bulkley valley - lakes district
airshed management society

COMMUNITY ACTION PLAN *for* CLEAN AIR

A five-year strategy

3

SUPPORTING SCIENCE & TECHNICAL INFORMATION

LAST UPDATE: JUNE 11, 2006

CHAPTER 3

Supporting Science and Technical Information

The purpose of this chapter is to provide the reader with a background of the science used in **airshed** management planning, specifically for the **BVLDAMS**. An accounting for the emission sources targeted in the Plan is also provided, along with a summary of the overall goals, indicators and strategies for the Plan.

3.1 Air Quality Science

Air quality in the BVLD airshed is typically driven by fine particulates emitted by combustion and dust sources. In conjunction with the emissions themselves (when and where they occur, how much is emitted, and whether they're smoke or dust related), weather and topography also play a defining role in determining **ambient** air quality in populated areas. In order to better understand the relationship between emissions, weather and topography, we rely on local knowledge, monitoring and modelling. By using these tools, effective strategies are developed to meet the goal of reducing the effects of fine particulate emissions, and indicators are chosen that demonstrate the results of implementing those strategies.

To help us better understand and even estimate when, where and under what conditions impacts to human health and the environment could occur, we rely on local knowledge, monitoring and mathematical modelling.

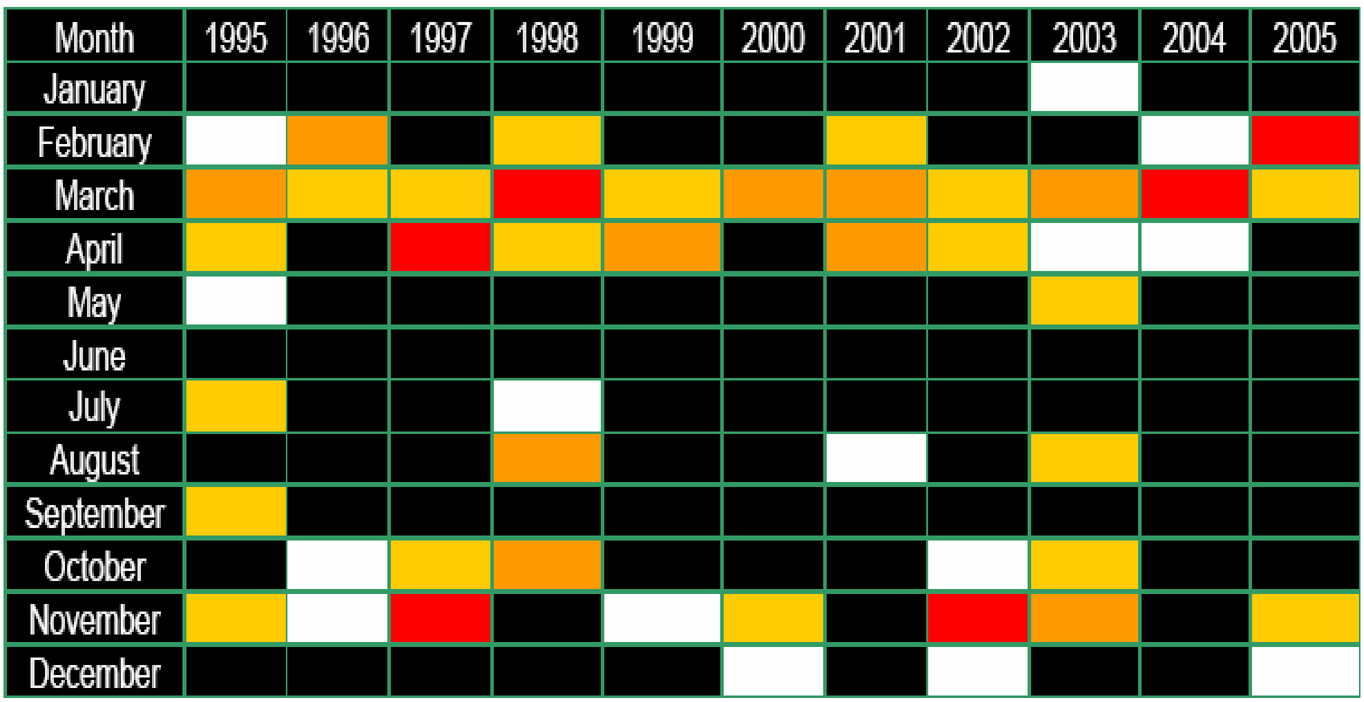
Ambient air pollutant concentrations are measured directly with monitoring equipment or estimated using mathematical models. Both techniques are being used to investigate everything from a single source to all sources of fine particulates in the BVLD. In order to accurately understand what impacts each source has on ambient air quality however, detailed **meteorology** and emission information is needed. Furthermore, due to the large variation in emissions and meteorology from day to day and year to year, understanding ambient air quality requires many years of data. Within the BVLD airshed planning area, there are numerous long term meteorological monitoring stations, as well as continuous fine particulate monitoring stations in Burns Lake (PM10), Houston (PM10 and PM2.5), Telkwa (PM10) and Smithers (PM10 and PM2.5). Non-continuous fine particulate monitoring stations are operating in Hazelton

(PM10 and PM2.5) and Kitwanga (PM10). See Appendix E for a summary of co-located air quality and meteorology stations in the BVLD.

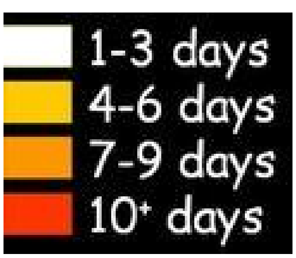
Table 3-1 illustrates the monthly seasonality associated with ambient levels of PM10 in Houston. Graphs for Burns Lake, Telkwa and Smithers show a similar trend with peaks in spring and fall (Levelton Consultants Ltd., 2002). There are a total of six periods where there were 10 or more days under an Air Quality Advisory or Burn Ban. These occurred in March of 1998, April of 1997, November of 1997, November of 2002, March of 2004 and February of 2005.

An Advisory is issued as a result of elevated levels of particulate matter detected by one or more of the air quality monitoring stations, and is based on the Air Quality Index. (AQI). The Air Quality Index is set as 0-25 GOOD 26-50 FAIR, 51-100 POOR, and 100+ VERY POOR. A sample air quality advisory is included in Appendix F.

TABLE 3-1 Summary of Air Quality Advisories and / or Burn Bans issued in the BVLD 1995-2005



Note: number of days includes the first day of an advisory or ban being issued and the last day on which the advisory or ban was in effect.



Ambient concentrations of fine particulates are compared to **benchmark** concentrations as a way of estimating the potential for health and environmental effects. These benchmark concentrations can be expressed as reference levels, guidelines, objectives or standards. A **PM10** trigger level of 26 $\mu g/m^3$ on a 24-hour average basis (fair category of the air quality index) is used as the level above which episode management actions may need to be considered in the BVLD airshed. When decisions are made regarding both mandatory and voluntary emission reduction actions, all factors contributing to air quality are considered including:

- Current and forecasted weather conditions
- 1-hour and 24-hour PM10 concentrations
- 1-hr and 24 hour PM2.5 concentrations (where available)
- Knowledge of contributing sources

These actions are used in an attempt to prevent air quality from deteriorating into the poor category (51^+ in the air quality index), and to help hasten an improvement in air quality. The index is a national system that is used to inform the public of ambient air quality conditions, and can be driven by any one of a number of pollutants. Although the air quality index does not yet include PM2.5, levels of this pollutant are taken into consideration for episode management in the BVLD when levels become elevated.

Meteorology and topography add layers of complexity to air quality management. Air flows like water in mountainous valleys like those in the BVLD. There can be multiple layers of air, flowing at different (wind) speeds, in different directions. In addition to the controlling influence of regional weather systems, there are daily and seasonal shifts in air flow patterns on a more local scale. For example, there are daily reversals of air flow in valleys as a result of heating and cooling cycles which can be more pronounced on a seasonal basis. These properties of air flow can be quantified through meteorological measurements and modelling. There are numerous observational weather stations collecting this kind of data throughout the BVLD airshed. Additional weather data is obtained from regional weather stations where upper air measurements occur, the nearest of which is in Prince George.

While meteorological and air quality monitoring is limited to locations where stations are located, modelling is not so restricted. Modelling uses measured meteorological data along with emission, land use and topographical information to estimate the weather and air quality at a number of predefined locations. This makes it especially useful in the BVLD where there are a limited number of monitoring stations in such a large area. **CALMET** is the meteorological model being used for the BVLD airshed, and **CALPUFF** is the air quality model.

Meteorological data (from surface and upper air observation stations) is used along with land use and topographical information to model the weather in three dimensions over a chosen period of time-for the BVLD this is being done for 2001 and 2002. The more observational data available, the more accurate the model will be at estimating weather between each station.

Emissions can be measured using instrumentation at existing sources, or they can be estimated using basic physical and chemical principles. Emission rates can also be generalized to some extent for use in similar situations throughout the airshed. The fine particulate emission inventory being developed for the BVLD uses both options to provide the best estimates of emissions from a variety of sources. For instance, a town may contain 250 woodstoves, which may be broken down into two types based on their burning efficiencies and smoke emission rates. The emission rates estimated for the two stove types are measured with the results published by researchers. Those published emission rates that best suit local conditions in terms of wood available for fuel use are then chosen to be representative for that source. The emission rate data can then be adjusted to the known stove types and locations.

Once developed, the modelled weather and locally-specific detailed emission data for all sources of fine particulates are used to model concentrations of that pollutant throughout the airshed. These modelled ambient concentrations of fine particulates are then compared with data from monitoring locations to ensure the model is predicting air quality in a reasonable manner. Once confidence in the model output is achieved, the model can be manipulated to change emissions and locations, remove or add sources to better understand what each source contributes to ambient air quality. This information, combined with local knowledge and monitoring data will then be used with common sense to make decisions on how to improve air quality in the BVLD.

3.2 How emission sources for this Plan were selected

A total of seven source categories were selected by members of the Community Working Groups as part of a “common sense” BVLD **emission inventory.** The seven categories are:

1) **Beehive Burners**
2) Other Regulated Sources (i.e. **stack emissions** and asphalt paving plants)
3) Forest Harvest Debris Burning
4) Agriculture, Land Development and Small Sawmill Debris Burning
5) Residential and Commercial Space Heating
6) Backyard Burning
7) Road Dust (from paved roads).

Selection of these sources was not random or arbitrary. Extensive deliberation within the CWGs took place to reduce the total number of sources from many to a list of the most important. The final categories are representative of both scientific evidence as well as people's view points derived from observation. Put simply, an emission inventory involves qualifying and quantifying the emissions in an area which contribute to ambient air quality. Qualifying entails determining what sources exist that emit the pollutant of interest, and quantifying involves determining how much each source emits and when. Emission data from the inventory is used to provide information regarding what % of total emissions in a airshed come from each source. Additionally, the emission data is used in dispersion modelling to estimate the contribution of those emissions to ambient air quality. The relationship between how much a source emits, and how much it contributes to ambient air quality is not a simple one, and was discussed in more detail earlier in this chapter.

It should be noted that the categories were chosen based on their fine particulate emissions. While these sources emit more than just fine particulates, the BVLDAMP is focused on this pollutant because it typically drives air quality in the airshed.

3.3 Other Contributing Emission Sources

While other sources of fine particulate do exist, their relative contribution to the overall scope of emissions is considered lower than the primary sources. Depending on resources available, these sources may be addressed individually in the Plan at a later date. Emission sources identified by CWGs that are not specifically dealt with in the Airshed Management Plan include vehicle tailpipes and aircraft, space heating with fuel other than wood, lawnmowers and other small engines, refuse disposal and municipal landfill waste, forest fires, unpaved roads, industrial food and agriculture (fish and meat smoking, coffee roasting, methane, etc), restaurants, home-barbeque and tobacco use.

Table 3-2 illustrates key components of the six major emission sources. Categories for each source include general geographic location, contributing season and a short summary of contribution to ambient air quality. It should be noted that as the emission inventory is not yet complete (with final report and modelling), it would be premature to quantify contributions as described in the beginning of this section. This table describes general properties of each emission source. It is meant to be short and illustrative so that should one have an interest in a particular source, one can refer to the chapter in which it is located for further descriptive information. In this table, sources are classified as Non-seasonal or Seasonal based on the time of year they are typically active (emitting fine particulate). Each source has the potential to contribute to air quality episodes when in operation, depending on total emissions from all sources, meteorology and location.

TABLE 3-2 Summary of Data on Contribution to Baseline and Ambient Air Quality

Profile	Beehive Burners	Other Regulated Sources (stacks)	Forest Harvest Debris Burning	Agriculture, Land Development and Small Sawmill Debris Burning	Residential and Commercial Space Heating	Backyard Burning	Road Dust (from paved roads)
Geographic	7 beehive burners (2 currently not in operation). 3 **tier 1** and 4 **tier 2** burners.		Usually more than 5 km from urban areas. Mountains and valleys within airshed.	Rural settings. Closer to urban areas than forest harvest debris burning.	Used in both urban and rural areas. More common in rural areas but urban areas are more concentrated.	Local bylaw dependent	All paved roads and parking lots where aggregate is used to increase winter traction.
Non-Seasonal	Yes	Yes (industry dependent)		Yes (small sawmills)		Yes	
Seasonal		Yes (industry dependent)	Fall, spring and some winter beetle wood burning	Fall and spring (agriculture, land development and small sawmill debris burning)	Fall, winter and spring		Fall, winter and spring

3.4 General Goals, Indicators, and Strategies

At the beginning of this planning process, it was made clear from community advisors that for the Plan to succeed, clear goals, indicators, and strategies for each emission source should be identified. In order for this emission-specific work to be accomplished, it was realized that general goals, indicators and strategies for the entire airshed needed to be set. Table 3-3 presents work in this area, and notes that the two overall goals for this Plan are to:

1. Gain a better understanding of air quality in the Plan area; and,

2. To continuously improve air quality in the BVLD Airshed

These two goals will form the basis of discussion at the BVLD Airshed Management Society's Annual General Meetings.

Table 3-3 General Goals, Indicators and Strategies

Goal	***Indicators***	***Strategies***
1. Gain a better understanding of air quality in the plan area.	Degree of agreement between modelled air quality results and actual measured air quality for "**episode scenarios**." Comparison of **PM2.5** and **PM10** concentrations at a number of locations in the airshed plan area.	Improve air quality and meteorological monitoring network and gain experience through air quality modelling scenarios. (CALPUFF) Obtain and expand air quality monitoring network-specifically PM2.5 instrumentation, and co-locate with existing PM10 equipment and meteorological monitors. Obtain a mobile monitoring station for air quality and meteorology.
2. Continuous improvement in air quality in the BVLD Airshed.	Mean annual PM10 and PM2.5 concentrations ($\mu g/m^3$). Reduce % of days where average daily PM10 concentration > 50 ug/m3. Interim goal = 1% Reduce % of days where average daily PM2.5 concentration > 30 ug/m3. Interim goal = 1% Percentage of "**potential episode days**"[1] where PM10 24 hour average is greater than 25 $\mu g/m^3$, by year and/or season. and PM2.5 > 15 ug/m3 by year and/or season Improve air quality due to PM10 and PM2.5 on all days (non-episode and episode days) - PED average PM10 and PM2.5 - Non – PED average PM10 and PM2.5 Monitor statistics on associated human health risks.	Reduce or eliminate air quality episodes through source specific emission strategies. Education and operational changes to improve air quality. Bring forward emerging research and changing regulations and policies.

[1] Potential episode day is one that is characterized by still air with above 15 ug/m3