GUIDANCE ON APPLICATION OF PROVINCIAL AIR QUALITY CRITERIA FOR $PM_{2.5}$

Ministry of Healthy Living and Sport

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Guidance on Application of Provincial Air Quality Criteria for $PM_{2.5}$

1. Purpose

To provide further guidance on the application of the provincial $PM_{2.5}$ air quality criteria for ministry staff and stakeholders.

2. Background

$PM_{2.5}$ refers to fine particles that are 2.5 micrometres (μm) or smaller in diameter. $PM_{2.5}$ is one of the most important outdoor air pollutants in B.C. from a human health perspective. $PM_{2.5}$ exposure is linked to a range of health impacts including inflammation of the airways, more frequent use of medications, increased emergency room visits, hospitalizations and premature mortality. No safe health thresholds have been identified.

In response to concerns over $PM_{2.5}$, the province has adopted new ambient air quality criteria for $PM_{2.5}$ in the form of daily (24-hour) and annual air quality objectives (AQO's) and an annual Planning Goal. This is in addition to the provincial PM_{10} objective of 50 $\mu g/m^3$ (24-hour average) already in place.

Criteria	Level	Averaging Period
Air Quality Objective	25 $\mu g/m^3$	Daily (with achievement based on annual 98th percentile level)
Air Quality Objective	8 $\mu g/m^3$	Annual
Planning Goal	6 $\mu g/m^3$	Annual

Provincial air quality objectives are the primary set of criteria used to manage air quality in B.C. They are non-statutory limits – that is, they are not legally binding unless referred to in a regulation, authorization or local bylaw. Air quality objectives are used to:

- Gauge current and historical air quality,
- Guide decisions on environmental impact assessments and authorizations,
- Guide airshed planning efforts, and
- Guide regulatory development.

The 24-hour air quality objective is also used to guide decisions on whether to issue an air quality advisory.

The Planning Goal is intended as a voluntary target to guide airshed planning efforts and encourage communities to maintain good air quality in the face of economic growth and development.

In general, strict rules of application for air quality criteria have not been prescribed in this province. This has given regulators the flexibility to consider new or existing emissions within the context of a number of other local factors, such as current and predicted air quality, proximity of potential impacts to populated or sensitive areas, and

whether there is an airshed plan in place or under development. This has also led to concerns by some about inconsistent approaches used across the province, the lack of clear expectations, and the difficulty this poses to those stakeholders operating in multiple regions in B.C.

In view of these factors, the ministry has developed a consistent provincial approach that maintains flexibility to accommodate regional/local considerations in local air management decisions.

3. Guiding Principles

The following principles were used to guide development of this implementation guide:

- To promote ecosystem integrity;
- To position the Ministry of Environment for the future;
- To consider environmental, social, health and economic interests;
- To working with others;
- Continuous improvement and keeping clean areas clean, reflecting the provisions of the Canada-wide Standards for PM and Ozone that state that polluting up to a limit is unacceptable and the best way to avoid future problems is to keep clean areas clean;
- Flexibility, recognizing that regulators require some latitude to manage the cumulative impacts of multiple emission sources, for the protection of human health and the environment;
- Science-based decision-making, using the most appropriate level of science to support decisions; and
- Airshed protection, striving to identify, understand and reduce cumulative environmental risk and impacts.

4. Application of Ambient Air Quality Criteria

4.1 Definition of $PM_{2.5}$

$PM_{2.5}$ is directly emitted to the atmosphere (i.e. primary $PM_{2.5}$) and produced in the atmosphere via various reactions involving precursor gases such as sulphur dioxide, oxides of nitrogen, volatile organic compounds and ammonia (i.e. secondary $PM_{2.5}$). For dispersion modelling purposes, these fractions are also referred to as the filterable and condensable fractions, respectively.

Ambient measurements reflect a mix of primary and secondary particles. In areas such as the Lower Fraser Valley, the secondary component can be a significant contributor to overall $PM_{2.5}$ levels. However, similar information at the source is often unknown or poorly characterized.

For dispersion modelling purposes, ministry staff will require potential and existing dischargers to provide data on filterable and condensable fractions of $PM_{2.5}$ as deemed necessary, and will require stack testing to verify the data after the modelling is complete and the discharges commence and/or discharges are modified or amended. Further

information on modelling requirements can be found in the *Guidelines for Air Quality Dispersion Modelling in British Columbia*[1]

Timing
The objectives are effective immediately, and are to be used to guide decisions on air management in this province, including authorizations and air quality advisories. This is to ensure the consistent use of objectives across the province to guide the management of $PM_{2.5}$.

The planning goal is available immediately for use by communities to guide airshed planning efforts.

4.2 Geographical Scope of Application
In general, provincial air quality criteria apply to areas where there is public access, i.e. areas beyond plant boundaries. As described in "Guidelines for Air Quality Dispersion Modelling in British Columbia[2], "plant boundaries" are defined as:

- the facility fenceline or the perimeter of disturbed area that defines where public access is restricted;
- if a facility is located within another larger facility boundary, the plant boundary is the boundary of the encompassing facility; or
- if a public access road passes through the plant, the plant boundary is the perimeter along the road allowance.

4.3 Application to Authorized Emissions
The *Environmental Management Act* (*EMA*) sets out the responsibilities of the Minister of Environment, and provides the ministry with overall responsibility for waste management in the province. The *EMA* provides the underlying legislation to air-quality-related regulations in B.C. It further gives Metro Vancouver the authority to manage air quality within the Greater Vancouver area.

Under sections 6(2) and 6(3) of the *EMA*, waste must not be introduced into the environment in the course of conducting a prescribed industry, trade or business unless in accordance with:

- the Act,
- a site-specific authorization (e.g. permit, approval or order),
- a regulation (including code of practice), and
- a waste management plan approved by the Minister.

The Waste Discharge Regulation prescribes those industries, trades, businesses operations and activities for the above purposes. Schedule 1 identifies those operations (Tier 1) that are of high risk to the environment and public health, or those where it has

[1] B.C. Ministry of Environment, 2007. See: http://www.env.gov.bc.ca/air/airquality/pdfs/aq_disp_model_06.pdf)
[2] *Ibid*

been determined that code of practice development is impractical. Such operations require some form of site-specific authorization. Schedule 2 identifies medium risk operations (Tier 2) that may be authorized by meeting the requirements of a regulation or code of practice. If neither has been developed, then a permit or approval is required. Those industries, trades, businesses not listed in either Schedules 1 or 2 are considered low risk (Tier 3) and do not require a formal authorization to discharge waste. However, the discharges must not cause pollution or present a risk to public health.

4.3.1 Application to Permits and Approvals

The issuance of a permit or approval is based upon a multi-step process described more fully in the ministry's guidance document "Waste Discharge Authorizations." [3]

As part of the process to apply for a permit or approval, technical information must be provided to the ministry that describes the source and its potential impacts on the environment. For high risk/complex authorizations that fall under Schedule 1 of the Waste Discharge Regulation (i.e. Tier 1 discharges), the applicant is required to prepare a detailed technical assessment report. The manager clarifies this requirement during a pre-application meeting. For moderate risk or less complex Tier 1 discharges and Tier 2 discharges where a code of practice or regulation is not in place, an environmental impact technical assessment report may not be required. Instead, supporting technical information is provided directly in the application form package.

Where a technical assessment is required, ministry staff work with applicants in the early stages to clarify ministry expectations with respect to:

- ambient air quality objectives,
- ambient monitoring requirements,
- emission control technology requirements, and
- recommended approach to dispersion modelling.

This involves close collaboration between ministry staff involved in source management and ambient monitoring and protection to ensure a consistent and coordinated approach.

Once complete, ministry staff conduct a review of the submitted impact assessment and technical report. The director may then issue a permit subject to conditions considered advisable for the protection of the environment. In determining what is advisable, the director considers information provided by ministry staff, the applicant, concerned persons and other agencies.

The director may consider current or future economic growth and the associated cumulative impacts of multiple emission sources in an airshed when determining an applicant's maximum allowable impact on that airshed. This extends to undeveloped areas, to ensure that no single source "uses up" the entire capacity of an airshed. A more formal approach to identifying allowable incremental increases in air contaminant levels,

[3] See: http://www.env.gov.bc.ca/epd/waste_discharge_auth/intro.htm

such as used in the U.S. Prevention of Significant Deterioration (PSD) Program, does not exist at this time. However, the potential development of a PSD-type program is appropriate for future discussion.

The adoption of new objectives does not trigger an automatic review of authorizations. However, exceedance of the ambient air quality objectives may warrant a review of existing authorizations in an airshed, along with more frequent compliance inspections and use of best available technology on new and existing facilities, as described in the Provincial Airshed Planning Framework.[4]

4.3.2 Application to Regulated Facilities

Regulations, including codes of practice, set enforceable standards that apply to prescribed industries, trades, businesses, activities or operations. Regulated facilities operating in areas that exceed the air quality objectives may be subject to more stringent regulatory requirements, with the determination made on an area-specific or case-by-case basis. Where deemed necessary to protect the public or the environment or where the intent of a code of practice will be met by a substitution, the *EMA* gives the minister or director the authority to substitute a different requirement than that contained in a code of practice. In the case of a regulation approved by cabinet, more stringent standards can be included for sensitive areas. For example, more stringent emission standards are required for asphalt plants located in the Lower Fraser Valley and Prince George airsheds relative to elsewhere in the province.

4.4 Application to Airshed Planning

Airshed planning is a process to coordinate activities affecting air quality in a defined area or airshed. This approach recognizes that local air quality is influenced by a number of activities and emission sources, stakeholders and overlapping jurisdictions. As part of this process, the ministry manages authorized and regulated sources under its jurisdiction as described in Section 4.3.

Air quality objectives are viewed as an immediate target for all communities. Where areas are approaching or exceeding the air quality objectives, and where an airshed approach is determined to be the most effective means to improve air quality, the ministry will support the development and implementation of an airshed plan.

As no threshold has been identified, below which health effects are not observed, the ministry further supports the principles of Continuous Improvement and Keeping Clean Areas Clean. For this reason, communities are encouraged to maintain air quality levels below the air quality objectives and to strive toward or maintain levels equivalent to or less than the Planning Goal of 6 $\mu g/m^3$ (annual average). Communities determine how quickly and to what degree they work towards this goal.

4.5 Air Quality Advisories

Air quality advisories are issued by regional offices of the Ministry of Environment and Metro Vancouver to inform the public of degraded air quality, and to trigger actions to

[4] See: http://www.env.gov.bc.ca/air/airquality/pdfs/airshedplan_provframework.pdf

reduce or avoid emissions. This may occur when measured air quality levels approach or exceed "acceptable" levels, as defined by established air quality objectives. For $PM_{2.5}$, the trigger level would be the ambient objective of 25 $\mu g/m^3$ (based on a forecast or measured running 24-hour mean concentration).

Actions triggered in response to an air quality advisory may be voluntary or mandatory. Examples of voluntary actions include asking the public to take alternative forms of transportation other than single occupancy vehicles, or avoiding backyard burning.

Mandatory actions are those prescribed in a regulation, authorization or bylaw. Examples of mandatory actions include burn bans in accordance with the Open Burning Smoke Control Regulation, and bans on woodstove or backyard burning use in accordance with local bylaws.

In some instances, a facility may be required under permit to reduce or alter operations in response to an air quality advisory. This is typically required where:

- Emissions from an authorized source (including those resulting from upset conditions) have been linked to past exceedances of air quality objectives, and
- A major new source is entering an airshed that already experiences exceedances of air quality objectives.

Additional factors that would be considered prior to requiring an emission reduction strategy include the magnitude and duration of typical air quality episodes as well as the ability of a facility to curtail emissions in an efficient and timely manner.

5. $PM_{2.5}$ Monitoring and Reporting

All monitoring sites are required to meet minimum siting standards to ensure that a representative measure of air quality is made.[5] All sites are audited by the ministry every 6 months to verify that monitors are operating properly to ensure the collection of valid and complete data.

The provincial monitoring network is comprised of a large number of automated TEOM instruments, followed by a mixture of filter-based gravimetric Partisol and dichotomous samplers, as summarized in Appendix I. Provincial and territorial managers of the National Air Pollutant Surveillance (NAPS) network rely on testing performed by the U.S. Environmental Protection Agency (EPA) to establish reference or equivalent methods for air quality monitoring. A list of current EPA-approved $PM_{2.5}$ samplers can be found in Appendix II.

The Partisol and dichotomous samplers currently used in the provincial monitoring network are considered to be reference samplers. However, the TEOMs in current use have not received such designation. Such TEOMs have been shown to under-measure relative to filter-based samplers, especially during the winter in some communities. It is expected that a number of TEOM instruments will be upgraded within the next few years

[5] "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements Version 1.0 (Draft)." EPA-454/D-06-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, October 2006.

to reference or equivalent reference samplers established by NAPS managers, beginning in the most populated areas. Full-scale change-out of the TEOM network will be a long-term effort.

For the purpose of air quality advisories, decisions should be based on available continuous measurements (including TEOM data), calculated on a rolling 24-hour average). Achievement of the air quality objectives for the purposes of annual reporting or environmental assessments should be based on reference or equivalent reference sampler data or, where available, TEOM data that has been adjusted using correction factors that have been developed by the ministry to meet minimum data quality objectives that are being established by NAPS managers. Summaries of recent air quality data (unadjusted) are provided in Appendix III. For specific guidance on calculating $PM_{2.5}$ concentrations for comparison with provincial ambient air quality objectives, see Appendix IV.

6. Summary

The province has adopted new ambient air quality criteria for $PM_{2.5}$ in the form of daily (24-hour) and annual air quality objectives (AQO's) and an annual Planning Goal. Guidance has been developed to assist stakeholders and ministry staff in the application of these criteria to various air management decisions, including those related to authorizations, regulated facilities, air quality advisories and airshed planning. Additional guidance has been provided with respect to the monitoring and reporting of $PM_{2.5}$.

Appendix I. $PM_{2.5}$ Monitoring Sites in B.C. (as of December 31, 2007)

[Excludes GRIMM and BAM monitors currently being tested]

Site ID	Site Name	Location	TEOM	Partisol	Dichot
E218444	100 Mile House Access Centre	On roof of B.C. Access Centre - 100 Mile House		x	
E246240	Abbotsford Airport - Walmsley Road	31790 Walmsley Road	x		x
E259717	Armstrong Riverside	Tolko Industries Armstrong Sawmill		x	
0310177	Burnaby Kensington Park	6400 E. Hastings	x		
E207418	Burnaby South	5455 Rumble Street	x		x
E225267	Burns Lake Fire Centre	#8 4th Avenue	x		
E229798	Campbell River Tyee Spit	2662 Tyee Spit	x		
E243617	Castlegar Fire Hall			x	
E220891	Chilliwack Airport	Airport Road	x		
	Cowichan Valley				New
	Cranbrook				New
E259398	Creston Piper Farms	Canada/US Border	x		
E220218	Crofton South	7390 Alberta Place	x		
E222520	Elk Falls Dogwood	Adjacent to 660 Westmere	x		
E206193	Elkview Coal (PA1807) North of Michel Hotel	300 metres north of Michel Hotel		x	
0250017	Elkview Coal (PA1807) Sparwood Civic Building	Roof of Civic Building on Spruce Street		x	
0250184	Elkview Coal (PA1807) Whispering Winds Park	Lower Elk Valley Road		x	
E250350	Fort Nelson Chalo School	Chalo Road (First Nations Reserve)	x		
	Ft. St. John				New
E235070	Golden Hospital	835 9th Avenue South	x		
E256315	Golden Townsite	835 9th Avenue South	x		
E263701	Grand Forks City Hall	2217 4th Street	x		
E207520	Grand Forks City Hall	Background Monitoring Site		x	
E255713	Hazelton NWCC			x	
E223756	Hope Airport	62715 Airport Road	x		
M107004	Houston Firehall	3382 11th Street	x		
E206898	Kamloops Brocklehurst	Mayfair Street	x		x
E266222	Kamloops Dalhousie	1259 Dalhousie Drive		x	
E206725	Kamloops Federal Building	Post Office, Downtown Kamloops		x	
E261178	Kamloops Wildlife Park			x	

Site ID	Site Name	Location	TEOM	Partisol	Dichot
0500886	Kelowna College	3333 College Way	x		x
E223827	Kitimat Rail	CN Rail Yard	x		
E216670	Kitimat Riverlodge	651 Columbia Street	x		
E264882	Langford Lakewood Elementary School	2363 Setchfield	x	x	
E209178	Langley Central	23752 52nd Avenue	x		
E258637	Lillooet T'IT'Q'ET	West end of administration office building		x	
E265082	Lillooet T'IT'Q'ET Pumphouse	Adjacent to pumphouse on Scotchman Road		x	
E253329	Lumby Greenridge Supply	Shuswap Road, Lumby		x	
0770709	Mackenzie	Fletcher Challenge	x		
E264161	Merritt Gillis House	Gillis House, Merritt		x	
E264682	Merritt Parcel Street	Met Tower on Parcel Streel, Merritt		x	
E229797	Nanaimo Labieux Road	2080A Labieux Road	x		New
E206375	Nelson Government Building	Nelson Government Building		x	
E258315	Nelson Kutenai Place	333 Victoria Street	x		
E267442	North Nechako			x	
E257415	Osoyoos Canada Customs	202 Hwy 97S	x		
E260557	Pemberton Signal Hill Elementary				x
E232244	Pitt Meadows Meadowlands Elementary School	18477 Dewdney Trunk Road	x		
0310162	Port Moody Rocky Point Park	Moody Street and Esplanade	x		
0220204	Powell River Cranberry Lake	Wildlife Sanctuary	x		
0220205	Powell River Wildwood	Wildwood Motors	x		
0450270	Prince George Gladstone School	7005 Gladstone Drive	x	x	
0450324	Prince George Lakewood School	Lakewood Junior Secondary School		x	
0450307	Prince George Plaza 400	1011 4th Avenue	x	x	x
0450232	Prince George Van Bien	Van Bien Elementary School		x	
E259277	Prince George Western Acres (Background)	City of Prince George sewage lagoons located at Western Acres adjacent to Hwy. 16 West, 15km west of downtown.		x	
E266302	Quadra Island Cape Mudge Village	in village	x		
E216667	Quesnel Maple Drive	950 Mountain Ash Road	x		
E208096	Quesnel Senior Secondary	585 Callanan Street	x		x
E228064	Quesnel West Correlieu School	850 Anderson	x		
E251469	Revelstoke Begbie	Roof of Mt. Begbie school		x	
E248021	Revelstoke Mt Begbie School	402 Downie Street	x		
E253229	Saanich Stellys Cross Road	North side of Stelly's Crossroad west of the Saanich Fairgrounds	x	x	

Site ID	Site Name	Location	TEOM	Partisol	Dichot
E206589	Smithers St Josephs	4020 Broadway Avenue	x	x	x
E253330	Spallumcheen Township Office	4164 Spallumcheen Way	.	x	
0310172	Squamish Government Building	2ND Street, Squamish		x	
E240336	Stewart	ROOF OF RESIDENCE		x	
E230557	Telkwa	1304 Birch Street	x		
M107028	Terrace BC Access Centre	104 - 3220 Eby Street	x		
E269123	Trail Aquatic Centre	1875 Columbia Avenue	x		
E234293	Valemount	A parttisol PM 10 sampler is located on the firehall building roof.		x	
E256101	Vanderhoof	Provincial Courthouse on Bute Avenue		x	
E232246	Vancouver International Airport #2	3153 Templeton Street	x		
0310175	Vancouver Kitsilano	2550 West 10th Avenue	x		
E249492	Vernon Science Centre	2704 Highway #6	x		
E260701	Victoria Christopher Point	DND property at Rocky Point	x		
0110031	Victoria Royal Roads University	2005 Sooke Road	x		
E231866	Victoria Topaz	923 Topaz, Victoria	x	x	x
E227431	Whistler Meadow Park	Meadow Park Sport Centre	x		
E229457	Williams Lake 168 Mile Road	1365 168 Mile Road		x	
0550502	Williams Lake Columneetza School	1045 Western Avenue	x		
E248797	Williams Lake CRD Library	180 North Third Ave	x		
0605020	Williams Lake Skyline School	225 Hodson Road	x	x	
E222242	Williams Lake Water Tower	Gravel access road at the end of Midnight Drive, Williams Lake.		x	

Appendix II. List of Designated Reference and Equivalent Methods for $PM_{2.5}$

The following samplers have been designated by the U.S. Environmental Protection Agency (EPA) as reference methods or equivalent methods for ambient $PM_{2.5}$ measurement (as of March 20, 2008). Environment Canada and provincial/territorial managers of the National Air Pollution Surveillance (NAPS) network have identified Canadian reference methods as those designated by the U.S. EPA.
(Source: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf)

Andersen Model RAAS2.5-200 $PM_{2.5}$ Ambient Audit Air Sampler

BGI Inc. Models PQ200 or PQ200A $PM_{2.5}$ Ambient Fine Particle Sampler

BGI Inc. Models PQ200-VSCC or PQ200A-VSCC $PM_{2.5}$ Sampler

Graseby Andersen Model RAAS2.5-100 $PM_{2.5}$ Ambient Air Sampler

Graseby Andersen Model RAAS2.5-300 PM2.5 Sequential Ambient Air Sampler

Met One BAM-1020 Monitor - PM2.5 FEM Configuration (Federal Equivalent Method)

Rupprecht & Patashnick Partisol®-FRM Model 2000 PM -2.5 Air Sampler

Rupprecht & Patashnick Partisol® Model 2000 PM -2.5 Audit Sampler

Rupprecht & Patashnick Partisol® Model 2000 PM -2.5 FEM Audit Sampler

Rupprecht & Patashnick Partisol®-Plus Model 2025 Sequential Air Sampler

Thermo Electron Model RAAS2.5-100 FEM PM2.5 Ambient Air Sampler

Thermo Electron Model RAAS2.5-200 FEM PM2.5 Audit Air Sampler

Thermo Electron Model RAAS2.5-300 FEM PM2.5 Sequential Ambient Air Sampler

Thermo Electron Corporation Model RAAS2.5-300 FEM PM2.5 Sequential Ambient Air Sampler

Thermo Environmental Instruments, Incorporated Model 605 “CAPS” Sampler

Thermo Scientific Partisol 2000-FRM PM2.5 Air Sampler

Thermo Scientific Partisol-Plus 2025 Sequential PM2.5 Air Sampler

Rupprecht & Patashnick Partisol®-Plus 2025 PM-2.5 Sequential Sampler

URG-MASS100 Single PM 2.5 FRM Sampler

URG-MASS300 Sequential PM 2.5 FRM Sampler

Appendix III-1. Summary of Annual Mean $PM_{2.5}$ Levels
(in $\mu g/m^3$, based on TEOM measurements)

Site ID	Site Name	2002	2003	2004	2005	2006
E246240	Abbotsford Airport - Walmsley Road	5.4	5.3	5.0	5.2	4.1
0310177	Burnaby Kensington Park	.	.	4.9	4.9	4.5
E207418	Burnaby South	.	.	5.2	5.5	4.7
E220891	Chilliwack Airport	4.9	4.9	5.0	4.7	4.6
E220218	Crofton South	.	.	.	.	4.8
E250350	Fort Nelson Chalo School	.	.	.	.	3.8
E243516	Fort St John	4.0	.	.	.	.
E256894	Golden CPR	.	.	.	5.1	.
E256895	Golden Golf Course	.	.	.	2.9	.
E235070	Golden Hospital	.	**10.2**	.	7.1	6.8
E256315	Golden Townsite	.	.	.	6.7	6.6
E223756	Hope Airport	.	.	.	4.5	3.4
M107004	Houston Firehall	7.2	6.5	6.2	6.2	6.2
E206898	Kamloops Brocklehurst	6.7	7.9	5.7	4.7	5.0
0500886	Kelowna College	6.0	**8.5**	5.8	4.6	5.2
E223827	Kitimat Rail	.	3.7	4.1	3.7	.
E216670	Kitimat Riverlodge	.	2.7	2.9	2.7	2.6
E249735	Langford Dogwood School	.	.	5.7	.	.
E209178	Langley Central	5.4	5.6	.	5.6	5.1
E229797	Nanaimo Labieux Road	5.2	4.2	4.1	4.4	3.7
E258315	Nelson Kutenai Place	.	.	.	.	4.7
E257415	Osoyoos Canada Customs	.	.	.	4.1	5.2
E232244	Pitt Meadows Meadowlands Elem. School	5.2	5.6	5.3	5.5	5.0
0310162	Port Moody Rocky Point Park	.	.	5.8	6.0	5.5
0220204	Powell River Cranberry Lake	3.7	3.7	3.2	3.0	3.2
0450270	Prince George Gladstone School	.	.	.	.	6.7
0450307	Prince George Plaza 400	**9.2**	**10.8**	**10.6**	7.9	7.6
E216667	Quesnel Maple Drive	**8.2**	.	**8.2**	6.9	7.5
E221885	Quesnel Pinecrest	7.4	**8.6**	**8.3**	7.8	.
E208096	Quesnel Senior Secondary	**8.8**	.	**8.9**	7.3	8.0
E228064	Quesnel West Correlieu School	5.5	.	6.3	5.3	5.5
E253229	Saanich Stelly's	.	.	7.6	.	.
E206589	Smithers St Josephs	.	.	.	6.7	6.8
M107028	Terrace BC Access Centre	.	.	3.2	3.4	3.1
E232246	Vancouver International Airport #2	5.8	5.9	5.5	6.0	4.9
0310175	Vancouver Kitsilano	.	.	5.8	5.9	5.2
E249492	Vernon Science Centre	.	**8.4**	6.8	5.6	5.8
0110031	Victoria Royal Roads University	5.1	4.5	4.3	4.1	4.0
E231866	Victoria Topaz	7.1	5.9	5.6	5.4	5.6
E227431	Whistler Meadow Park	.	.	.	4.0	4.0
0550502	Williams Lake Columneetza School	6.7	7.5	7.2	6.7	6.8
E248797	Williams Lake CRD Library	.	6.3	6.5	5.6	5.6
0605020	Williams Lake Skyline School	6.5	6.8	7.5	6.7	6.5

Note: Exceedances of annual objective of 8 $\mu g/m^3$ highlighted in bold.

Appendix III-2. Summary of Annual Mean $PM_{2.5}$ Levels (preliminary)
(in $\mu g/m^3$, based on Partisol measurements)

Site ID	Site Name	2006	2007
0310172	Squamish Government Bldg	5.4	4.7
0450232	Prince George Van Bien School	**8.9**	**8.3**
0450270	Prince George Gladstone School	**8.2**	7.4
0450307	Prince George Plaza 400	**9.6**	**8.5**
0450324	Prince George Lakewood Secondary School	8.0	7.0
0605020	Williams Lake Skyline School	**8.2**	
E206589	Smithers		6.1
E218444	100 Mile House	7.7	-
E234293	Valemount	**9.8**	7.7
E251469	Revelstoke	**11.1**	**9.2**
E235329	Lumby Greenridge		**10.2**
E256101	Vanderhoof	**9.0**	7.7
E258637	Lilooet Titq'et	5.0	
E259277	Prince George Western Acres Background	4.3	5.8
E260557	Pemberton Signal Hill Elementary School	4.8	
E261178	Kamlooops Wildlife Park	6.7	6.2

Appendix III-3. Summary of 24-hour $PM_{2.5}$ Levels
(Annual 98th percentile in μg/m3, based on TEOM measurements)

Site ID	Site Name	2002	2003	2004	2005	2006
E246240	Abbotsford Airport - Walmsley Road	14	15	15	14	12
0310177	Burnaby Kensington Park	.	.	14	14	13
E207418	Burnaby South	.	.	14	13	13
E220891	Chilliwack Airport	14	16	14	12	15
E220218	Crofton South	.	.	.	.	13
E250350	Fort Nelson Chalo School	.	.	.	.	11
E243516	Fort St John	13	.	.	.	.
E256894	Golden CPR	.	.	.	14	.
E256895	Golden Golf Course	.	.	.	9	.
E235070	Golden Hospital	.	**48**	.	19	19
E256315	Golden Townsite	.	.	.	18	19
E223756	Hope Airport	.	.	.	12	12
M107004	Houston Firehall	24	23	19	22	21
E206898	Kamloops Brocklehurst	20	**41**	18	13	16
0500886	Kelowna College	18	**41**	17	12	22
E223827	Kitimat Rail	.	11	13	11	.
E216670	Kitimat Riverlodge	.	9	12	8	9
E249735	Langford Dogwood School	.	.	14	.	.
E209178	Langley Central	16	19	.	15	13
E229797	Nanaimo Labieux Road	12	10	11	11	10
E258315	Nelson Kutenai Place	.	.	.	.	15
E257415	Osoyoos Canada Customs	.	.	.	11	24
E232244	Pitt Meadows Meadowlands Elem. School	13	16	14	16	15
0310162	Port Moody Rocky Point Park	.	.	15	15	14
0220204	Powell River Cranberry Lake	9	10	10	8	10
0450270	Prince George Gladstone School	.	.	.	.	22
0450307	Prince George Plaza 400	**32**	**41**	**34**	**27**	23
E216667	Quesnel Maple Drive	**27**	.	**27**	25	**26**
E221885	Quesnel Pinecrest	22	23	25	23	.
E208096	Quesnel Senior Secondary	25	.	**28**	21	24
E228064	Quesnel West Correlieu School	20	.	22	16	18
E253229	Saanich Stelly's	.	.	14	.	.
E206589	Smithers St Josephs	.	.	.	19	20
M107028	Terrace BC Access Centre	.	.	12	13	9
E232246	Vancouver International Airport #2	18	16	16	18	14
0310175	Vancouver Kitsilano	.	.	15	15	13
E249492	Vernon Science Centre	.	**27**	19	15	20
0110031	Victoria Royal Roads University	15	11	11	11	11
E231866	Victoria Topaz	18	15	16	14	14
E227431	Whistler Meadow Park	.	.	.	11	10
0550502	Williams Lake Columneetza School	23	**26**	22	19	21
E248797	Williams Lake CRD Library	.	19	19	16	19
0605020	Williams Lake Skyline School	20	20	25	17	21

Note: Exceedances of 24-hour objective of 25 μg/m3, based on annual 98th percentile concentration, highlighted in bold.

Appendix IV. $PM_{2.5}$ Reporting

Based on the CCME "Guidance Document on Achievement Determination Canada-wide Standards for Particulate Matter and Ozone",[6] the following calculation methodologies should be used when comparing ambient data to provincial air quality criteria.

1. Data Completeness

A daily value for $PM_{2.5}$ refers to the 24-hour average concentration of $PM_{2.5}$ in $\mu g/m^3$ measured from midnight to midnight (local standard time). For continuous monitors, at least 18 hourly measurements are required to calculate a valid daily value. For manual samplers, the sampler must run for at least 18 hours during the day.

2. Annual Data Completeness

An annual data set should be considered complete if at least 75% of the scheduled sampling days in each quarter have valid data. Years with less than 75% data in any quarter and a 98th percentile value greater than or equal to the air quality objective of 25 $\mu g/m^3$ should be flagged for reporting.

3. Calculating the 24-hour Average Concentration

A daily value for $PM_{2.5}$ refers to the 24-hour average concentration of $PM_{2.5}$ in $\mu g/m^3$ covering the period from midnight to midnight (local standard time). The 24-hour $PM_{2.5}$ is to be reported to the nearest integer (e.g. 11.65 $\mu g/m^3$ is rounded to 12 $\mu g/m^3$).

4. Calculating the Annual 98th Percentile Value

Use of percentiles is a means of adjusting for differences in sample size and ensuring that the values used for achievement determination are not unduly affected by extreme events. The 98th percentile is the daily value out of a year of monitoring data below which 98 percent of all values fall. Annual 98th percentiles are to be reported to the nearest integer.

The annual 98th percentile (98P) is determined and defined as follows:

- Sort all the daily 24-hour $PM_{2.5}$ concentration values for the given year into an array of numbers ordered from lowest to highest (x1, x2, x3,…..xn).
- Repeat equal values as many times as they occur.
- Calculate the number "id" defined as,
  id = 0.98*n (the product of 0.98 and n), where
  i = the integer part of the number
  d = the decimal part of the number
  n = total number of the daily 24-hour concentration values
  The annual 98P is then defined to be the $(i + 1)^{th}$ largest value in the ordered array (x1, x2, x3,…..xn).

[6] Canadian Council of Ministers of the Environment (2002) "Guidance Document on Achievement Determination. Canada-wide Standards for Particulate Matter and Ozone", revised 2007 (see: http://www.ccme.ca/assets/pdf/1391_gdad_e.pdf).

- For the daily 24-hour $PM_{2.5}$ concentrations that satisfy the data completeness criteria, the above steps yield a 98P that correspond to the following based on the total number of available daily concentration values. Data are reported to the nearest 1 $\mu g/m^3$.

5. Calculating the Annual Average

An annual average value for $PM_{2.5}$ reflects the average of four quarterly means (e.g. Jan.-Mar., Apr.-Jun., Jul.-Sep. and Oct.-Dec.). The annual average $PM_{2.5}$ concentrations should be reported to the nearest 0.1 $\mu g/m^3$.

Intermediate calculations should retain all available digits and decimal places.