest official; and
- Log sort and forwarding facilities.

Proximity:

- Burn must occur on the same parcel of land that the material originated;
- 100 m or more from residences and businesses; and
- 500 m or more from schools in session, hospitals and other sensitive facilities.

Timing:

- Only during appropriate dispersion conditions (ventilation index 'good' on burn day and 'good' or 'fair' predicted for the following day; see below);
- Duration not longer than 72 hours (Category A) or 96 hours (Category B); and
- Not more than once every 15 days or more than 4 times in a year for a particular parcel of land (Category A only).

The venting (or ventilation) index is a measure of the dispersive ability of the atmosphere at a specified time and is determined from the height of the mixed layer (the vertical extent that pollutants released near the ground may mix with air above) and the wind speed. Higher winds and greater mixed layer height increase the index, which is expressed on a scale of 0 to 100. The following categories are used:

- 0 - 33: poor ventilation;
- 34 - 54: fair ventilation; and
- 55 - 100: good ventilation.

The venting index is produced by Environment Canada. The BCMoE makes the venting index available each day for each region of the province (<http://www.env.gov.bc.ca/epd/epdpa/venting/venting.html>), as well as a forecast of the value for the next day.

## 2.2.2 Provincial Open Fire Tracking System

The BC Ministry of Forests, Lands and Natural Resource Operations (FLNRO) Wildfire Service uses the Open Fire Tracking System (OFTS) to manage fire safety. Within this system, burns are identified as Category 2, Category 3 and Category 4 ('resource management'). These categories are defined in Table 2.1.

**Table 2-1: BC Open Fire Tracking System Burn Categories\***

| Open Burn Size Category            | Pile Size  | Concurrent Pile Limit         | Stubble or Grass Area  | Burn Registration Required? |
|------------------------------------|--|-------------------------------|--|-----------------------------|
| Category 2                         | Less than 2 m high, 3 m wide                     | 2 piles                       | Less than 0.2 ha   | No                          |
| Category 3                         | 3 or more piles less than 2 m high, 3 m wide; or | 3 piles or 1 of more windrows | Greater 0.2 ha   | Yes                         |
|                                    | 1 or more pile greater than 2 m high, 3 m wide   |                               |  |                             |
| Resource management ("Category 4") | No piles used for slash                          | No pile for slash             | No Limit; used for silviculture treatment, forest health management, wildlife habitat enhancement, fire hazard abatement, ecological restoration or range improvement. | Yes                         |

\* Table from 2014 BC Ministry of Agriculture emissions inventory project (provided by the BC Ministry of Agriculture).

Categories 3 and 4 require registration in the OFTS, Category 2 fires are exempt.

### 2.2.3 FVRD Open Burning Bylaws

Open burning can be separated to several categories, with residential (backyard) burning being one category used. Agricultural burning is another category, which includes burning of agricultural waste generated as a by-product of farming. Land clearing may also be identified in municipal or regional bylaws. While some of this burning falls within the Category 2 and 3 of the OFTS, Category 4 (land tenure or resource management) is not addressed in open burning bylaws as this is a responsibility of FLNRO. Category 4 burns are also exempt from the OBSCR.

Agricultural burning may or may not be addressed in municipal open burning bylaws, due in part to provincial legislation. While each province has their own related legislation, BC has the Farm Practices Protection Act (1996) (commonly known as the 'Right to Farm' Act) which replaced the previous Agriculture Protection Act (1989). In particular the Farm Practices Protection Act limits the ability of local governments to regulate or prohibit normal farm practices through nuisance bylaws. However the Act does not rule out regulating agricultural burns with other kinds of bylaws such as fire protection or public health bylaws<sup>2</sup>.

The bylaws for the FVRD municipalities, as identified through a review of the municipal websites are identified in Table 2.2. There currently are no open burning bylaws established by the FVRD, meaning there are no residential backyard burning requirements for the 8 electoral areas of the

<sup>2</sup> Personal communication with M. Kellerhals, BC MoE, December 30, 2015.

FVRD, although the OBSCR is in effect. At the municipal level, a total ban on open burning exists for Harrison Hot Springs (campfires are allowed under specified conditions). A total ban on residential burning within the urban catchment areas exists for Abbotsford and Chilliwack (and effectively for Hope). Residential burning is allowed without a permit for Mission and Kent, but only outside of the township boundaries, subject to the allowable burn periods.

The municipalities that allow burning all have a 'burn season' when all open burning is expected to occur. These burn seasons tend to avoid summer (when the risk of fire is greatest) and focus on spring and fall periods.

**Table 2-2: Summary of FVRD Open Burning Bylaws in Effect**

| Municipality or Area | Bylaw   | Identification of Ban or Partial Ban   | Burn Types Allowed                                    |                 |                 |
|----------------------|---|--|---|-----------------|-----------------|
|                      |   |  | Res   | Ag              | Land Clearing   |
| Abbotsford           | Bylaw 1513-2006; updated 2013                       | Ban during June - Sept   | no  | yes             | yes with permit |
| Chilliwack           | Open Air Burning Bylaw No. 3511; 2008               | Only Mar-Apr and Oct-Nov allowed burn periods  | no  | yes with permit | no              |
| Kent                 | Fire Prevention and Protection Bylaw No. 1448; 2009 | 3rd week May - Sept is allowed burn period   | only outside of the townsite boundaries (with permit) | yes with permit | yes with permit |
| Harrison Hot Springs | Bylaw No. 916; Burning of outdoor fires             | total ban  | no  | no              | no              |
| Hope                 | Bylaw No. 1006, 1998                                | Only 2 two-week burn periods allowed (Spring, Fall), actual dates determined each year | Effectively no*                                       | n/a             | yes with permit |
| Mission              | Consolidated Burning Bylaw 2975 - 1996              | Only April and Nov allowed burn periods  | Yes, permit required for urban areas                  | n/a             | n/a             |

NOTE: Res = residential, Ag = agricultural

\*Residential burning is only allowed if Council identifies and approves of a burn period for the season. Council has not approved of such a period for the last 10 years (information from Hope Fire Chief).



Since the OBSCR is in effect in the FVRD unless a bylaw identifies a more strict set of requirements, the FVRD municipal bylaws are not necessarily prescriptive of all burn activities (those not identified in the bylaws are labelled with 'n/a'). Some specifically address agricultural burning and land clearing while others do not. However, agricultural activities are not prevalent in all FVRD municipalities.

Additional criteria of interest in some of the bylaws are noted below. For simplicity, conditions expressed in the OBSCR, which may be re-expressed in a bylaw, are not identified here.

#### Abbotsford:

- No more than a single pile of agricultural waste materials can be burned at any one time on any one lot.
- The agricultural waste burn pile cannot exceed 3 m by 3 m by 1 m (height) unless obtaining a permit that allows a larger pile.
- The burn site must be within the Rural Area designation unless using specialized equipment approved by the Fire Chief.

#### Hope:

- Burning for lot clearing for development or for the purpose of yard clean up in a commercial or industrial area is possible with a permit.
- Burning of debris, refuse<sup>3</sup> and slash by the District of Hope or Government Ministries may occur with permit if disposal is not possible.

#### Mission:

- Residential burning allowed only if:
  - Property is located outside of the residential refuse collection area;
  - Piles of yard debris do not exceed 1m in diameter and height
  - Burn does not cause an unreasonable nuisance to any person in the neighbourhood

Table 2-2 does not show the number of permits issued in 2010 by municipality. There were a total of 1,483 permits issued in 2010. Of this number, Chilliwack had by far the most permits issued for agricultural burning in 2010, whereas Abbotsford had the most permits for land clearing. It is important to note that the number of permits issued does not necessarily indicate that more or less

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<sup>3</sup> Refuse' in this case relates to industrial/commercial and lot clearing activities. Although not stated in the bylaw directly, the refuse would be clean construction wood, based on comments from the local Fire Chief.

open burning is being conducted in those communities relative to others, since not all municipalities require permits for all types of burns.

## 2.2.4 Management of Open Burning in FVRD Communities

A number of interview questions were constructed to develop a greater understanding of open burning behaviours and current management actions employed in the FVRD. These questions (provided in Appendix A) were posed to the municipal Fire Departments (Fire Chief or designate) of each municipality, with additional information from others (e.g., city staff) as needed. Fire Department staff have the primary responsibilities for managing open burning, including educational initiatives as well as compliance and enforcement actions.

A summary of interview responses is provided by municipality below, focusing on 6 of the key questions posed during the interviews:

- i) Who tends to conduct open burning in the municipality;
- ii) What materials are typically burned;
- iii) What infractions of the bylaw can be identified;
- iv) Describe the current compliance and enforcement actions associated with the bylaw;
- v) What alternatives exist to burning and what barriers may exist to using these alternatives; and
- vi) What changes (if any) are expected to the bylaw and waste management in the near future?

A summary of the responses from each municipal Fire Department is provided below. A representative of the Harrison Hot Springs Fire Department could not be contacted during the interview period.

Abbotsford:

- i) Residents with acreages outside of the urban core tend to burn (e.g., agricultural burns). Larger agricultural operations account for most of the burning (est. 90%). Some burning happens in the urban core (illegally), primarily those new to the area. Campfires are rare.
- ii) Wood and woody debris is burned. Burning ditches (dry weeds) can occur in fall to aid water flow (although this is becoming more rare). Crop residue is also burned. One example provided is the burning of the remaining vegetation after harvesting and selling flower bulbs (burned to avoid disease). However, this tends to be done with a propane powered device drawn behind a tractor with good incineration and little smoke produced.

- iii) Virtually all complaints received relate to the burning of garbage such as plastics. It is expected that the garbage is often added to the permitted fire to conveniently get rid of additional waste.
- iv) Every complaint and identified violation is responded to and logged on the Fire Department management software. This data is made available to responders when investigating (2nd offenses have a mandatory fine).
- v) Alternatives include taking the wood waste to transfer stations or landfill. Chipping and composting is encouraged. Costs are a noted barrier – tipping fees and transportation of the waste. Curbside yard waste pickup is available in the urban catchment area with no limits and this is well used.
- vi) The bylaw is to be updated very soon to include an online application for permits (now active on the city website) as well as a detailed description of clearances that must be adhered to for burns (identifying greater distances to schools and hospitals than those in the OBSCR).

#### Chilliwack:

- i) The burners are associated with large agricultural operations although smaller operations (hobby farms) also contribute. Some (illegal) burning activity occurs in the urban catchment area and these tend to be shut down quickly.
- ii) Wood is burned, such as cedar hedging and other nursery by-products; blackberry burning occurs often. Garbage is sometime included (10% of fires or less) when burners add material to get rid of it. Mattresses, plastics, tires noted. These occurrences are less now than in the past.
- iii) Smoking occurs with some fires, in part due to piles that are too green or too wet. Burners are encouraged to let the piles dry out for a month or two. Garbage may also be added to the piles during the burns. Use of fans is encouraged to increase fire temperatures and burn efficiencies. Education focuses on removing the old mindset that any materials can be burned.
- iv) Enforcement has increased of late, with greater staff capacity. Non compliant burners are shut down quickly with fines for 2nd violation occurrences. Enforcement is largely complaint driven and fires are not usually investigated without a complaint.
- v) Alternatives include curbside pickup of organic waste, which can be provided to all residents on request (fee). Organic waste dropoff (all woods, with size restrictions) is accepted at the Parr Road transfer station with tipping fee.
- vi) No changes to the bylaw are expected in the near term. In 2017 a change will occur with residential curbside collection to separate organics (food waste and yard waste). Currently,

the Parr Road transfer station accepts yard trimmings and only minimal food waste. An expression of interest (EOI) is currently open to waste management providers to receive and process organic waste; this process is open to alternatives to the existing practices.

Kent:

- i) The burners include residents that have acreages as well as small and large agricultural operations. Quite a few of the resident burns are associated with campfires or dealing with yard waste. Approximately 80% of burns are from residents with the remaining 20% agricultural operations.
- ii) Most of what is burned is wood/debris. The Fraser River Debris Trap log sort (debris from the river) gets burned once a year (a very large fire). Hay may be burned but generally not other agricultural products (aside from tree debris). Crop residues are not generally burned due to smoke issues and instead are turned back into the soil (this is the stated fire dept preference). Garbage is burned on occasion but this is less common now (1 or 2 complaints of this nature each year).
- iii) Adding garbage to the fires used to be more of a problem. Burning of wet materials (wet hay, wet wood) can be a problem as well.
- iv) A visit to the burn site is done for all permits (120 issued so far this year). Often the burner is told to remove items from the burn pile(s) to ensure the materials match what is in the permit. Pile size is also inspected for compliance.
- v) Alternatives include a recycling and compost facility that is operated privately, which accepts all organic materials for a fee. Also, the municipality makes available three or four periods at the local gravel pit where wood, grass, leaves etc can be dropped off for free. Much of these materials are composted and chipped, along with the Kent's roadside brushing waste. Burns are conducted at the site once or twice a year to get rid of portions that cannot be dealt with. The burns are conducted with input from the Fire Chief.
- vi) No big changes are expected, although the fire dept wants to reduce large scale burning near the municipal boundaries. At present a large number of piles may be burned at one site (especially this year with the hazelnut tree disease). A greater use of grinding/chipping is desired. Cost identification for fees may be changed for greater detail associated with permits.

Hope:

- i) Burners include residents (backyard burning) as well as a few agricultural operations. There are 4 campgrounds within the municipality so campfires often occur there, which is allowed.

- ii) Virtually all materials burned are wood debris (branches, trees), with some construction debris (wood). Little in the way of crop residue. Some garbage burning occurs (e.g., added to wood fires), but not a great deal.
- iii) Difficulties controlling burns relate to confusion associated with provincial burn bans. These bans are not valid within municipal boundaries although residents think they are. When the provincial burn bans are lifted (and reported as such), residents often think that means they are free to burn, which is not the case. Some individuals believe they have a right to burn and misinterpret the bylaw.
- iv) Repeat offenders are infrequently fined. However, the allowed fine is only \$100, which is reportedly not much of a deterrent. Education is considered more effective. Also effective is the message that if the fire gets out of hand the owner will be responsible for firefighting costs (\$550/hour per truck).
- v) Alternatives to burning include curbside pickup that includes yard/garden waste. Up to 5 large containers can be used at any time (labeled appropriately with stickers). The fee for this service is included in the annual garbage collection fee. It is not known if this service extends outside of the main township but is expected to. 'Inconvenience' is noted as a deterrent, even for collecting yard waste to put at the curb.
- vi) No changes are expected in the near future. There is desire to change the bylaw so that one bylaw specific to open burning would be available, rather than the 'catchall' version that currently exists. However, this may not occur.

Mission:

- i) Residential/backyard burning constitutes most burning activities. Small agricultural operations (acreages, hobby farms) account for approximately 25% of burn events. Recreational fires (campfires etc.) occur 3 or 4 times per year.
- ii) Wood debris is burned. Grass is also burned even though it is not allowed. Burning of garbage occurs and is considered a problem. Complaints typically are about garbage burning.
- iii) Ignorance of the bylaw is often claimed.
- iv) Complaints are investigated and this is the main avenue for enforcement. Fines are levied for repeat offenders (2nd documented occurrence).
- v) Alternatives to burning include curbside pickup of yard waste in urban areas (no limit, brown bags must be used); this goes to the landfill where composting occurs. Once a year residents can pick up free compost.

- vi) There are no known changes expected to the bylaw or the waste management activities, although the Fire Department does not speak for City Hall on the topic of waste management.

#### 2.2.4.1 *Electoral Areas*

A brief interview was held with the FVRD Manager of Emergency Services to gain an understanding of the current open burning situation in the electoral areas. These areas are served by seven volunteer Fire Departments (acting within defined fire protection service areas). No open burning bylaw currently exists and so the residents are expected to comply with the OBSCR. Resident complaints associated with burning are logged and responded to (along with many other types of Fire Department responses). A 10 year record of the response data for the seven fire service areas was provided for review. The response data do not indicate whether or not illegal burning was taking place or whether the complaint corresponded to an actual open burning event. Instead, 'burning complaint' (the most numerous of the expected open burning complaint types) is logged as is 'visible smoke outside' (less frequent) and 'smell of smoke outside' (generally rare). These are separate from calls that obviously relate to a burning emergency (such as a building or structure on fire).

A maximum of 51 complaints were received in one service area in 2015 (36, 14 and 1, corresponding to the three complaint definitions above), while 35 and 29 were the next highest totals. A recent trend is evident, with total electoral area complaints that relate to open burning of 144 in 2015, 84 in 2014, 61 in 2013 and just 20 in 2012. The 2015 total was possibly influenced by 2015's hazelnut tree blight (it is not known if hazelnut tree crops are prevalent in the electoral areas). Looking further back in the complaints data, the next highest total number of complaints (to the 2015 total of 144) was 90 in 2009.

The following anecdotal comments to open burning in the electoral areas were offered:

- The general resident behavior favours burning over composting. There are transfer stations in the area that accept wood waste but this option may not be well used.
- Less than 20% of the burning is expected to include illegal materials (garbage).

The FVRD is currently considering the development of an open burning bylaw, which may be developed as early as spring 2016<sup>4</sup>.

#### 2.2.4.2 *Summary*

In general, open burning within the urban areas of the FVRD municipalities is not allowed. The two municipalities that indicate burning is possible in urban areas do not support this in effect

<sup>4</sup> Personal communication with C. Wilson, FVRD, Dec 15, 2015.



(it is effectively not allowed in Hope and one must gain a permit in Mission, which does not happen often). However, 'illegal' burning does occur in the urban areas and response to this differs depending on municipality (less tolerated with higher likelihood of fines in the larger municipalities). Alternatives to open burning exist in all municipalities, in the way of curbside garden waste pickup as well as transfer station or landfill facilities acceptance of wood waste. In at least one case (Chilliwack), the curbside pickup is offered outside of the urban catchment; but resident response is low (less than 1%). To a varying degree residents may not consider these options appealing over the convenience of burning.

'Illegal' burning exists in all municipalities, but the amount of this type of burning is decreasing in the more populated areas (Abbotsford, Chilliwack in particular). This statement is based on anecdotal comments from the Fire Departments, as it is difficult to collect data to assess trends. It is expected that some of this decrease relates to increased public awareness of air quality issues, in part developed through greater educational efforts taken by Fire Department staff, as well as city staff.

Another relevant trend that can be identified is a movement toward smaller burns (fewer piles allowed at one time) as well as greater clearances from schools and hospitals (Abbotsford in particular has made changes to the necessary clearances due to problems that have occurred in the past).

Additional discussion of the existing open burning activities in the FVRD communities is provided in Chapter 6, which includes identification of policy options.

### 3 OPEN BURNING, AIR QUALITY AND CLIMATE CHANGE

As noted in Chapter 2, open burning in the FVRD includes yard and garden waste, agricultural residue and woody debris (i.e., ‘slash’). Estimates for the emissions associated with these materials are provided in this chapter, focusing on PM. Emissions of other criteria contaminants are not included as they are considered lower priority compared to PM. In Canada, criteria air contaminants include PM, sulphur dioxide, nitrogen oxides, volatile organic compounds, carbon monoxide, ammonia and ozone (not directly emitted). In relation to conventional pollution sources, PM emissions from open burning are relatively high whereas emissions of other criteria contaminants are not.

However, this is not the case when burning garbage. Not only are PM emissions relatively high for burning garbage, but so are a host of toxic compounds (including metals such as mercury and lead, as well as polycyclic aromatic compounds or PAHs). These emissions often referred to as ‘air toxics’, have been characterized for items such as tires and plastics<sup>5</sup>. An estimate of the emissions due to burning garbage in the FVRD cannot be made since no estimate of the amount and composition of garbage burned in the regional district is available.

The climate change implications of open burning are expected to be minor, since many sources identify burning wood as carbon neutral. This relates to the short term carbon cycle whereby trees take up carbon during their lifetime and emit it back to the atmosphere once decaying. Whether trees decompose or are burned, the same carbon is returned to the atmosphere. This logic depends on replacement of the trees that decay or are burned, which may not occur. It is argued that the true carbon neutrality of burning wood requires an accounting of the change in wood volumes (i.e., forested areas) over time (Johnson, 2008). Burning of materials other than wood or vegetative waste, such as garbage (i.e. plastics) would emit greenhouse gases contributing to climate change.

However, the climate implications of burning wood are actually more complex than the paragraph above suggests. Some of the PM emitted can now be identified as Black Carbon (BC) and Brown Carbon (BrC), which are categorized as short term climate forcers (UNEP, 2011). While no estimates are available for the BC and BrC associated with open burning in the FVRD, many current emission inventory efforts include BC, BrC (or both) and estimates for these contaminants are expected to be available for the FVRD in the future.

Taken as a whole, open burning emissions have a significant PM footprint and a climate change footprint that is difficult to establish at this time. The air toxics footprint relates strongly to the amount of garbage that may be included with the biomass and this is currently not possible to estimate.

<sup>5</sup> See EPA AP 42 chapter on open burning: <http://www3.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf>

### 3.1 *FVRD Emissions Estimates*

Currently, there are two large scale emission inventories (EIs) that contain estimates for open burning in the FVRD. These include the 2010 Metro Vancouver (MV) Lower Fraser Valley (LFV) EI (to be updated for 2015) and the BC Ministry of Agriculture (M. Ag.) Agricultural EI completed by Rowan Williams Davies and Irwin Inc. (RWDI) in 2014 (RWDI, 2014). Each EI contains estimates of PM as well as other criteria air contaminants. The PM estimates are identified below.

#### 3.1.1 **Metro Vancouver Canadian Lower Fraser Valley Inventory**

Open burning emissions captured in the CLFV EI (2010) include the following categories:

- Prescribed burning (forestry);
- Land clearing;
- Residential burning; and
- Agricultural burning.

In each case, emissions are estimated from the number of permits issued, information associated with the permits (if available) and additional assumptions as needed for the amount of fuel (wood) consumed. PM emission factors used for the estimates were obtained from the US EPA. Further details are provided for each of the four categories, focusing on actions and data collected for the FVRD municipalities.

Prescribed burning:

Prescribed burning was estimated for the Chilliwack Forest District only (no related activity was documented for the other regions of the FVRD). Data was obtained for the prescribed burns in 2010, including the area treated (ha). An assumption of 135 tonnes/ha for the wood fuel was used, leading to a total estimate of 1,256 tonnes consumed in the year. This assumption originates from the US EPA, assuming equivalence with the Pacific Northwest (Region 6).<sup>6</sup>

Land clearing:

The number of permits issued by the municipal Fire Departments was used to estimate emissions. This information was supported with estimates of the mass burned for each permit; either by pile size and assumed density (400 kg/m<sup>3</sup>) or an average amount determined from past EI studies (167 tonnes/permit). In some cases, the permit holder was contacted for this estimate directly.

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<sup>6</sup> Relevant details can be found at <http://www.epa.gov/ttnchie1/ap42/ch13/final/c13s01.pdf>

#### Residential yard waste:

The number of permits issued from the municipal Fire Departments was used as the base activity, similar to land clearing. Each permit was multiplied by an assumed 0.15 tonnes waste/permit, based on information provided by the Fire Department officials. An exception to this was made for Mission, since permits are not required in this municipality (outside of the urban core, see Chapter 2 bylaw summary for Mission). In this case, an assumed amount generated and burned per capita was used.

#### Agricultural burning:

Agricultural burning estimates also were based on permits issued by the municipal Fire Departments. In some cases, an estimate of the tonnes burned/ permit was also gained (Abbotsford, Kent). For those without the permit data, an assumption of 0.534 tonnes/permit was assumed, as an average of the municipalities in the LFV that did supply estimates.

### 3.1.2 BC Ministry of Agriculture Inventory

An agricultural emissions inventory project was completed for the BC Ministry of Agriculture in 2014 (RWDI, 2014), identifying the significant sources in the agricultural sector, including open burning. The open burning estimates include land clearing, silviculture/forestry, wildlife habitat enhancement and domestic range improvement and 'municipal open burning' which deals with agricultural residues that are exempt from the OBSCR (and occur within municipal boundaries). Emissions relating to the NTFS Category 3 and 4 burns stem from permit data for the year (registrations) whereas emissions for municipal open burning stem from estimates of acres in production (by type of crop) and assumed amounts per acre that are burned. The amounts burned per acre were developed by a limited survey of municipalities in the province. Every municipality without a complete ban on burning (and with ALR lands) was assessed for burning estimates.

Only the estimates associated with agricultural burning were available from the M. Ag. The estimates were provided as 'draft' status, not yet finalized.

#### 3.1.2.1 BC Agriculture Emission Inventory Methods

Municipal open burning estimates for agricultural residues on Agricultural Land Reserve (ALR) areas are based on the expected residue amounts produced by type of crop and an assumed fraction of these residue amounts that are burned. A land use inventory for the province, supported by the 2011 Census of Agriculture, was used to estimate crop areas by type. A percentage of crop residue that is burned was systematically allocated in the estimates. On average, 0.5% of dry crop residues were assumed to be burned; similar to previous inventory estimates of this nature (a survey of municipalities conducted during the project confirmed this percentage was reasonable for the province as a whole). Estimates for crop residues applied in the inventory ('Fuel Loading') by

land cover category are shown in Table 3.1, also showing emission factors that were used. The emission factors were sourced from a recent California Air Resources Board (CARB) publication<sup>7</sup>.

Permitted, non-permitted and illegal burns are expected to be captured in these estimates. To serve as an example, the survey conducted as part of the study implied that Abbotsford would have an expected total crop residue of 69,738 tonnes; with 178 tonnes burned or 0.26% (no other FVRD municipalities were surveyed). The amounts burned were determined from the municipal permits for that year, along with an estimate of the number and size of unpermitted burns (determined from discussions with municipal staff). Other municipalities indicated a higher percentage of residue burned, which supports the 0.5% level consistently applied to all municipalities (including Abbotsford). Only those municipalities with a complete ban on burning were excluded from the estimation methodology.

**Table 3-1: Crop Residue Estimates and Emission Factors by Land Cover Category (from 2014 M. Ag. EI)**

| Land Cover Category   | Emission Factors (kg/tonne) |                  |                   |                 |                 |     |      |                 | Fuel Loading (tonnes/hectare) |
|-----------------------|-----------------------------|------------------|-------------------|-----------------|-----------------|-----|------|-----------------|-------------------------------|
|                       | PM*                         | PM <sub>10</sub> | PM <sub>2.5</sub> | NO <sub>x</sub> | SO <sub>2</sub> | VOC | CO   | NH <sub>3</sub> |                               |
| Corn                  | 5.8                         | 5.7              | 5.4               | 1.6             | 0.2             | 3.3 | 35.4 | 0.6             | 9.4                           |
| Field crop vegetables | 8.7                         | 8.5              | 8.2               | 2.3             | 0.3             | 6.9 | 60.5 | 1.0             | 4.7                           |
| Orchard               | 4.0                         | 4.0              | 3.7               | 2.6             | 0.1             | 3.1 | 33.2 | 0.5             | 5.1                           |
| Vine                  | 3.2                         | 3.2              | 3.0               | 2.6             | 0.0             | 2.5 | 29.2 | 0.5             | 4.7                           |
| Field Crop – Hay      | 8.7                         | 8.5              | 8.2               | 2.3             | 0.3             | 6.9 | 60.5 | 1.0             | 4.7                           |
| Grape                 | 3.2                         | 3.2              | 3.0               | 2.6             | 0.0             | 2.5 | 29.2 | 0.5             | 14.0                          |

**Notes:**

\* Total Particulate was assumed to be 98%PM10, based on California Air Resource Board data.

Data from the EI model were supplied in a database format that included all agricultural burning estimates for the province. The FVRD regions were identified in the database, including Abbotsford and the 7 electoral areas. No emissions were attributed to Chilliwack, Mission, District of Kent, Village of Harrison Hot Springs or District of Hope. Since Chilliwack and Kent allow burning and have ALR lands, emission estimates were expected for these municipalities (investigation of this issue is ongoing).

<sup>7</sup> Managed Burning Emission Factor Table. <http://www.arb.ca.gov/ei/see/mngdburnemissionfactors.pdf>. Reviewed May 22, 2015.

### 3.1.3 Open Burning Particulate Matter Estimates

The estimate of ‘current’ open burning emissions of PM in the FVRD from the two sources of data are summarised in Table 3.2.

**Table 3-2: PM Estimates for FVRD Open Burning**

| Data Source | Year | Source Group | Source Area   | Total PM (tonnes) | PM <sub>10</sub> (tonnes) | PM <sub>2.5</sub> (tonnes) |
|-------------|------|--------------|---------------|-------------------|---------------------------|----------------------------|
| MV          | 2010 | Ag burning   | Fraser Valley | 7.88              | 7.88                      | 7.88                       |
| M Ag        | 2011 | Ag burning   | Fraser Valley | 5.7               | 5.6                       | 5.4                        |
| MV          | 2010 | Prescribed   | Fraser Valley | 10.85             | 8.41                      | 7.67                       |
| MV          | 2010 | Yard waste   | Fraser Valley | 7.15              | 4.76                      | 4.76                       |
| MV          | 2010 | Landclearing | Fraser Valley | 38.00             | 25.34                     | 25.34                      |

\* Decimal places are not an indicator of accuracy.

A breakdown of the MV open burning estimates by FVRD region is shown in Table 3.3. No estimate for residential, agricultural and land clearing burning in the electoral areas could be made by MV, due to lack of data.

**Table 3-3: MV Open Burning Estimates by Municipality/Electoral Area**

| FVRD Community       | Population     | PM <sub>2.5</sub> Emissions (tonnes) |              |               |             |              |
|----------------------|----------------|--------------------------------------|--------------|---------------|-------------|--------------|
|                      |                | Residential                          | Agricultural | Land Clearing | Prescribed  | Total        |
| FVRD Municipalities  | 267,141        | 4.76                                 | 7.87         | 25.34         | 0.00        | 37.98        |
| FVRD Electoral Areas | 16,764         | n/a                                  | n/a          | n/a           | 7.67        | 7.67         |
| <b>FVRD Total</b>    | <b>279,741</b> | <b>4.76</b>                          | <b>7.87</b>  | <b>25.34</b>  | <b>7.67</b> | <b>45.65</b> |

By comparing the two available inventories, supported by the interviews with the FVRD municipal Fire Chiefs, it is expected that the residential and agricultural open burning estimates in the MV EI are likely under-represented. This is not expected to be the case for the land clearing and prescribed burning categories. A reasonable upper bound to the residential and agricultural estimates is 3x and 2x the MV estimates respectively. The following rationale for this statement is as follows:

- Residential burning occurs in all of the municipalities and electoral areas, including within urban areas (although little is expected within the Abbotsford and Chilliwack urban catchment boundaries). Significant burning also occurs in Hope, both within (e.g., illegal) and outside of the urban area and the majority of this burning is not represented in the permit data.

- While data exist to characterize the agricultural burns, the M. Ag. approach identifies the possibility that the total is under-predicted. Interviews with the Fire Chiefs show that permitted burns are added to at times (e.g., a defined pile will have additional materials, including illegal materials, added over time in some cases). In addition, 2010 may not be a relatively high activity year for agricultural burning (2015 for example may have greater emissions due to the hazelnut tree blight).

It is therefore expected that the total annual open burning PM<sub>2.5</sub> emissions in the FVRD may be as high as 63 tonnes. This constitutes almost 7% of the 968 tonne total estimated for the FVRD<sup>8</sup> and makes it a larger contributor to this total than light duty vehicles (45 tonnes) and heavy duty vehicles (48 tonnes). The largest source group for PM<sub>2.5</sub> in the FVRD is heating (276 tonnes, mostly due to wood heating).

### 3.2 *FVRD Ambient Monitoring Data*

Currently, there are 6 ambient monitoring stations in the FVRD, although T43 (Mission) began operating in mid 2014 and therefore does not have sufficient data to be of interest to this study. For particulate matter (PM), Tapered Element Oscillating Microbalance (TEOM) instruments have historically been used, although Synchronized Hybrid Ambient Real-time Particulate (SHARP) instruments have been used since 2013 for all PM<sub>2.5</sub> measurements. Table 3.4 provides a summary of data availability at the stations.

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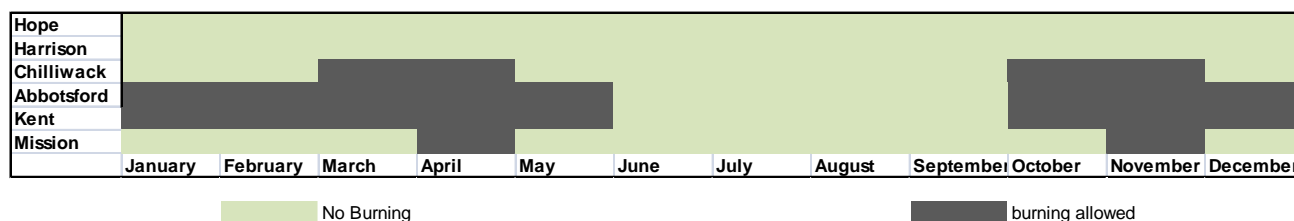
<sup>8</sup> 2010 EI data for all sources was provided by Metro Vancouver.



**Table 3-4: FVRD Monitoring Station Data Availability**

| Station                    | Contaminants monitored  | PM instrumentation   | Availability (94 – 2014)  | Notes           |
|----------------------------|---|--|---|-----------------|
| T12 Chilliwack             | NO <sub>2</sub> , NH <sub>3</sub> , O <sub>3</sub> , CO, SO <sub>2</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> | TEOM (PM <sub>10</sub> , PM <sub>2.5</sub> ); SHARP 2014 (PM <sub>2.5</sub> only)    | PM <sub>2.5</sub> and PM <sub>10</sub> from mid 1995, NH <sub>3</sub> from 2005, SO <sub>2</sub> from late 2001, NO <sub>2</sub> (all), CO (all), O <sub>3</sub> (all)            |                 |
| T33 Abbotsford – Mill Lake | NO <sub>2</sub> , O <sub>3</sub> , CO, SO <sub>2</sub> , PM <sub>10</sub> , PM <sub>2.5</sub>                   | TEOM (PM <sub>10</sub> , PM <sub>2.5</sub> ), SHARP (PM <sub>2.5</sub> only), 2014   | NO <sub>2</sub> , O <sub>3</sub> , CO, SO <sub>2</sub> , PM <sub>10</sub> from late 1998, PM <sub>2.5</sub> from mid 2010, NH <sub>3</sub> from 2005, PM <sub>2.5</sub> from 2014 |                 |
| T34 Abbotsford             | NO <sub>2</sub> , NH <sub>3</sub> , O <sub>3</sub> , SO <sub>2</sub> , PM <sub>2.5</sub>                        | TEOM   | PM <sub>2.5</sub> from 2002, NO <sub>2</sub> from late 2003, NH <sub>3</sub> from 2005, SO <sub>2</sub> from early 2006, O <sub>3</sub> from late 2006                            | Ended Sept 2010 |
| T44 Agassiz                | NO <sub>2</sub> , O <sub>3</sub> , PM <sub>2.5</sub>  | SHARP  | From mid 2013   |                 |
| T45 Abbotsford Airport     | NO <sub>2</sub> , NH <sub>3</sub> , O <sub>3</sub> , CO, SO <sub>2</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> | TEOM<br>SHARP (PM <sub>2.5</sub> only), 2014   | From mid 2012   |                 |
| T29 Hope                   | NO <sub>2</sub> , O <sub>3</sub> , CO, PM <sub>10</sub> , PM <sub>2.5</sub>                                     | TEOM (PM <sub>10</sub> , PM <sub>2.5</sub> )<br>SHARP (PM <sub>2.5</sub> only), 2014 | NO <sub>2</sub> , O <sub>3</sub> , CO, PM <sub>10</sub> from late 1996, PM <sub>2.5</sub> from early 2004   |                 |

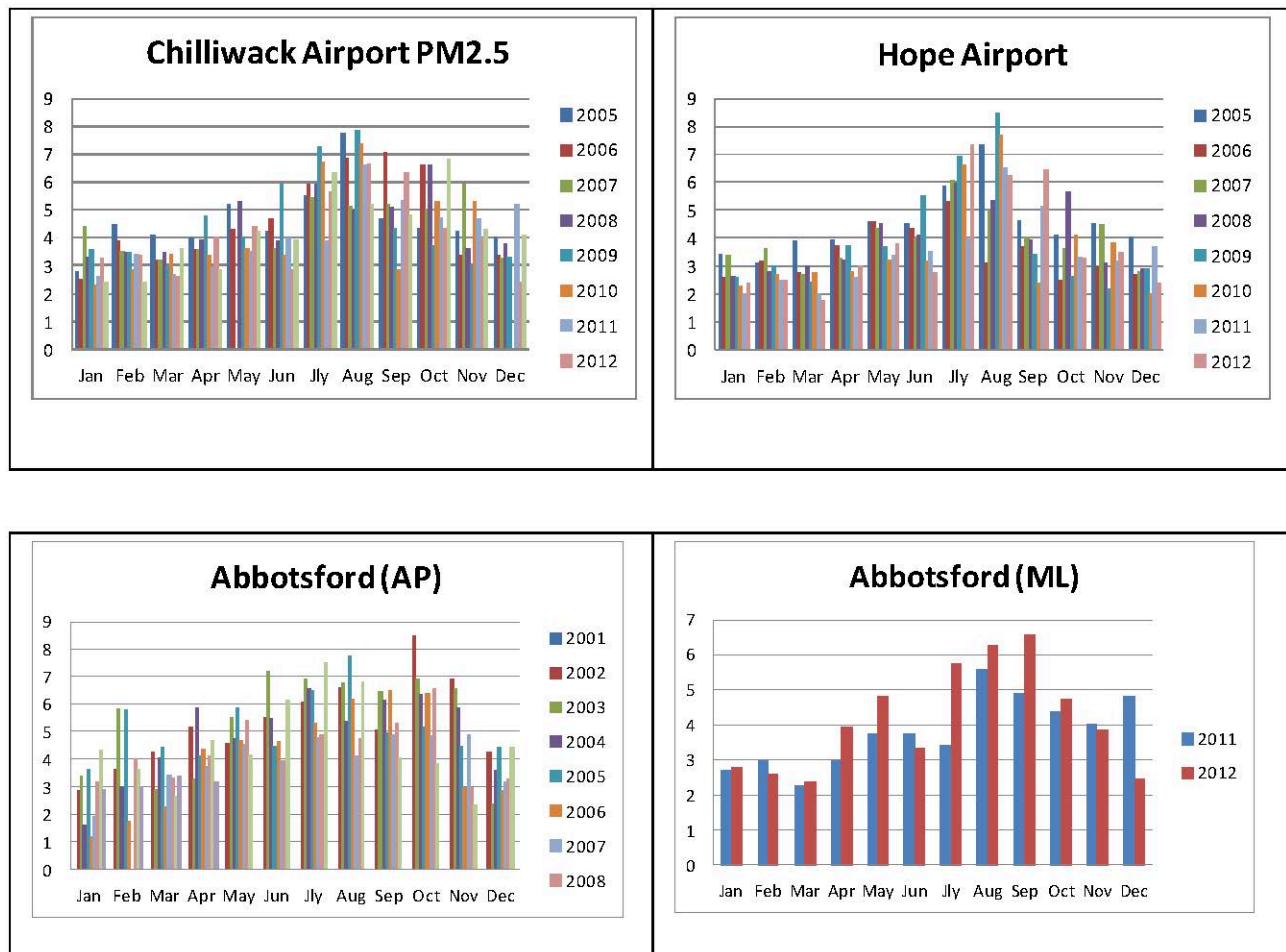
Figure 3.1 provides a visualization of the allowed burn periods in the FVRD. While Hope allows for determination of a burn period each year (Council decision required), no such period has been approved during the last ten years. Allowable burn periods, if chosen, are typically set to avoid the driest months during the summer when fire hazards are higher.



**Figure 3-1: Allowed burn periods in the FVRD municipalities**

March and April in the spring, and October and November in the fall, are the months when most of the burning would be expected. As shown in Figure 3.2, there is not a general trend that could be

attributed to allowed open burning periods. The monthly average  $PM_{2.5}$  concentrations tend to be highest in July and August, which is partly due to drier conditions (which leads to increased suspended dust) and sporadic wildfire activity in the province (as well as the western states).



**Figure 3-2: Monthly Average  $PM_{2.5}$  (TEOM) Data at FVRD Monitoring Stations**

The  $PM_{10}$  and  $PM_{2.5}$  station data is further evaluated in Table 3.5, identifying percentile ambient concentrations as well as compliance with the provincial air quality objectives.

**Table 3-5: Statistics for Daily Average PM 2.5 Concentrations (all values in  $\mu\text{g}/\text{m}^3$ )**

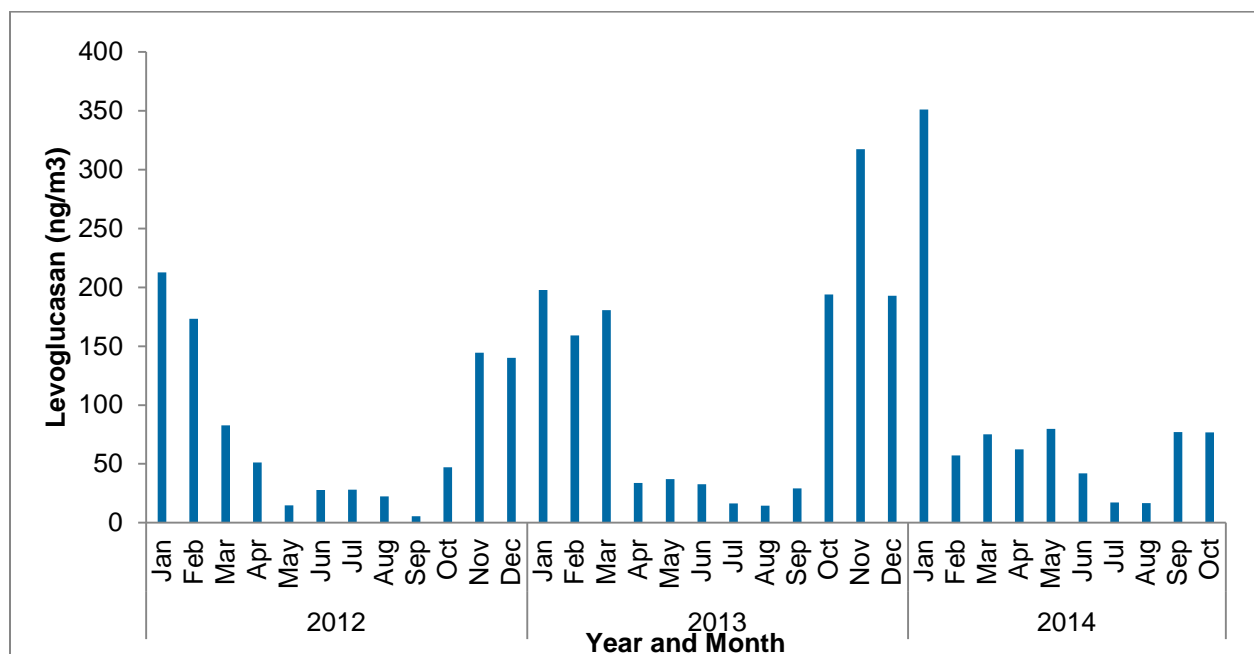
|                 | Chilliwack | Hope      | Abbotsford T33 | Agassiz   | Abbotsford T34 | Abbotsford T45 |
|-----------------|------------|-----------|----------------|-----------|----------------|----------------|
|                 | 1995-2013  | 2004-2014 | 2010-2014      | 2013-2014 | 2002-2010      | 2012-2014      |
| Avg Daily Mean  | 4.670      | 3.941     | 3.960          | 6.075     | 4.003          | 6.075          |
| max             | 35.708     | 34.646    | 18.592         | 22.654    | 21.690         | 22.654         |
| min             | 0.000      | 0.000     | 0.258          | 0.629     | 0.000          | 0.629          |
| std dev         | 3.084      | 2.942     | 2.625          | 3.294     | 3.178          | 3.294          |
| 99th Percentile | 15.297     | 14.083    | 13.009         | 15.662    | 13.249         | 15.662         |
| 98th Percentile | 13.333     | 12.031    | 11.227         | 14.178    | 11.788         | 14.178         |
| 75th Percentile | 6.000      | 4.942     | 5.275          | 7.925     | 5.547          | 7.925          |
| 50th Percentile | 4.036      | 3.263     | 3.433          | 5.388     | 3.325          | 5.388          |
| 25th Percentile | 2.504      | 2.083     | 2.046          | 3.600     | 1.690          | 3.600          |
| 5th Percentile  | 1.083      | 0.923     | 0.929          | 1.983     | 0.000          | 1.983          |
| missing         | 0.088      | 0.128     | 0.000          | 0.068     | 0.545          | 0.068          |

Incidences of measurements exceeding the provincial 24-hour average objective of  $25 \mu\text{g}/\text{m}^3$  accounted for less than 1 percent of the data and show no obvious relationship to the allowed burning periods. Exceedances occurred in August 2014 (>10 incidences), August 2010 and September 2006 in Chilliwack, Hope, Abbotsford and Agassiz. These events were likely influenced by wildfires (large wildfires in BC. are noted for 2014 and 2010 in particular)<sup>9</sup>.

### 3.2.1 Speciated Monitoring Data

The National Air Pollution Surveillance (NAPS) program collects data across Canada for a number of air contaminants. Speciated data is collected for PM through filter-based instruments. In some cases, the filters are analyzed for levoglucosan. This organic compound is produced upon pyrolysis of cellulose during combustion of wood and is used as a tracer for fresh smoke from biomass burning (B.R.T. Simoneit, 1999). Measurements for the years 2012 – 2014 were obtained from the NAPS monitoring station at 1073 Columbia Street in Abbotsford (T45). Peaks were observed in late fall through early spring of each year, corresponding to the allowed burning period. However this marker is also attributed to the use of woodstoves in urban areas (Keith Jones, 2011). As noted in the 2010 MV EI, wood burning emissions for heating are higher than those due to open burning.

<sup>9</sup> <http://bcwildfire.ca/history/LargeFires.htm>



**Figure 3-3: Monthly Average Concentrations of Levoglucosan Measured in Abbotsford**

Average levoglucosan concentrations are low relative to those that may be seen in other airsheds that actively manage PM emissions. However, the climates of these airsheds are significantly different than the climate of the LFV, which would influence the measured concentrations. Table 3.6 indicates that the concentrations for Abbotsford are low relative to those seen in Whitehorse and Golden and comparable, although lower than those seen in Kelowna.

**Table 3-6: Comparison of Average concentrations of Levoglucosan**

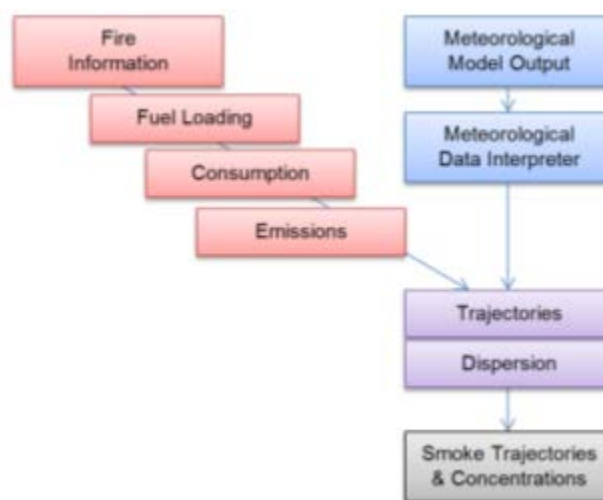
| Location                       | Time Period                           | Levoglucosan (ng/m <sup>3</sup> )<br>(avg ± sd) |
|--------------------------------|---------------------------------------|---|
| Kelowna (Jones, 2012)          | Apr 2006 - Mar 2007                   | 145 ± 194                                       |
|                                | Apr 2006–Sep 2006                     | 26 ± 29   |
|                                | Oct 2006 – Mar 2007                   | 307 ± 206                                       |
| Golden (Jones, 2012)           | Dec 2006 – Feb 2007                   | 1020 ± 478                                      |
| Abbotsford                     | Jan 2012 – Oct 2014                   | 98 ± 136  |
|                                | Jan – Mar (2012-2014)                 | 159 ± 173                                       |
|                                | Apr – Jun (2012-2014)                 | 39 ± 46   |
|                                | Jul – Sep (2012-2014)                 | 24 ± 36   |
|                                | Oct (2012- 2014), Nov-Dec (2012-2013) | 148 ± 179                                       |
| Whitehorse (Keith Jones, 2011) | Jan 2009 - Mar 2009                   | 418 ± 419                                       |

Wood smoke apportionment analysis using positive matrix factorization (PMF) is currently being completed with data from Burnaby and Abbotsford by Environment Canada. However, as with the levoglucosan data, separation of open burning contribution from other burning sources such as residential wood combustion is difficult and would not be expected<sup>10</sup>.

### 3.3 Predictive Tools

#### 3.3.1 BlueSky Framework

There are several related products/tools associated with the BlueSky Framework (BSF). BSF is a framework to simulate the dispersion of emissions from forest, agricultural and range fires and includes several independent modules to characterize fuel, fire information, emissions and dispersion. The main benefit of BSF is its coordination of these modules to a meaningful output (prediction) for staff tasked with fire management. BSF is open source and flexible, such that newer modules can be incorporated as improved simulation abilities develop. The open source nature of the model allows for the option of user-defined enhancements<sup>11</sup>.



**Figure 3-4: BSF Schematic of Inputs and Calculations (from BSF Manual V3.5.0)**

<sup>10</sup> Personal communication with K. Jones, Environment Canada, December 16, 2015.

<sup>11</sup> STI Inc, 2014. The BlueSky Framework Manual. Prepared for the USDA Forest Service Seattle, WA.

BSF runs on a Unix/Linux platform and requires spatially and temporally gridded meteorological data as well as spatially tagged fire (emission) inputs.

In Canada, the Canadian Bluesky Playground is an ongoing (experimental) project that utilizes the BSF and is based on the Bluesky Playground developed for the U. S. Department of Agriculture (USDA) Forest Service. The Canadian version is supported by Parks Canada, BCMoE, BC FLNRO, Natural Resources Canada and the University of British Columbia (UBC)<sup>12</sup>. The Canadian Bluesky Playground (CBP) is an interactive web-based tool that allows the user to create emissions scenarios (as Broadcast, Piles or Wildfire type) with a number of additional inputs that affect the burn conditions. Considering the 'pile' designation, these inputs include number of piles, pile shape, pile height, wood composition and percent consumption. A great benefit of the tool is its direct access to meteorological forecast fields at 4km horizontal grid resolution. In effect, the tool allows the user to utilize a sophisticated atmospheric modelling tool without a high degree of skill and cost that would otherwise be required to configure a local simulation of open burning.

### 3.3.2 Regulatory U.S. Environmental Protection Agency (US EPA) Tools

Regulatory dispersion models are commonly used to assess air quality impacts of industrial sources such as stacks. There are several dispersion tools freely available for this purpose, with the US EPA being the primary provider<sup>13</sup>. The simplest freely-available 'screening' dispersion tool is the US EPA SCREEN3 model, while an additional screening model (also freely-available) with more capability is the US EPA AERscreen model. These models are attractive for their relative ease of application without the need for collecting and formatting meteorological data, while using Gaussian plume dynamics that other, more sophisticated models use.

As identified in Figure 3.5, Gaussian plume dynamics are representative of neutral or buoyant gas releases (including fine particulate matter, which acts like a gas near the source). Through empirical studies, neutral or buoyant gas releases have been found to be well approximated with a Gaussian (bell-shaped) distribution (Beychok, 1995). Plume dilution is represented as a function of wind speed and the horizontal and vertical standard deviations of the plume (generally called 'dispersion parameters' that can be estimated from atmospheric conditions such as cloud cover, time of day and wind speed).

Gaussian plume dispersion assumes a continuous emission source. A Gaussian plume model projects the plume out to infinity with a consistent centreline and concentration distributions in the horizontal and vertical that expand with distance. Additional modules can be added to the Gaussian plume approach to deal with the influences of terrain, wake induced turbulence (due to a building or obstacle near the source) and others.

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<sup>12</sup> Firesmoke.ca/playground.

<sup>13</sup> See <http://www3.epa.gov/scram001/>

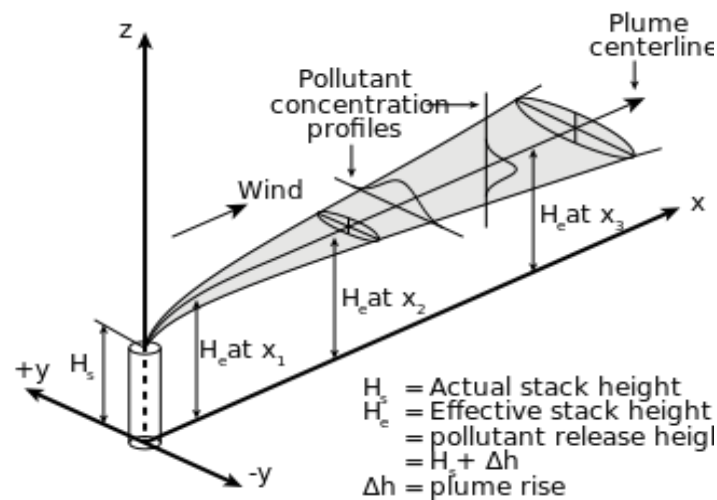


Figure released under the GNU Free Documentation License (Author BMacZero)

### Figure 3-5: Gaussian Plume Representation

While Gaussian plume models (and other regulatory models) are largely focused on industrial emission sources such as stacks, which require a 'point' source representation, other source representations are available for less defined emission inputs, including 'area' and 'volume' sources. These source representations are identified below, with their typical applications and limitations:

- Point: Stack height, stack diameter, exhaust temperature, exhaust exit temperature, emission rate;
- Area: Release height, length, width, emission rate; and
- Volume: Release height, initial lateral dimension, initial vertical dimension, emission rate.

A potential weakness of the area and volume source representations in the screening models is lack of ability to represent buoyancy due to temperature of the emissions. More sophisticated Gaussian regulatory models (such as the model CALPUFF that was used by UNBC as described in the Prince George case study) add an option to include temperature and effective vertical velocity to the area source designation, in effect allowing a 'buoyant area source' representation. The SCREEN3 and AERscreen models do not have this option.



### 3.3.3 Test Applications

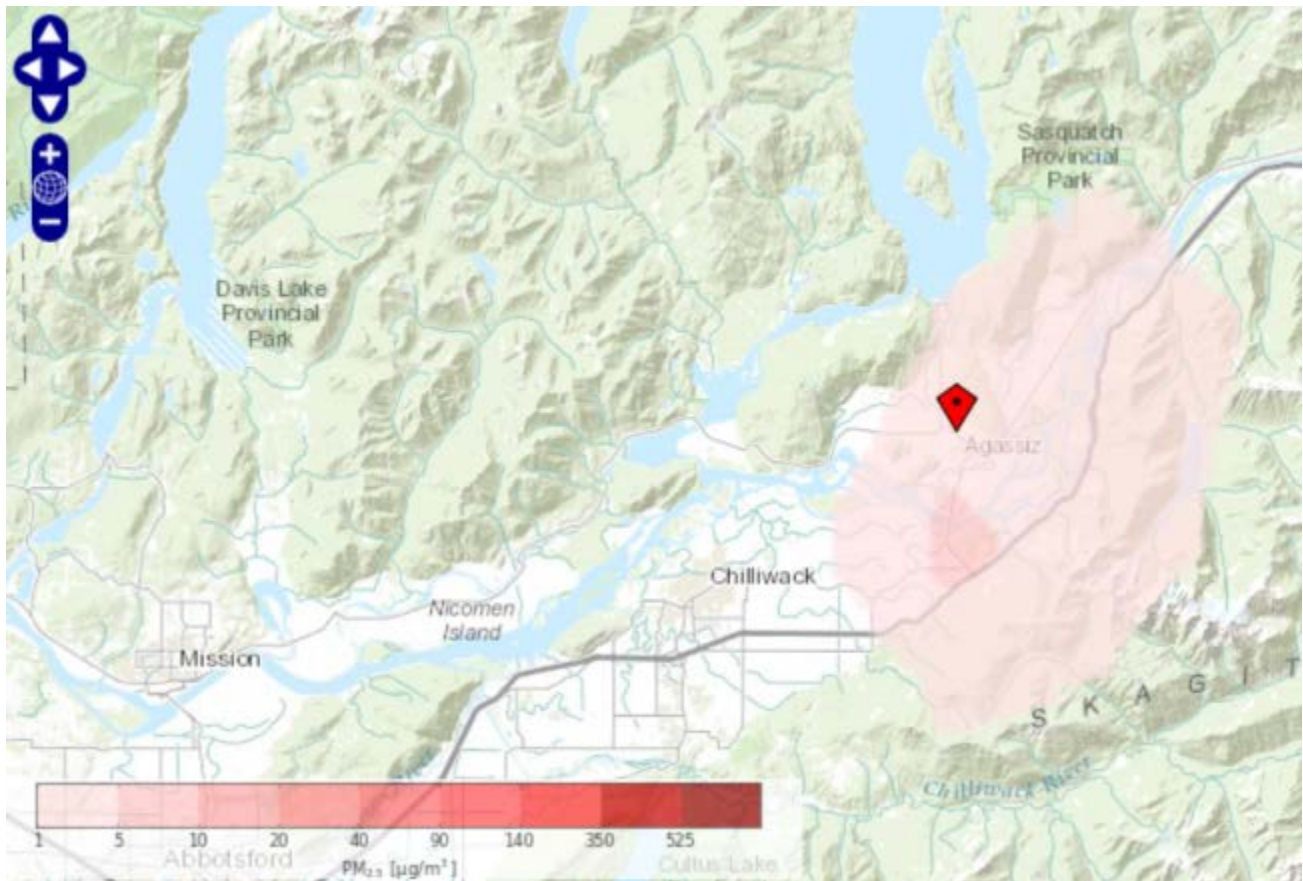
#### 3.3.3.1 BlueSky Playground

The Playground model is expected to be relevant for larger scale burns, such as those that occur in Washington state each year (Candace M. Berg, 2003). For this reason, a realistic burn scenario of larger size for the FVRD was pursued to test the model. Kent is a primary producer of hazelnuts in BC, as are other regions of the FVRD. In 2015, the trees suffered a complete loss due to the Eastern Filbert Blight reportedly migrating up from Oregon and Washington. During an interview with District of Kent Fire Department staff, it was identified that one or more of the associated landowners culled their nut tree stocks with the intent of burning them to be rid of the waste. Therefore a realistic scenario, although one that may only occur in rare occasions, would be to burn a number of piled trees in the District of Kent (during allowable venting conditions as per the local bylaw). Test inputs for an actual one-day burn event that occurred in Kent during the fall of 2015, are as follows:

|                                       |               |
|---------------------------------------|---------------|
| Pile size (based on maximum in bylaw) | 6 by 6 metres |
| Pile number                           | 15            |
| Amount burned (tonnes)                | 413           |

The number and size of the piles were characterized from information supplied by the Fire Chief. Such a burning event could be considered outlying with respect to those arising from normal agricultural practices, and more in line with land clearing which involves whole trees. The amount burned was calculated by BlueSky Playground based on a semi-spherical pile of shrub/hardwood and an assumed 90% consumption of the fuel. The resulting PM emissions estimates were compared with estimates based on the 2010 Metro Vancouver Emissions Inventory methodology for land clearing. The two estimates were within an order of magnitude: BlueSky Playground estimated 2.3 tonnes of PM<sub>2.5</sub> as compared with 4.1 tonnes estimated using the MV method.

The dispersion and trajectory model within BlueSky Playground predicted *hourly average* PM<sub>2.5</sub> concentrations up to 20 - 40 µg/m<sup>3</sup> within the LFV as shown in the produced snapshot of the run in Figure 3.6. This prediction is associated with the actual meteorological conditions during the burn day (as simulated by the model). This 1-hour snapshot corresponds to 11 pm, when dispersion conditions would be worse than during the afternoon. It is not known whether the actual fire persisted this long during the day. However, the daily average (24-hour) prediction is less than 1 µg/m<sup>3</sup>, which is well below the provincial 24-hour PM<sub>2.5</sub> objective of 25 µg/m<sup>3</sup>. Ambient PM<sub>2.5</sub> measurements at the FVRD monitoring stations on this day indicate hourly PM<sub>2.5</sub> levels from 0 to 22 µg/m<sup>3</sup>, with a 24-hour average (all stations combined) of 8 µg/m<sup>3</sup>. These levels are similar to those experienced two days later (with an identical 24-hour average of 8 µg/m<sup>3</sup>), meaning that the effect of the burn on ambient PM<sub>2.5</sub> levels at the monitoring stations is likely too small to be easily identified.



**Figure 3-6: BlueSky Playground maximum 1-hour  $PM_{2.5}$  prediction for the test case.**

There are limitations to the BlueSky Playground model outputs; tabular results (i.e., summary of hourly average concentrations by location) are not accessible and so graphical outputs such as Figure 3-6 must be interpreted to determine the model outcomes. In addition, the spatial resolution of the model leads to averaging of the predicted results, meaning that the maximum spatial impacts cannot be determined. For these reasons, the model is suitable to answer the question 'is the airshed negatively impacted' rather than 'will residents in the vicinity of the burn be impacted'.

The test also indicates that 'large' individual open burns (i.e., larger than most of the burns that occur in the FVRD communities) are not likely to have observable impact on ambient  $PM_{2.5}$  concentrations across the valley on their own, if burning occurs during appropriate ventilation conditions (such as the test case). However, this conclusion is based on the one test case only, and should be further evaluated in the future.

The model is expected to have value when considering burn events that are much larger than normal – such as multiple burns at different locations or an extreme case of an individual burn (such as the annual Fraser River Debris Trap log sort burn in Kent that may be an order of magnitude or more higher than this test case). Applying BlueSky Playground to such events would be informative.

### 3.3.3.2 SCREEN3

The same scenario and emission rates were modelled in SCREEN3. This model assumes straight line advection and dispersion (i.e., following the general wind direction as in Figure 3.5) under six possible meteorological regimes A to F (representing very unstable to very stable atmospheric conditions). The model predicts ground-level concentrations with distance from the source.

The source was represented with the volume designation, as follows: emission rate 26.6 g/s (2.1 tonnes over 24 hours), source release height 5 m, initial lateral dimension 20 m, initial vertical dimension 20 m. ‘Very unstable’ conditions were selected, to match the expected atmospheric conditions during the afternoon the burn took place (this would not be applicable during the evening hours).

SCREEN3 does not have sophisticated graphical outputs, so no output graph is shown. The model only predicts 1-hour average concentrations (so 24-hour averages, if desired, must be scaled from the 1-hour values).

Model outputs show a 1-hour concentration of 143  $\mu\text{g}/\text{m}^3$  at 500 m distance, dropping to 38 and 21  $\mu\text{g}/\text{m}^3$  at 1 km and 2 km distances respectively. Choosing ‘slightly unstable’ conditions (which may represent early evening conditions), leads to model predictions increasing to 1200, 460 and 160  $\mu\text{g}/\text{m}^3$  at the same distances.

SCREEN3 is expected to predict concentrations higher than reality and higher than what more refined dispersion models would indicate, to ensure the worst case impacts of the source are identified in all possible situations. It is expected that these results may be overly conservative for reasons of source characterization (poor ability to characterize the true behaviour of the fire plume). Tracking evolution of the plume (and its impacts) over several hours is not possible, which is also a serious limitation.

## 4 POLICY REVIEW

### 4.1 *Provincial Open Burning Smoke Control Regulation*

The OBSCR applies to any parcel of land designated as Crown land or public land (park, area open to the public), but also extends to private land. Burn operators do not need to obtain a permit, but must follow the requirements of the regulation. While the rule is in effect for all areas, different criteria are held for 'Category A' areas (sensitive) and 'Category B' areas (all areas not Category A). All urban areas are considered Category A. For the FVRD, this would include the six municipalities.

Additional criteria are included in the OBSCR to those identified in Chapter 2. In particular, the burning activity must halt if adverse conditions arise (e.g., shift in weather pattern, smoke impacting others). A municipal or regional bylaw more restrictive than the OBSCR, if existing, is expected to be followed.

An update to the OBSCR is expected in 2016 and the proposed changes are currently identified on the BCMoE website (BCMoE(b), 2015). Proposed revisions to the regulation include use of primary and secondary smoke sensitivity zones (instead of Category A and B), *encouraging* the use of commercially available air curtain incinerators to reduce emissions, establishing specific rules for smoke sensitivity zones, enabling development of 'smoke management plans' for specific areas, developing Best Management Practices (BMPs) and using a 'one window system' (with BC FLNRO) for registering and tracking open fires (BCMoE(d), 2010). Smoke sensitivity zones will likely be based on population density such that regions with greater than 200 people/square kilometres will have more stringent regulations applied (BCMoE(b), 2015). It is expected that this definition will place the entire LFV valley floor within the FVRD within the primary (or high) sensitivity zone, along with the immediate surroundings.

Air curtain incinerators are currently required in some local bylaws for the burning of land clearing debris (and encouraged in others). This technology involves forcing a curtain of air over burning material to improve combustion (and reduce PM emissions).

The proposed general and zone-based rules of the OBSCR are found in the BCMoE policy intentions paper, provided in Appendix B.

### 4.2 *Bylaws used in BC. Communities*

Bylaws in effect in the municipalities and regional districts in British Columbia are generally similar in nature, reflecting the BCMoE template developed and provided in 1998. Greater restrictions are typically identified in the more densely populated areas. Some of the key factors that can differ in the various bylaws that can be identified from the 2012 provincial bylaw review (Coccola, 2012) are noted below:

#### Bans or partial bans:

- Partial bans, if used, tend to either identify a long period during which open burning is not allowed (e.g., May to September) or distinct, shorter periods when burning is allowed (e.g., one month in spring, one month in fall). In the extreme, only specific days during a noted period are allowed burn days (e.g., first Friday and Saturday during an identified month).

#### Exemptions (from a ban):

- Often include camp fires and beach fires; in more urban settings, only cooking fires within a pit may be exempted from a ban or partial ban. Although not always stated, barbecues are expected to be exempted in all cases.
- While land clearing is not always identified it may be exempted from the bylaw (example Smithers) or addressed in a separate bylaw (example Cowichan Valley Regional District).

The 2012 Coccola study also identified what alternatives to open burning are available. The documented alternatives tend to be curbside pickup or community waste transfer stations that allow yard and garden waste over set periods or at all times. In the more beneficial alternatives, transfer stations or landfills were noted to have zero tipping fees for 'yard waste', up to 650 kg in the extreme case (Central Okanagan Regional District). The Central Okanagan Regional District bylaws also included a free chipping program for agricultural waste (orchards). A 2015 update to the provincial summary of backyard burning bylaws is available (<http://www.env.gov.bc.ca/epd/bcairquality/reports/pdfs/bylaws-2015.pdf>).

A review of open burning bylaws for the communities on Vancouver Island (Wyton, 2011) identifies several issues of interest through discussions with the relevant municipal contacts:

- Most bylaw development has evolved through fire prevention regulation; some recent bylaw developments have addressed air quality or have had a greater focus on air quality.
- According to most, burning bylaws are not difficult or costly to enforce.
- Communities with a complete ban on open burning report few infractions or fine collection problems.
- The permitting process can be an effective education tool; it allows discussion and potential adjustment of burning behaviours.
- Communities that have recently instituted burning or air quality bylaws have also typically considered waste management prior to release (e.g., chipping program or debris pickup).

Wyton (2011) found that campfires can develop into refuse fires in jurisdictions where other forms of burning are not allowed. For this reason, campfires are now specifically identified in some open burning bylaws. A summary of the Vancouver Island open burning bylaws reviewed is provided below.

- Summary of Vancouver Island Open Burning Bylaws (from Wyton, 2011)
  - Municipalities reviewed: 33
  - New or updated open burning bylaws since 1997: 13
  - Burning bans (4 confined to the urban containment): 18
  - Campfire bans (specified within the 18 bans, above): 9
  - Campfires allowed, with regulations: 15
  - Incinerator bans: 12
  - Incinerator allowed (with and without permission): 9
  - Partial bans (for most or part of the year with specified times for regulated burns): 17
  - Burning by permit only: 13
  - Land clearing burn bans: 12
  - Land clearing burn allowed with regulation: 12

### 4.3 *Case Study Bylaws*

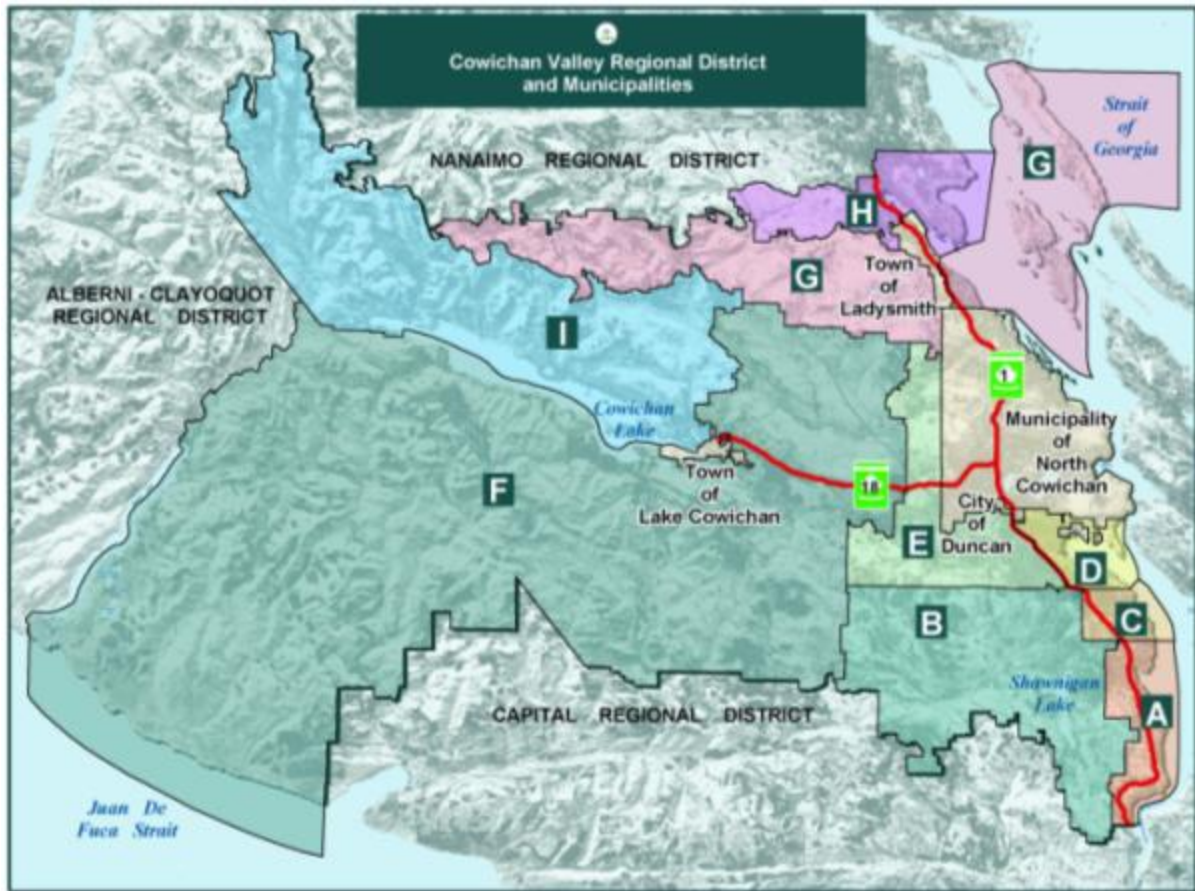
Several case studies are reviewed in this section, focusing on key differences that have been noted in the existing bylaw reviews. Other issues of interest to this study are also highlighted, such as supporting staff (e.g., bylaw development and/or enforcement) and related enforcement activities.

#### 4.3.1 *Case Study 1: Cowichan Valley Regional District (CVRD)*

##### 4.3.1.1 *CVRD Background*

The CVRD includes four municipalities and nine electoral areas, as shown in Figure 4.1.





**Figure 4-1: Figure 4.1: CVRD Municipalities and Electoral Areas**

The total population of the CVRD is 80,332 (2011 estimate). Of this total, approximately 50% live in the municipalities of Duncan, North Cowichan, Ladysmith and Lake Cowichan. The Electoral Areas A – I contain most (approximately 40%) of the remaining population. The local economy is noted to include a strong agricultural sector (685 farms), forestry and tourism. Tourism is the largest business sector according to the CVRD website.

Also of relevance, there are four Improvement Districts within the region (Cowichan Bay Fire Protection District, Mill Bay Fire Protection District, Shawnigan Lake Fire Protection District and Thetis Island Fire Protection District), not shown. Improvement Districts are usually located in rural areas of BC. and are empowered by the province to provide local services such as water, fire protection and garbage collection but not the general governance and planning services that municipalities and regional governments provide (BC Government, 2015).



#### 4.3.1.2 Relevant Bylaws

CVRD Bylaw No. 3716 - Smoke Control Regulation Bylaw, 2013 (CVRD, 2013) restricts backyard burning in electoral districts A, B, C, D and E as well as Cowichan Bay and Shawnigan Improvement Districts and the Mill Bay Fire Protection District. It is currently being reviewed for districts F and G. The bylaw was patterned after the North Cowichan Fire Protection Bylaw, 2008 (North\_Cowichan, 2008), which permits open burning between March 15 – April 15 and October 15 – November 15 only, with additional criteria:

- Proximity limits (to buildings, property lines);
- Daylight hours only, subject to the provincial ventilation index being 'good';
- Fire diameter and height restrictions (pile being burned), no more than one hand-piled fire per property at any time;
- Material must originate from property where burned, consisting of untreated natural wood and brush only;
- Definitions for acceptable recreational fire pits; and
- Subject to local fire restrictions.

CVRD Bylaw No. 3716 was developed following a directive from the regional government that an open burning bylaw be developed for the region. This bylaw follows the criteria identified above, with additional specifications:

- Large permitted burning materials such as stumps and wood over 8 inches in diameter may be burned over a maximum period of 72 hours (if fire is smokeless);
- Fire must be continually controlled and supervised, maintained so as not to constitute a nuisance;
- Identification of the Fire Inspector's rights and potential actions; and,
- Campfires also identified (allowed, with requirements).

Permits are not required to conduct residential open burns.

CRVD Bylaw 2020, Land clearing Management Regulation Bylaw, 2009 (CVRD, 2009) is also used to manage open burning, specifically for land clearing activities. The bylaw specifically notes that it does not apply to persons carrying out normal farm practices within the meaning of the Farm Practices Act (British Columbia), as well as any forest practice as defined by the Forest and Range Practices Act (British Columbia). The bylaw requires use of an air curtain burner for all open burning of land clearing debris. The air curtain burner must be registered with the CVRD prior to use.

#### 4.3.1.3 *Bylaw Development*

A clear objective of the CVRD Bylaw 3716 is consistency and a desire to reduce the amount of open burning across the regional district. Open burning is identified as a main source of air pollution in the Cowichan region, including burning associated with forestry, land clearing and backyard burning; 'agricultural operations' are also identified, which presumably includes agricultural burning (CVRD, 2010).

Currently, the bylaw is in effect for the municipalities and Electoral Areas A – E. Electoral Areas F, G, H and I are not included, as their elected Directors believe their residents are reluctant to accept such a bylaw. However, it is hoped that these areas will agree to be included at some point in the future. Of the Improvement Districts, three have decided to comply with the bylaw (Cowichan Bay Improvement District, Shawnigan Improvement District and Mill Bay Fire Protection District). The Shawnigan Lake Fire Protection District is non-compliant and supports its own bylaw.

Through interviews with CVRD staff several related items of interest were reviewed, which are summarised below.

A noted sensitivity of the bylaw development was (is) the differences in expectations and behaviours from urban residents to more rural residents. The North Cowichan bylaw was considered a good balance, in part because the municipality has a mix of urban and rural residents. Other municipalities in the CVRD do not allow open burning at all (e.g., Ladysmith, Duncan) and this expectation tends to be supported by most of the municipal residents in the CVRD. This expectation is not very popular in the rural areas.

The allowable burn periods are shorter than used previously by the regional district, but are thought to represent periods dry enough that materials could burn effectively, yet not constitute a fire hazard. Previously, when burning was allowed in the wetter months, saturated materials and poor venting caused difficulties. The currently allowed two months are not associated with adverse air quality conditions in general (i.e., based on monitoring data).

The CVRD solicited legal advice on the question of agricultural burning and the regional district's authority to control it in the Electoral Areas and Improvement Districts. Ultimately, including agricultural burning in the bylaw was not considered feasible.

There is no landfill within the CVRD and all garbage is transported to the U.S. As such, waste management in the regional district constitutes a significant cost. However, the CVRD co-manages the solid waste management and recycling stations with the municipalities in the regional district and allows free drop off of yard waste year round. There are no mass or volume limits to the yard waste and reportedly agricultural waste is accepted, with some limitations.

Bylaw enforcement occurs through two CVRD staff members. Management of the bylaw largely occurs through responding to calls from residents (e.g., neighbours complaining about burning activities). Most of these calls tend to go straight to the CVRD, while some go to the Fire Department. A protocol has been identified with the Fire Department such that many of the calls to the Fire Department are routed to the CVRD. CVRD staff identify whether or not the fire is considered a nuisance or a fire hazard. If considered a fire hazard the complainant is directed to call 911 and get the Fire Department to respond. If considered a nuisance, the CVRD bylaw officer responds. Adherence to the bylaw is considered good; with fewer issues raised than before the regional bylaw was implemented.

#### 4.3.1.4 Ongoing Efforts

The region continues work on a Regional Airshed Protection Strategy. An air quality study completed for the region in 2014 identified occasional exceedances of the provincial PM<sub>2.5</sub> objective and that these relatively high concentrations were primarily due to local open burning, as well as wood burning appliances (winter) and regional forest fires. The draft Regional Airshed Protection Strategy (2015) notes the importance of open burning bylaws and the success of the backyard burning regulation in 5 electoral areas and 4 municipalities. The further reduction of PM<sub>2.5</sub> from open burning due to land clearing and backyard burning is identified as an objective associated with the goal of protecting human health. Key actions associated with this goal include raising public awareness of the health impacts of wood smoke, alternatives to burning and best practices management, with further effort towards a consistent airshed wide regulatory approach to open burning<sup>14</sup>.

An action item currently being considered is to explore a complete ban on backyard burning for additional high density (urbanized) areas in the region, while maintaining alternate disposal option of yard and garden debris.

### 4.3.2 Case Study 2: Regional District of Central Okanagan (RDCO)

#### 4.3.2.1 RDCO Background

The RDCO is comprised of two electoral areas, east and west. Other large subregions are the cities of Kelowna and West Kelowna, and the District of Lake Country. The District of Peachland and the Westbank First Nations Indian Reserves (IRs 8-12) are smaller in area and are also within the RDCO boundaries.

The IRs are governed by a council led by Chief Black Bear which provides a range of financial, human resources and financial services. They have their own bylaws (Westbank Laws) as well as designated law enforcement officers who enforce penalties including those related to illegal open burning.

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<sup>14</sup> Draft Strategy available from the CVRD upon request.

The Department of Engineering and Public Works in the District of Peachland provides curbside yard-waste collection, where yard-waste includes branches and leaves. There is a designated bylaw officer from May through September who enforces the municipal bylaws including that for fire safety and smoke control.



**Figure 4-2: RDCO Municipalities and Electoral Areas**

The bulk of the RDCO population reside within the city of Kelowna. Although the region is noted for its vineyards and orchards, the most significant employment sectors are the construction, real estate and professional services industries (RDCO, 2012 Economic Profile Regional District of Okanagan, 2012). However, comments from RDCO staff imply that open burning is carried out almost entirely by the agricultural community.

#### 4.3.2.2 Central Okanagan Clean Air Strategy

All subregions collaborate in developing and implementing The Central Okanagan Clean Air Strategy. The goal of this strategy is to maintain clean air in part by restricting PM levels to values below the federal & provincial objectives and continually improving (lowering) the annual average concentrations. Air quality in the region is generally good, despite occasional exceedances such as the episode in August 2015 which was influenced by the Washington forest fires. However there is a large senior population with respiratory problems who are the primary impetus for regional air quality control. Monitoring data in Kelowna indicates no significant annual trend, but a general expectation is that PM levels may increase in the future due to increased forest fires (RDCO, Central Okanagan Clean Air Strategy, 2015).

Specifically, the Clean Air Strategy aims to eliminate open burning. Residential backyard burning is banned. Size restrictions are placed on campfires, even in residential areas in some of the districts such as Peachland and West Kelowna. The Farm Practices Protection Act is considered an obstacle to burn management, due to the extensive agriculture in the region; however, the RDCO has successfully implemented controls such as a more stringent venting index (than applied at the provincial level). This success is due in part to a positive working relationship between regulators, enforcers and the agricultural community. There are plans to further restrict the allowed burn periods. Specifically, the region intends to enforce or encourage later burn start times because early morning venting conditions are considered to be less ideal than conditions later in the day.

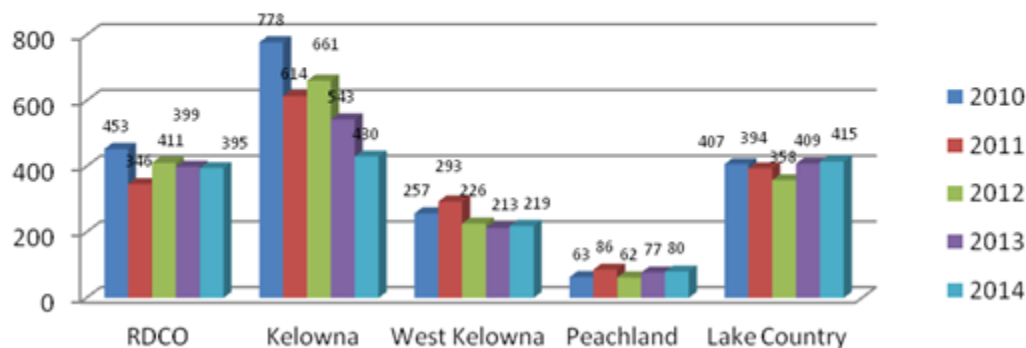
There has been some success with alternatives for orchard owners such as the free wood chipping programme. Although there is a cost to the landowner for the preparation for chipping there is also a cost in preparing to burn, so the programme is marketed on this basis. Reportedly, this programme gets overloaded at times due to a limited budget and long wait-times. This issue can motivate orchard owners to burn instead and, to alleviate it, there are plans to offer rebates to those who choose to pay for the chipping themselves at a value commensurate with the cost of a permit.

The region has involved the public (through Facebook, Minemixer) in developing this strategy and found in particular the wood chipping program as a means to prevent open burning, was popular. The public is encouraged to call their local Fire Department with any complaints. Subsequent to a complaint the Fire Department will investigate, put out the fire and fine. However, illegal burning is not considered to be a significant problem.

#### 4.3.2.3 *Relevant Bylaws*

Regulatory control of open burning is applied at the municipal and regional district level. All of the relevant bylaws enforce similar restrictions such as distance from forest, building or property line (30 meters), time of day (7am – sunset, although there is intent to reduce this window), appropriate venting index and ‘good’ air quality. The Central Okanagan uses an adjusted venting index scale, with 65 – 100 identified as ‘good’ (as opposed to the Environment Canada scale, where 55 – 100 is ‘good’).

## Central Okanagan Open Burning Permits by year 2010-2014



**Figure 4-3: Central Okanagan Open Burning Permits (figure provided by RDCO staff)**

The RDCO Regional Fire Prevention Bylaw No. 1066 (2011) controls open burning within the fire protection boundaries except for Peachland and the First Nations. Burns require a permit, 'good' ventilation (65 – 100) and a current PM<sub>2.5</sub> concentration of 15 µg/m<sup>3</sup> or less (previous 24-hour value). Burns cannot exceed 3 days. All burning subject to this bylaw is also subject to the RDCO bylaw no. 773 (1998, updated 2011) which additionally addresses campfires (which do not require a permit). Permits are only granted to lots greater in area than 1 hectare. This area limitation is part of the ban on residential backyard burning. Bylaw No. 773 also states that campfires must be less than 1 meter in height and diameter.

The municipal open burning bylaws are as follows:

- City of Kelowna, bylaw 10760 is more restrictive than the regional bylaws in that it forbids residential outdoor wood burning.
- District of Lake Country, bylaw 612 is a burning bylaw as distinct from a fire or smoke control bylaw. Open burning is subject to a further restriction relative to the regional bylaw: piles must be less than 2 meters in height and 3 meters in diameter.
- District of Peachland, bylaw 1718 is very similar to the regional bylaw except campfires also require a permit.
- District of West Kelowna, bylaw 0114 has a further size restriction on campfires (0.5 meter diameter).



- Westbank First Nation Fire Protection Law No. 2005-11 restricts permitted open burns to when the Federal Mountain Services Weather Office venting index is above 54. It also provides for ceremonial burning. Two area restrictions are noted (0.85 hectares and 1 hectare).

#### 4.3.2.4 *Ongoing Efforts*

The region is reviewing the current bylaws in effect with a view to harmonizing and improving them. As part of this strategy there is the intent to participate in related research such as updating the regional emissions inventory and developing an impacts evaluation tool.

### 4.4 *Other Case Studies*

#### 4.4.1 *The City of Prince George*

The City of Prince George (PG) identifies air quality as one of its 6 priorities. Due to its lower elevation relative to the surroundings (i.e., the PG ‘bowl’), air flow is at times restricted. This causes PM<sub>2.5</sub> exceedances (Prince-George, 2007) and motivates regulation of wood burning. PG implemented the first Clean Air Bylaw in BC (2001) and has since updated it (2010). This bylaw prohibits outdoor burning of yard or land clearing waste and regulates “recreational fires” in permanent outdoor fireplaces of limited size. Suspected violators are reported to the Fire Department, who inspect and put out the fire if it is illegal. However, anecdotal comments from City staff suggest there is minimal violation.

The local university (UNBC) has played a role in the air quality study and review that precedes the current version of the bylaw. It also maintains involvement through the PG Air Improvement Roundtable (PG AIR) that was first created in 1998<sup>15</sup>. A comprehensive airshed modelling effort helped prioritize actions within the City’s Air Quality Management Plan. A follow up computer modelling study was completed by UNBC to assess influence regions around the city where open burning would negatively influence air quality within the city (Ainslie & Jackson, 2009). This study was designed to influence decision making regarding requests for burning permits. While the study and its outcomes have been made available to city staff, it is not known how the study outcomes may have been used to develop the current policy (interview with city staff was requested but was not successful during this study timeline).

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<sup>15</sup> See <http://www.pgairquality.com/about-pgair>



#### 4.4.2 Squamish-Lillooet Regional District (SLRD)

The SLRD is comprised of 4 electoral areas (EAs) (A, B, C and D) and 4 member municipalities (District of Lillooet, Village of Pemberton, Resort Municipality of Whistler and District of Squamish). There are also two First Nations (St'at'imc and Squamish). In the northwest within St'at'imc territory is EA A, a scenic mountainous region with a history of mining. Current predominant industries are tourism and forestry. Directly to the east and within the same First Nation's territory is EA B where agriculture and forestry are important and the District of Lillooet is the main industrial hub. Agriculture such as potato farming, forestry and tourism underpin the economy of EA C which is in the middle of the SLRD and has close ties with Village of Pemberton. EA D is the furthest south, and is a scenic recreational center wherein there are several ocean front communities (Porteau Cove, Furry Creek and Britannia Beach) as well as the Resort Municipality of Whistler.

Although there is a regional intent to regulate open air burning of wood (SLRD, 2007) no bylaw has yet been developed for this specifically. Cost of region-wide enforcement is a concern, and it is considered primarily a provincial responsibility. However, there are bylaws for regulating this activity within some of the sub regions.

SLRD Bylaw 1352-2014 regulates the management of land clearing, other than for agricultural purposes, in the ocean front communities of EA D which are within the fire protection area of Howe Sound East. The intent of this bylaw is to control air pollution by requiring burning of such material to be done with an air curtain burner. Violation is subject to a fine.

The Squamish fire service bylaw 2314-2014 requires permits for open burning and campfires. Although the limitations on campfires are specified it's not clear what types of open burns occur. This bylaw is part of the Squamish Clean Air Initiative and is complemented by their curbside collection program which accepts small branches. Squamish has a designated office for enforcing all bylaws.

The resort Municipality of Whistler's fire prevention bylaw 2046-2014 does not allow open burning except for residential campfires which require a permit. The ban on open burning has been in effect since 2008.

## 5 CONCLUSION: SOLUTIONS

Open burning in the FVRD was found to constitute a significant portion of the PM loading to the region, potentially as high as 7% of the total from all sources. However, the actual open burning emissions estimate is uncertain, due to lack of available data (permit data) in some cases as well as significant ‘illegal’ burning in some areas. Burns occurring under the OBSCR that are small enough not to require a burn registration number (Category 2 in the FLNRO OFTS) may be numerous and while some of these burns are captured under the existing municipal bylaws, many are not.

While the ambient PM monitoring data in the FVRD was evaluated as part of this study, no clear relationship could be identified between the open burning activities and ambient PM concentrations. This is not surprising, since the ‘burn season’ differs by municipality and the potential ambient effects of open burning are expected to be localized in most cases. Monitoring stations tend to be located in urban areas and much of the open burning occurs outside of these higher density locations.

Given the current attention to the potential human health effects of  $PM_{2.5}$ , further effort to quantify the open burning emissions is justified. It is noted that there are two key groups that currently have emissions inventory initiatives that encompass open burning in the FVRD: Metro Vancouver (through their comprehensive emissions inventory work for the LFV every five years) and the Ministry of Agriculture (through a recently developed agricultural emissions inventory for the province, in draft form). Both groups would benefit from additional data associated with open burning; while some of the municipalities have greater data availability in general (for example, all open burning requires a permit in Chilliwack and the permit details can be readily used for emissions estimates), this is not the case for the electoral areas or Mission.

The potential for improvement of open burning characterization in the FVRD largely relates to burn activity information (identification of wood consumed in each burn). The project steering committee is also interested in a better characterization of illegal open burning. Through the case studies pursued in this project, no evidence could be found of a municipality or regional district that collects information of this nature to make detailed estimates of the illegal open burning activity (and emissions). However, this does not mean that there are no Canadian local governments that document illegal burning in a detailed manner nor that it is an overly difficult task. The FVRD is encouraged to take an active role in collecting and facilitating improvements to the annual open burning information for the region.

Specific recommendations are noted below, categorized to policy options, open burning alternatives, and predictive management tools.

## A. Policy Options

The zone based rules of the provincial policy intentions paper related to open burning are included in Appendix B. However, the BCMoE has made some changes to their policy intentions since this time and therefore consultation with the BCMoE is recommended for any near-term policy developments (during the period before the provincial policy intentions are publicly updated). Several of the ‘key elements of the proposed revisions’ identified in the intentions paper are informative of supporting or complementary actions that could be considered at the municipal or regional district level. These key elements are briefly summarized below:

- 1) Use of a framework for smoke management – two zone categories based on population density
- 2) Encouraging the use of air curtain incinerators to reduce emissions
- 3) Setting zone-specific rules for planning and undertaking burns (e.g., proximity to schools or hospitals)
- 4) Enabling ‘smoke management plans’ in specific areas
- 5) Utilizing a ‘one window’ system (with FLNRO) for registering and tracking open fires
- 6) Developing Best Management Practices (BMPs) to support burn operators and other stakeholders

All FVRD municipalities and the entire valley floor within the FVRD, along with communities in tributary valleys (such as the Sunshine Valley, Fraser Canyon, Chilliwack River Valley) are expected to be included in the ‘high’ sensitivity zone. This means that a good portion of the FVRD electoral areas will likely be within the second, less sensitive zone.

The allowed burn periods in the FVRD should be considered. The BCMoE has conducted an analysis of the venting index over the FVRD from 2002 - 2013<sup>16</sup>. Over this period, the forecasted afternoon venting index was found to have approximately twice the days with a frequency of ‘good’ scores (55 – 100) during March and April compared to October and November. In addition, the frequency of days with a ‘good’ afternoon venting forecast and subsequent afternoon forecast of ‘good’ or ‘fair’ (i.e., acceptable two-day windows for open burning in the current OBSCR) was over twice as high during March and April than October and November. This analysis (provided in Appendix C) implies that a burn season that favours the spring over the fall would be advantageous in terms of local air quality. In addition, dispersion conditions clearly deteriorate during the evening and early morning hours of the day. Several municipal bylaw examples exist that require burning to

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<sup>16</sup> Analysis completed by M. Kellerhals, BCMoE, provided to SNC-Lavalin on December 16, 2015.

be limited to a set period of time during the day (including Chilliwack); it is expected that permit conditions in some cases may also specify a similar requirement.

It is likely that most of the open burning in the FVRD occurs in rural areas, including the rural areas of the municipalities. Each municipality has an existing bylaw that governs open burning activities. Through interviews with the municipal Fire Chiefs, it was identified that there is a level of confusion in one municipality over allowed burn periods, and this confusion could exist in other municipalities as well. This implies that greater consistency across the municipalities and electoral areas, and education relating to allowed burn conditions would be a positive step.

Open burning is well managed in the municipalities in general and some of the positive management actions are informal (meeting between burner and Fire Department staff to suggest good burning practices). Work towards formalizing best management practices (BMPs) is recommended in the near term, and this is an element that could be included in future municipal as well as the regional district open burning bylaws. The BMPs would essentially include what is now discussed with the burners in several municipalities – leaving woody materials to dry for a period of time, how to pile and manage the waste during the burn (including how crop residue should be added, if relevant), and how forced air assistance would be used to develop a hotter and more complete burn. A great deal of knowledge and experience exists with the municipal Fire Chiefs and this could be called upon in development of the BMPs. Example BMPs exist in other BC jurisdictions (e.g., Kelowna<sup>17</sup>). Providing education/outreach in support of a BMP is also recommended, to ensure residents are aware of how burning practices as well as atmospheric conditions influence smoke emissions at the local and regional levels.

Improvement in open burning activities (achievement of lower emissions and lower impacts) may involve further development of the municipal bylaws as well as the establishment of a regional district level bylaw (for the electoral areas). These are addressed separately below.

#### Municipal Bylaw Recommendations:

- I. Require that all open burning be subject to a permit (exception campfires).
- II. Use of a consistent allowed burn period for all municipalities. While a spring (March-April) and fall (October-November) period (as Chilliwack currently uses) is reasonable to use, shortening the fall period to October only and encouraging more burns to occur in spring than fall would better align with an expectation of good dispersion conditions.

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<sup>17</sup> See <http://apps.kelowna.ca/CityPage/Docs/PDFs/Environment%20Division/Air%20Quality/2011/ag-best-practices-guide-english.pdf>, which includes a section on open burning practices.

- III. Require that all open burns be conducted between 9 a.m. and sunset, unless through a special circumstance (i.e., an air curtain incinerator is used or Fire Department staff are on hand).
- IV. No open burning be allowed for properties smaller than 1 hectare.
- V. Requirement of mandatory forced air assistance for land clearing burns (possibly extending to all burns greater than a defined threshold).
- VI. Develop an open burning best management practice (BMP) guidance document (or web summary) that is referenced in the open burning bylaws.

For point I above, there are several beneficial reasons to requiring permits, including greater control, lower impacts, acting as a first level deterrent, opportunity to educate and share BMPs, support for quantifying open burning emissions and avoidance of days with a high occurrence of open burning (further discussed in the paragraph below). Challenges to requiring permits for all open burning relate to resident compliance and human resource capacity (particularly with volunteer fire departments). Requiring registration of all open burning would be an alternative that would likely achieve some of the benefits noted above. Registration could occur over the phone, through a web form or through a paper form.

For point II, there is potential concern that having a shorter allowed burn period could lead to greater air quality effects simply due to more burning on a particular day/week when compared to use of a longer burn season. A balance can be considered in this regard: better dispersion conditions leads to reduced localized (e.g., neighbour) and airshed impacts for a set amount of burning but an increase in the amount of short-term burning could negatively impact the airshed. It is expected that the former outweighs the latter in general. However, permitting would allow some control over this potential concern (e.g., using a limit to the number of allowed burns on a particular day).

It is noted that for point V, Chilliwack already does not allow land clearing burns. Therefore a longer term strategy would be to continue restricting land clearing burns until this type of burning is not allowed in any municipality. Forced air assistance is currently used for some open burning in the FVRD municipalities (through suggestion or requirement from the local Fire Department), although through use of fans rather than an air curtain incinerator. Forced air assistance improves air flow, increases combustion temperatures and reduces smoke emissions. The need for forced air assistance (and the use of forced air assistance requirements in other BC jurisdictional bylaws) increases with the size of burn. Some discussion and evaluation of how the forced air assistance requirements could be developed and expressed for the municipal bylaws is provided in Appendix D.

Enforcement of the municipal open burning bylaws is not consistent in all municipalities and this is an additional issue that could be improved upon. While bylaw enforcement is not considered a problem for Abbotsford and Chilliwack, it can be a challenge for areas with volunteer Fire

Departments. Gaining a consistent approach to illegal burns in all municipal areas is recommended and this approach should include documenting sufficient information that would allow estimates of related emissions (size and duration of fire, and materials burned).

#### Regional District Bylaw Recommendations:

- I. Select an existing municipal bylaw (or portion of the bylaw) that addresses open burning to pattern a regional district bylaw. The Abbotsford and Chilliwack bylaws may be suitable examples.
- II. Identify 'high' smoke sensitivity areas of the electoral areas through use of a map, in consultation with the BCMoE.
- III. Require that all open burning be subject to a permit within the high sensitivity areas, and subject to registration within the secondary areas (so that all open burning is tracked).
- IV. Specifically identify residential, agricultural and land clearing burns so these can be tracked similar to those within the municipalities.
- V. Use of a consistent allowed burn period for all electoral areas (as noted for the municipalities).
- VI. Require that all open burns be conducted between 9 a.m. and sunset within the high sensitivity areas, unless through a special circumstance (i.e., an air curtain incinerator is used or Fire Department staff are on hand)
- VII. No open burning be allowed within the high sensitivity areas for properties smaller than 1 hectare.
- VIII. Requirement of mandatory forced air assistance for land clearing burns within the high sensitivity areas (possibly extending to all burns greater than a defined threshold).
- IX. Develop an open burning best management practice (BMP) guidance document (or web summary) that is referenced in the open burning bylaw.

## **B. Alternatives to Open Burning**

Reducing open burning is typically associated with viable alternatives to burning, such as waste pickup or ease of drop off at transfer stations and landfills. As clearly expressed by some of the municipal Fire Chiefs, there is a 'culture of burning' that exists and a resident expectation that the alternatives are both costly and time consuming. Other jurisdictions outside of the FVRD have taken more extreme measures to combat this culture, notably with free organic waste drop off services at transfer stations. The District of Kent has a practical version of such a service that may minimize

costs: specific periods during the year are identified to residents when they can drop wood waste off at the local gravel pit for free. A chipper is on hand to deal with much of this waste, with larger materials subject to a burn (expected to be under ideal burn conditions).

Agricultural burning includes crop residues, grasses and weeds. Alternatives for this type of burning include rotating the residues to the soil and other possible actions. The Regional District of Central Okanagan (RDCO) has a successful program that involves chipping and composting wood waste as an alternative to burning. However, this program is tailored to the orchard industry and has a significant cost to the RDCO. This example shows that a successful alternative to agricultural burning is likely region-specific and oriented towards the dominant agricultural practice(s) in the region. It is also noted that effective programs of this nature have involved strong collaboration between the agricultural industry and government. Some of this collaboration already exists in the FVRD municipalities with significant agricultural industry and for this reason the management of agriculture burning at the municipal level in Abbotsford, Chilliwack and Kent is more advanced than in other parts of the province. A review of the current agricultural practices in the electoral areas (and potential strategies to avoid open burning) may be a key component of the feasibility study suggested.

For broad initiatives related to collection and processing of wood waste in BC, it is typical for municipalities to do the collection, with some level of participation of the regional district to administer the transfer stations and landfills. At this time, the FVRD municipalities manage most of the collection, diversion and disposal activities within their jurisdictions. In addition, a 'user pays' approach to using these facilities is currently favoured. This situation therefore presents a difficulty regarding broader initiatives that would encompass the entire region. For this reason, a feasibility study is recommended to consider region-wide initiatives for increasing waste wood drop off and potential end-uses of the waste (including supporting and/or developing a related market for the waste products).

Many jurisdictions struggle to identify a practical alternative to open burning that does not have a significant cost. Chipping can be a hazardous activity and equipment is sensitive to misuse (which is why operation is typically left to the owner of the equipment). For large enough operations (example, RDCO), the chipper may be brought to the landowner to operate there. It is expected in many cases that the chipped wood is best discharged on the ground where it was generated to avoid handling and transport costs, and so one potential use has been as a mulching agent to keep down weeds or for moisture management. For centralized wood waste acceptance and diversion at transfer stations and landfills, wood as a source of energy is often identified as a potential value. The OBSCR policy intentions paper states:

*Some alternatives to open burning – such as land filling, composting, or chipping and hauling – may generate more greenhouse gases (GHGs) than open burning. However, near to communities, the particulate matter reductions from reducing open burning far outweigh the GHG costs of doing so. Recovering some of the material for biofuel can be a benefit because the electricity and/or heat that is*



*generated is an added value that is otherwise lost in an open burn, and biofuels can help displace the use of fossil fuels. Pollutant emissions from centralized waste-to-energy facilities can be controlled to a much lower level than open burns.*

The generation of electricity or useful heat from wood waste is usually not considered financially viable without industrial scale operations (such as a pulp or saw mill). Although it is possible that a large facility could be heated with wood fuel (wood chips or similar), a large and consistent volume would be needed, as well as areas/processes to dry and cure the fuel. Given the climate and population density of the FVRD, this end-use of wood waste is not considered practical in general and likely a topic that could be more effectively addressed by one of the larger municipalities if of interest (due to access to wood waste within a smaller footprint).

Aside from composting, chipped wood may also be used as an amendment for high nitrogen wastes (i.e., dairy manure or sewage treatment) as it binds up nutrients to avoid ammonia off gassing and nitrate groundwater pollution. It also may reduce VOC emissions. Chipped wood can also be used as simple bedding in animal feeding areas. These are potential uses that may or may not have been explored by one or more of the municipalities or the regional district in the past.

The following recommendations are made for solid waste management in the FVRD:

- I. Conduct a review of agricultural practices in the electoral areas to develop initiatives at transfer stations and landfills in the electoral areas that aid in reducing agricultural burning.
- II. Consider the provision of a similar service in the electoral areas to that offered in Kent: free wood waste drop off at one or more transfer stations or landfills during set periods of time within the electoral areas.
- III. Conduct a feasibility study for providing a regional district level free or reduced-fee wood dropoff program.
- IV. Conduct a feasibility study for the potential volumes of wood waste that could be captured in the FVRD, along with potential end-uses (markets) that could be developed or further developed through collaboration with the municipalities.

### **C. Predictive Management Tools**

As noted in this study, at least one BC. jurisdiction has used a predictive air quality tool in management of the open burning activities (Prince George) and at least one is considering developing a tool (RDCO). Representing open burns within a computer model is not a trivial task and simple models (screening models such as SCREEN3 and AERScreen) are not recommended due to their limitations. The Prince George example is considered practical and a recommended approach to consider if a management tool is desired by the FVRD.

Abbotsford has adjusted its bylaw proximity restrictions due to past problems with smoke experienced in public locations and some exploring of this issue is recommended to ensure other areas in the FVRD are appropriately protected. This could be one application of the air quality tool noted above. The PG approach was developed by UNBC and that experience may be useful if a similarly oriented modelling study is conducted by the FVRD.

The BlueSky Playground model was found to be an excellent tool, for two reasons: characterization of the open burn is automatically accomplished within the model (in an appropriate way accounting for the temperature and buoyancy of the plume) and application is user-friendly and quick. The model is not useful for small burns due to its scale (it cannot predict near-source maximum concentrations) but is very useful to consider large burns and their potential impact to the entire FVRD region. It is recommended that FVRD staff conduct a test case of the model with a realistic (large) burn situation to review performance of the model (possibly by comparing model results to ambient monitoring) and to consider the predicted impacts and how they may differ during different seasons of the year and/or meteorological regimes. This may provide additional information to choose suitable times to conduct large scale burns. It is noted that the web-based model is still in development and a useful addition to its reporting abilities would be a data table output of predicted concentrations at set locations. Currently, only a graphical output is available.

Further open burning policy refinements associated with where, when and what size of open burns are permissible may benefit from use of a dispersion tool. It is strongly suggested that a tool of this nature not be used as part of the permitting process but rather to help set specific bylaw requirements.

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Open Burning Interview Questions

OBSCR Policy Intentions Paper



## APPENDIX C

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### FVRD Ventilation Index Analysis

The venting index analysis below relates to the index forecast that is made every morning by Environment Canada, identifying the current day (afternoon) expected conditions as well as the following day (36 hour forecast) afternoon conditions. The current OBSCR requires a forecast of 'good' for the current day and 'good' or 'fair' for the following day. In the table below, 'G-F' represents the best ventilation category.

| Fraser Valley | Month | # Days | Percent of Days Meeting Venting Criteria |     |     |     |
|---------------|-------|--------|--|-----|-----|-----|
|               |       |        | G-F                                      | G   | F-F | F   |
|               | 1     | 372    | 7%                                       | 10% | 14% | 26% |
|               | 2     | 339    | 13%                                      | 19% | 27% | 45% |
|               | 3     | 372    | 41%                                      | 50% | 61% | 78% |
|               | 4     | 360    | 55%                                      | 62% | 75% | 89% |
|               | 5     | 372    | 64%                                      | 68% | 81% | 90% |
|               | 6     | 360    | 65%                                      | 70% | 82% | 89% |
|               | 7     | 372    | 66%                                      | 69% | 83% | 89% |
|               | 8     | 372    | 55%                                      | 58% | 85% | 92% |
|               | 9     | 339    | 31%                                      | 37% | 63% | 78% |
|               | 10    | 341    | 19%                                      | 27% | 35% | 56% |
|               | 11    | 330    | 12%                                      | 19% | 22% | 41% |
|               | 12    | 341    | 8%                                       | 13% | 15% | 30% |

Note:

G-F represents a day with afternoon forecast for that day as 'good' and afternoon forecast for the next day (36 hours in advance) as 'good' or 'fair'

G represents a day with afternoon forecast 'good'

F represents a day with afternoon forecast for that day as 'fair' or 'good'

F-F represents a day with afternoon forecast for that day as 'good' or 'fair' and afternoon forecast for the next day (36 hours in advance) as 'good' or 'fair'

Forced Air Assistance and Air Curtain Incinerators

As noted in the main body of this report, the BCMoE OBSCR Intentions Paper identifies that air curtain incinerators (ACIs) will be encouraged, particularly in the primary smoke sensitivity areas. Use of forced air assistance will be **required** at log sorts. While an ACI would be acceptable, other types of forced air assistance, such as blower fans, are also indicated to be acceptable if they meet the air flow thresholds indicated in Table 1. This alternative is provided for those instances where road access may restrict the use of an ACI.

**Table C.1: Required air flow for ‘suitable’ forced air assistance device (from OBSCR Intentions Paper)**

| Volume of Wood Waste   | Minimum Required Air Flow |
|------------------------|---------------------------|
| < 80 m <sup>3</sup>    | 8 000 CFM                 |
| 80 -150 m <sup>3</sup> | 10 000 CFM                |
| > 150 m <sup>3</sup>   | > 10 000 CFM              |

It is not known how the blower fans that are currently recommended by Fire Department staff in parts of the FVRD compare with the air flow rates noted above. But it does support the idea that blower fans may be suitable alternatives to ACIs in some cases.

### **Air Curtain Incinerators (ACIs)**

Improved wood combustion and lower PM emissions are expected with increased air flow and higher burn temperatures. While this may be achieved through use of commercial fans (as are currently recommended by Fire Department staff in some cases in the FVRD municipalities), an ACI, also known as an air curtain destructor is often identified as a commercial tool that can be used for this purpose. A picture of an ACI is provided below, from a current vendor.



**Figure C.1: Air Curtain Incinerator (from Air Burners LLC)**

Figure 2 shows the principle of operation of an ACI. While the diagram relates to an above-ground 'firebox', ACIs may also be placed into a pit in the ground. The box tends to be about the size of a large waste dumpster.

ACIs may vary in sophistication, with the more sophisticated designs requiring assembly on site and therefore have limited mobility. The U.S. Forest Service has been involved with emissions testing of ACIs, including the Air Burners equipment shown above.

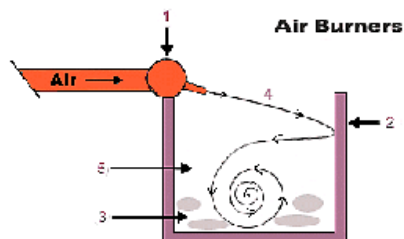


Figure 2—Air burner.

1. Air-curtain burner manifold and nozzles direct high-velocity airflow downward along refractory-lined walls.
2. Self-contained unit allows for fire containment and easy ash cleanup.
3. Vegetation to be burned.
4. Airflow forms an air curtain over the burning vegetation.
5. Continuous airflow overoxygenates the burning vegetation, allowing for higher burning temperatures and a more complete burn.

### Figure C.2: Schematic of ACI in operation

(figure from <http://www.fs.fed.us/eng/pubs/html/05511303/05511303.html>)

A 2007 study identified some of the existing emissions data for ACIs at that time (Miller & Lemieux, 2007). In general, it was determined that:

*It is very likely that even poorly operated systems will exhibit significantly lower PM emission levels when they are able to increase the high-temperature residence time of the pyrolyzed organics that form most of the fine PM*

While one of the identified tests determined an emission factor of 0.05 g/kg, some pilot-scale ACI results were found to be similar to uncontrolled open burn rates (i.e., on the order of 10 g/kg). It was expected that some of this difference could be due to combustion of wet materials.

A summary of ACI PM emissions was completed by the U.S. Forest Service for two companies that manufacture self-contained box-styled ACIs (Air Burners and McPherson Systems Inc.). The PM<sub>2.5</sub> emission factors for each were determined to be much lower than those associated with open burning. Also noteworthy, the higher combustion efficiency (CE) was found to leave far less waste following combustion.

**Table C.1: ACI and Open Burning Emission Factors (lbs/ton)**

(from <http://www.fs.fed.us/eng/pubs/html/05511303/05511303.html>)

|                                  | CO <sub>2</sub> | CO    | CH <sub>4</sub> | NMHC | PM 2.5 | CE (%) |
|----------------------------------|-----------------|-------|-----------------|------|--------|--------|
| Broadcast burning—Ponderosa Pine | 3,286           | 179.8 | 6.6             | 5.4  | 36.0   | 90     |
| Pile burning—Ponderosa Pine      | 3,268           | 178.5 | 13.9            | 9.9  | 25.5   | 89     |
| LLC Air Curtain                  | 3,616           | 26.3  | 1.4             | 1.1  | 1.1    | 99     |
| McPherson Air Curtain            | 3,613           | 30    | 1.1             | 0.6  | 1.4    | 99     |

The BCMoE Intentions Paper identifies opacity limits for acceptable ACIs: 10% (6 minute average) during operation and 35% during startup (within the first 30 minutes). The Lemieux study above indicates that the 10% opacity limit (after startup) is achievable and a value closer to 5% would be expected from at least some of the existing ACI units.

### **Summary of ICI and Forced Air Assistance**

The BCMoE Intentions Paper suggests that ACI use could include requirements for operator training and/or certification. This is reflected in at least one BC regional district that requires acceptable ICIs to be registered with the district before their use. While some of these expectations likely relate to issues of safety, some may also relate to acceptable performance standards (such as the opacity limits identified in the Intentions Paper).

It is not known if an ACI currently exists in the FVRD. If not, it would be valuable to seek operations information from another district (performance of unit, annual use, operating costs) to determine if one or more units could be used in the FVRD without a high degree of expense. BC MoE staff may also have useful information in this regard. This possibility may be complementary to one of the study recommendations (that the FVRD consider providing a similar service in the electoral areas to the free wood waste dropoff periods in Kent).

Mandatory use of forced air assistance for land clearing burns is another of the study recommendations. As implied in the BCMoE Intentions Paper, road access may not facilitate use of an ACI in all cases and alternative use of blower fans (as are currently supported in at least one FVRD municipality) should be considered. This implies that the forced air assistance requirement for land clearing burns (if used) could be expressed as minimum air flow criteria, similar to the OBSCR Intentions Paper indication. A best management practices (BMP) document could help burners understand what size (and number) of blower fans would meet the air flow criteria.

Use of blower fans over an ACI may increase risk of fire spreading beyond the burn area and this risk was identified to SNC-Lavalin during the study interviews. This topic should also be considered when evaluating how blower fans could be supported in a bylaw requirement for use of forced air assistance.





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