Chapter 3: Supporting Science and Technical Information 2009 Addendum

Chapter 3 of the BVLD Clean Air Plan provides a background of air quality science and emission sources in the BVLD Airshed. It proposes some general strategies to meet two overall Plan goals, and identifies a number of indicators to measure the success of various airshed-wide implementation strategies.

The air quality science described in Section 3.1 of the Plan and the emission source discussions in Sections 3.2 and 3.3 are still relevant today, with a few exceptions that are described in source-specific Chapters 4 to 10. Tables 3.1 and 3.2 below provide an update on Section 3-4 of the Plan. Table 3.1 summarizes the general (airshed-wide) strategies that were implemented for each of the Plan goals and Table 3.2 reports back on some of the key indicators.

Table 3.1: Update of Strategies Implemented 2004-2008

Goals	Strategies
1. Gain a better understanding of air quality in the plan area.	**Gain experience in air quality modelling by using CALPUFF to model local scenarios.** In 2005/06 the Ministry of Environment used CALPUFF to model air quality conditions in the entire BVLD airshed using emission data provided by a micro emissions inventory for 2001 and 2002. CALPUFF was selected because it behaves well in mountainous terrain. Results from the dispersion modelling exercise were presented at the 2006 BVLD AMS AGM. In general, while model results were found to properly characterize winter and summer air quality, they could not properly characterize spring and fall air quality when emissions of open burning and road dust are most active (see Graph 3.0). This indicates that more work is needed to better quantify and characterize these emission sources. In the fall of 2008 an environmental consultant was hired to use CALPUFF to model 2002 air quality in Smithers and Houston under two scenarios: 1) with the beehive burners running; and 2) with new energy recovery systems and/or pellet plant dryers instead. All other emission sources remained the same in the two scenarios. There were some challenges in characterizing the industrial emission sources, and different characterization methods produced slightly different results. Additional work is needed to determine how to best characterize these emission sources so that dispersion models can be used to examine results under different emission scenarios. At this time, it is uncertain if and when additional work will be completed. **Expand air quality monitoring network, specifically $PM_{2.5}$ instrumentation, and co-locate with existing PM_{10} equipment and current meteorological stations.** Three new continuous $PM_{2.5}$ monitors (TEOMs) were installed in the BVLD airshed over the 5

<table>
<tr><td></td><td>year implementation of the Plan:
Smithers, August 2004
Burns Lake, October 2006
Telkwa, October 2006
In Smithers and Burns Lake the new $PM_{2.5}$ TEOMs were co-located with the existing PM_{10} TEOMs. Additionally, a non-continuous, 1-in-6 day $PM_{2.5}$ monitor (Partisol) was installed in Smithers in November 2006. This was replaced by a Dichotomous PM Sampler (which provides data for $PM_{2.5}$ and PM_{10}) in February 2008.

The Ministry of Environment is currently replacing older $PM_{2.5}$ TEOMs across the province with $PM_{2.5}$ instruments that meet Federal Equivalency Method (FEM) designation, a status given to instruments with superior accuracy, such as the FDMS type TEOM. The TEOM in Smithers is expected to be switched by the end of summer 2009, with Burns Lake and Houston on schedule for April 2010. In Telkwa an FDMS TEOM was installed in February 2009. It is co-located with the older TEOM, and is being used to investigate questionable data that is thought to be due to large variations in relative humidity (moisture).

Non-continuous monitors were also deployed in Kitwanga and Hazelton:
In Kitwanga, a PM_{10} non-continuous, 1-in-6 day Partisol ran from 2004 through 2007, before it was changed to $PM_{2.5}$ at the beginning of 2008. Results showed few exceedences of provincial air quality criteria so the monitoring program finished in April 2009.
In Hazelton, $PM_{2.5}$ and PM_{10} Partisols were co-located at the Northwest Community College until December 2008. Starting in January 2009 the PM_{10} Partisol was removed and installed as a $PM_{2.5}$ instrument in New Hazelton. A correlation study with the $PM_{2.5}$ results from the two locations in Hazelton is underway. In 2010 the Partisol in New Hazelton may be moved to Old Hazelton for 1 year to perform a similar correlation study there in order to determine the most suitable long term monitoring location for the Hazelton communities.</td></tr>
<tr><td>2. Continuous improvement in air quality in the BVLD airshed</td><td>Reduce or eliminate air quality episodes through source-specific emission strategies.

Various strategies were employed by the AMS and other stakeholders to reduce specific emission sources. The AMS focussed its efforts on forest debris harvest burning (Chapter 4) and residential and commercial space heating (Chapter 8), but tried to take action on all emission sources. The source-specific emission strategies that have been implemented are summarized in the updates for Chapters 4 to 10.

Undertake public education.

A Communications Strategy to support implementation of the Plan was developed and approved in 2005. It identifies 11 priority actions based on key messages and target audiences.

Public education activities have included an Annual General Meeting each spring, a Burn Operators Forum each fall, and a website. In addition, from 2004-2008, membership updates, newsletters, articles for major newspapers and local government newsletters, press releases, presentations to local government and “coffee shop” conversations have been quite successful in raising awareness about air quality and positive actions that individuals, industry, and government can take to improve air quality. In addition, the AMS has participated in a number of local fairs and trade shows, where customized displays, handouts, and a woodstove demonstration trailer were used to engage the community in meaningful dialogue.</td></tr>
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	Bring forward emerging research and issues. Through activities described under “public education” (above), the AMS has brought forward emerging research and issues to a range of stakeholders.

Many of the indicators proposed in the Clean Air Plan involve reporting out on ambient concentrations of particulate matter (PM_{10} and $PM_{2.5}$) in the airshed. There are some redundancies in these indicators, so Table 3.2 only includes comments on some of the key indicators. Graphs 3.1 to 3.4 visually present annual average concentrations of PM_{10} and $PM_{2.5}$ and the % of episode days for the four major BVLD communities: Burns Lake, Houston, Telkwa and Smithers.

Table 3.2: Indicator Results

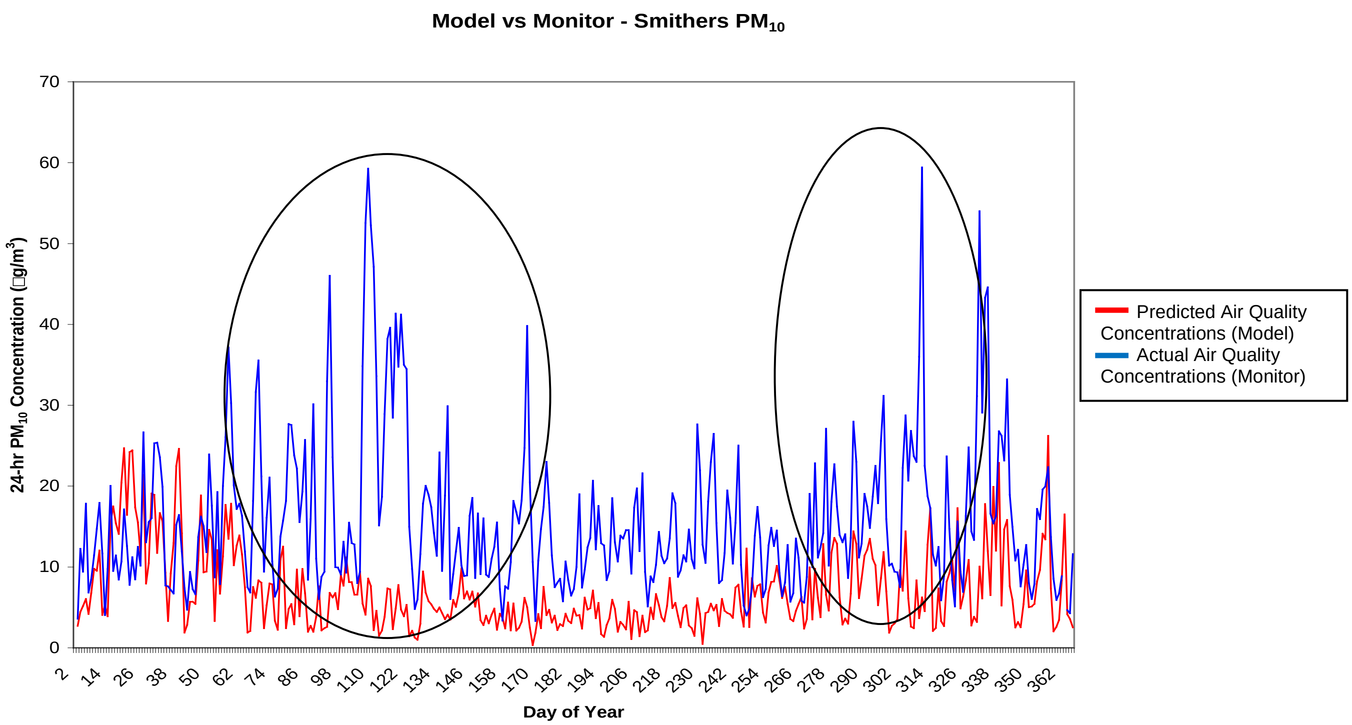
Goals	Indicators
1. Gain a better understanding of air quality in the plan area.	**Degree of agreement between modelled air quality and actual air quality.** See the discussion in Table 3.1 (above) about modelling efforts. To date, models have only been able to achieve satisfactory results in certain seasons, and further work is needed to refine characterization of some emission sources including major industrial sources, open burning and road dust. **Comparison of $PM_{2.5}$ and PM_{10} at a number of locations in the airshed.** Annual average PM concentrations are of similar magnitude in all of the BVLD communities (see Graphs 3.1 to 3.4). Data collected over the past decade suggests that PM_{10} concentrations may be slightly higher in Burns Lake and lower in Smithers, with Houston reporting values in between. The $PM_{2.5}$ dataset is not as comprehensive, but the results appear to be the opposite, with Smithers having the highest concentrations, and Burns Lake having the lowest. This is likely a reflection of different monitoring station locations and emission sources in the communities (for example, the Burns Lake monitor is more susceptible to road dust emissions). The Telkwa dataset is less complete but shows results of the same relative magnitude, while results from Hazelton and Kitwanga suggest that air quality is slightly better at the western (less developed) end of the airshed.
2. Continuous improvement in air quality in the BVLD airshed	**Reduce annual average PM_{10} and $PM_{2.5}$ concentrations ($\mu g/m^3$) in BVLD Communities.** It is difficult to conclude if there are consistent, improving trends in air quality, however, it appears that annual average PM_{10} and $PM_{2.5}$ concentrations have decreased slightly over the past decade. PM_{10} has shown the most prominent trend in recent years, but more data is needed before a significant trend can be confirmed since there is large inter-annual variability in the data (see Graphs 3.1 to 3.4) which is likely caused by weather. **Reduce % of days where:** **Average 24hour PM_{10} concentration > 50 ug/m^3. Goal for 2008 = 1%** **Average 24hour $PM_{2.5}$ concentration > 30 ug/m^3. Goal for 2008 = 1%** Overall, between 2004 and 2008 there were no clear trends or significant changes in the

	number of days when PM_{10} & $PM_{2.5}$ levels were above these concentrations (which represent air quality advisory-level days[1]) in BVLD communities. $PM_{2.5}$ came much closer to achieving its goal than PM_{10}, which rarely made the target of 1% of days per year under a concentration of 50 ug/m^3. This is likely a result of springtime road dust issues, which can skew annual averages. Graphs 3.1 to 3.4 summarize air quality data for the four major communities in the BVLD Airshed. Table 3.0 summarizes the number of advisory-level days for PM_{10} (defined as 24hr concentration > 50 ug/m^3) and Table 3.1 summarizes the number of advisory-level days for $PM_{2.5}$ (defined as 24hr concentration > 25 ug/m^3)

In April 2009, the Province of B.C. released new ambient Air Quality Objectives for $PM_{2.5}$ which include a 24hr objective of 25 µg/m^3 (with achievement based on annual 98th percentile), an annual objective of 8 µg/m^3, and an annual planning goal of 6 µg/m3. The 24hr objective is equal to the threshold for issuing air quality advisories.

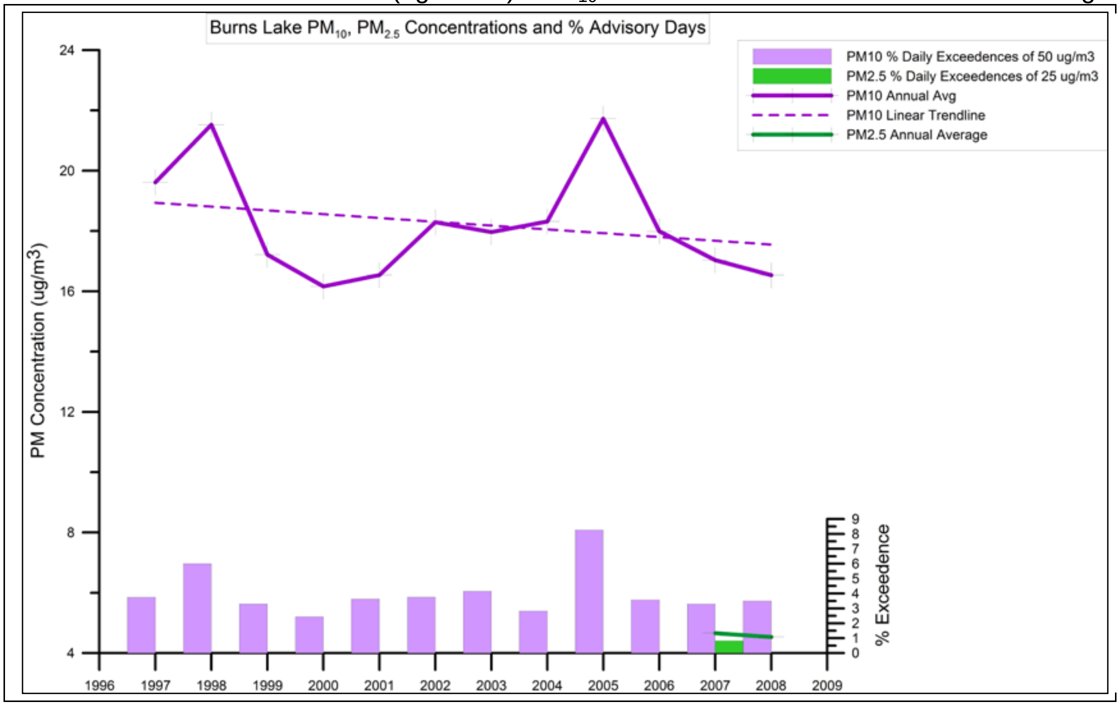
The next version of the Clean Air Plan should include a revised list of indicators that eliminate some redundancies, and also should incorporate the annual planning goal of 6 µg/m^3 and the 24hr objective of 25 µg/m^3.

<u>Graph 3.0 – Dispersion Model Results (Predicted - Red) vs. Air Quality Monitor Results (Actual - Blue) for Smithers.</u> Note the higher level of agreement in PM_{10} concentrations in the winter months (Day 2 to 70 and Day 350 to 365 show similar results) and moderate agreement in the summer (results from Days 180 to 270 follow similar trends, although actual results are generally higher than predicted results). However, large discrepancies exist in the spring and fall periods (these periods are circled in the graph).

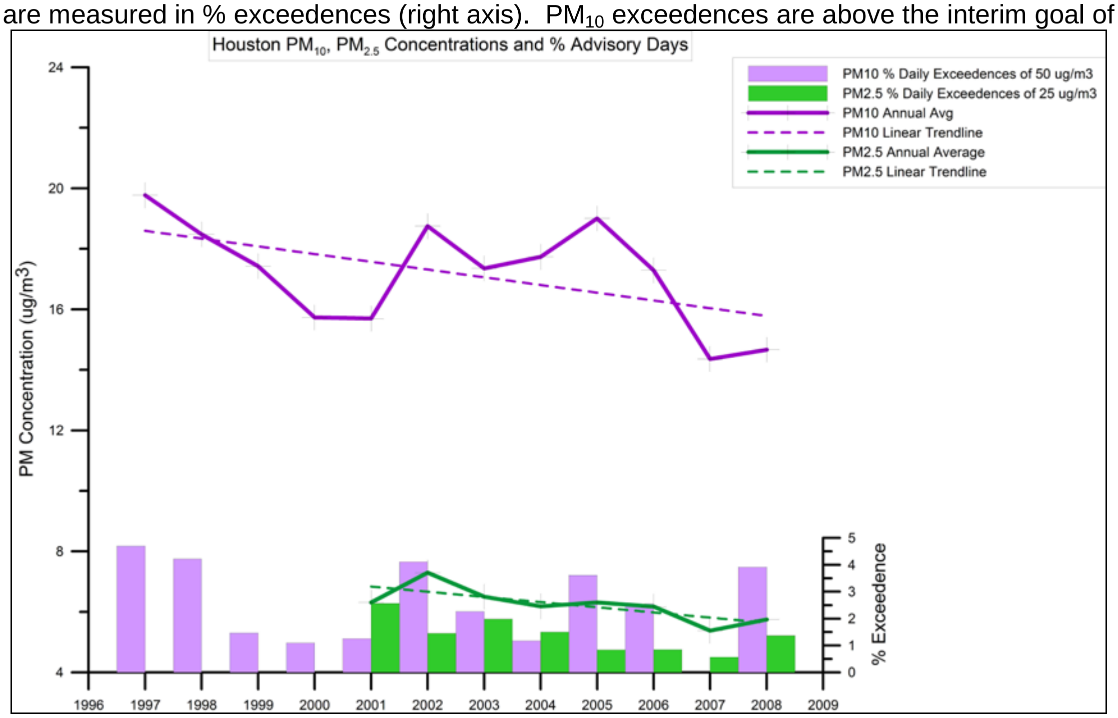


1 In 2009 the threshold for issuing air quality advisories dropped from 30 µg/m^3 to 25 µg/m^3. Graphs 3.1 – 3.4 have been updated to reference the newer, more stringent concentration level.

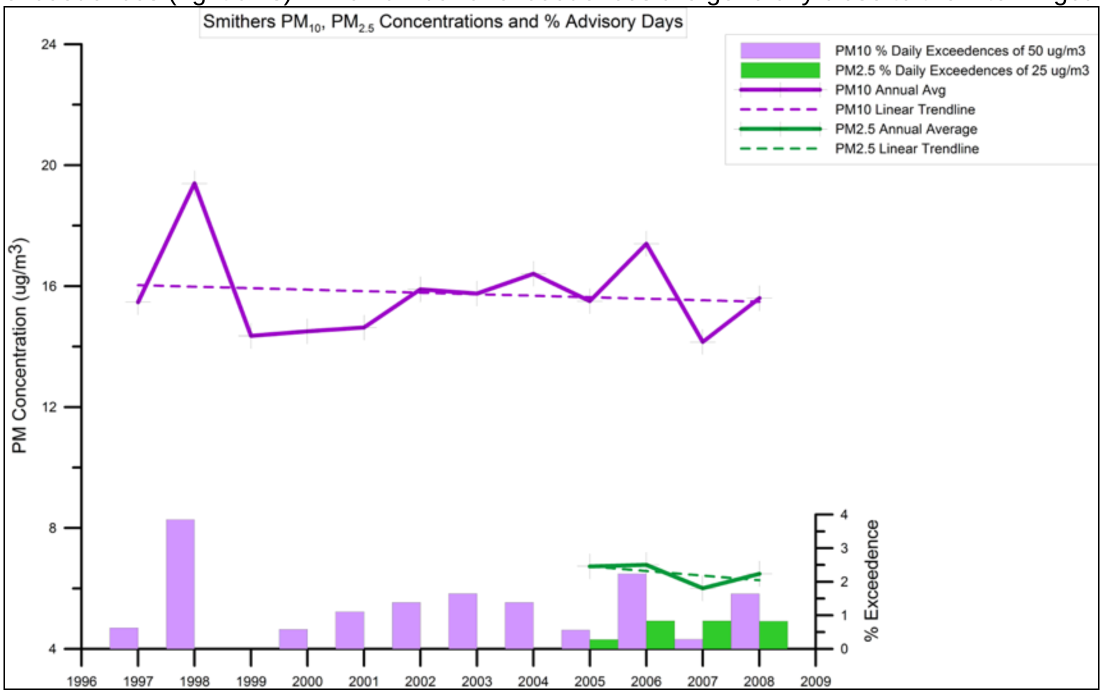
Graph 3.1 – Air Quality Monitoring Results for Burns Lake. Annual average PM_{10} (purple line) and $PM_{2.5}$ (green line) concentrations are measured in ug/m^3 (left axis). The linear trendline for PM_{10} (dashed purple) suggests an improvement in air quality since monitoring began in 1997. There is insufficient $PM_{2.5}$ data to determine a trend. The annual percent of days at advisory levels for PM_{10} (purple bars) and $PM_{2.5}$ (green bars) are measured in % exceedences (right axis). PM_{10} exceedences are well above the interim goal of 1% or less.



Graph 3.2 – Air Quality Monitoring Results for Houston. Annual average PM_{10} (purple line) and $PM_{2.5}$ (green line) concentrations are measured in ug/m^3 (left axis). The linear trendlines for PM_{10} (dashed purple) and $PM_{2.5}$ (dashed green) both suggest an improvement in air quality since monitoring began in 1997 for PM_{10} and 2001 for $PM_{2.5}$. The annual percent of days at advisory levels for PM_{10} (purple vertical bars) and $PM_{2.5}$ (green vertical bars) are measured in % exceedences (right axis). PM_{10} exceedences are above the interim goal of 1% or less.



Graph 3.3 – Air Quality Monitoring Results for Smithers. Annual average PM_{10} (purple line) and $PM_{2.5}$ (green line) concentrations are measured in ug/m^3 (left axis). The linear trendline for PM_{10} (dashed purple) seems relatively stable since monitoring began in 1997, and there is still insufficient $PM_{2.5}$ data to determine a trend. The annual percent of days at advisory levels for PM_{10} (purple bars) and $PM_{2.5}$ (green bars) are measured in % exceedences (right axis). The number of exceedences are generally close to the interim goal of 1% or less.



Graph 3.4 – Air Quality Monitoring Results for Telkwa. Annual average PM_{10} (purple line) and $PM_{2.5}$ (green line) concentrations are measured in ug/m^3 (left axis). The linear trendline for PM_{10} (dashed purple) suggests didn't improve over the monitoring period 1997-2005 but there is no recent data to compare to other stations in the airshed. There is also insufficient $PM_{2.5}$ data to determine a trend. The annual percent of days at advisory levels for PM_{10} (purple bars) and $PM_{2.5}$ (green bars) are measured in % exceedences (right axis). PM_{10} exceedences fluctuated around the interim goal of 1% or less when monitoring took place.

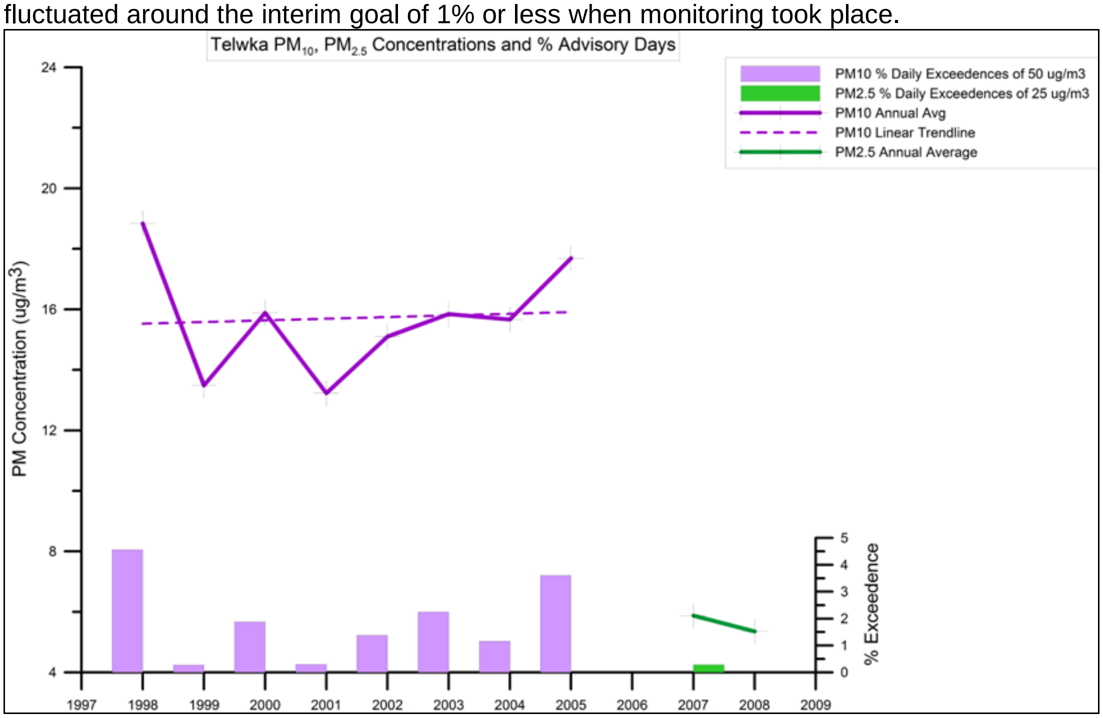


Table 3.0 – PM_{10} Advisory-Level Days for the BVLD Airshed, Based on Data from Burns Lake, Houston and Smithers. This table summarizes the number of advisory-level days in the airshed, based on 24hr average PM_{10} data being > 50ug/m^3. Most advisory-level days are in the spring months (road dust season – see Chapter 10), and the % of days is well in excess of 1% in all years.

Month	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
January							3				1	1
February	2	6						1	5	4	2	2
March	5	13	4	7	4	3	8	8	7	8	4	8
April	6	4	3	1	7	7	2	1		5	5	
May	2	1				1						
June			1			1						
July												
August					1							
September												
October	4	2					1					
November	1	2	6			8	5		1	1		1
December	1			1								2
Total	21	28	14	9	12	20	19	10	13	18	12	14
%	5.8%	7.7%	3.8%	2.5%	3.3%	5.5%	5.2%	2.7%	3.6%	4.9%	3.3%	3.8%

Table 3.1 – $PM_{2.5}$ Advisory-Level Days for BVLD Airshed, Based on Data from Burns Lake, Houston and Smithers. This table summarizes the number of advisory-level days in the airshed, based on 24hr average $PM_{2.5}$ data being > 25ug/m^3. Most advisory-level days are in the fall and winter months (open burning and winter heating seasons – see Chapters 6 and 8), and the % of days is generally between 1 and 2% - slightly above the goal of 1% of days. It should be noted that 2006 to 2008 are the only years with complete datasets. Prior to 2006, $PM_{2.5}$ data is only available for Houston (with the exception of 2004 which includes data from Smithers as well).

Month	2001	2002	2003	2004	2005	2006	2007	2008
January			1	2	2		1	1
February			1				2	
March			1					
April								
May								
June								
July								
August								
September								
October		1						
November	4	3	2	5		2		
December			2	2	1	2	1	6
Total	4	4	7	9	3	4	4	7
%	1.1%	1.1%	1.9%	2.5%	0.8%	1.1%	1.1%	1.9%