

**Report to the Canadian Council of Ministers of the Environment:**

**An Update in Support of the  
Canada-wide Standards for Particulate Matter and Ozone**

**Prepared by the Joint Action Implementation Coordinating Committee (JAICC)**

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## EXECUTIVE SUMMARY

### 2003 Science Review

This report provides an update on advances in the fields of health and environmental science (including economic analysis) relating to the Canada-wide Standards for Particulate Matter (PM<sub>2.5</sub>) and Ozone and to make a recommendation on the matter of a Canada-wide Standard (CWS) for particulate matter between 2.5 and 10 micrometres in diameter (PM<sub>2.5-10</sub>, or simply “the coarse fraction”).

With regard to the present CWSs for PM<sub>2.5</sub> and Ozone, advances in the state of knowledge generally support and strengthen the knowledge which was used to decide on the current CWSs. A peer review process to further define the directions suggested by the new and developing health science information is underway. The results from this process will be available by Spring 2004 and will inform the 2005 review of the standard.

Advances to date provide some new information that jurisdictions are relying on in developing their management strategies and implementation plans. There are continued indications that action to significantly reduce the emissions of precursor pollutants (sulphur dioxide, nitrogen oxides, volatile organic compounds and gaseous ammonia) will be necessary and effective in some regions in order to achieve the current Canada-wide Standards.

The assessment of the health and environmental science regarding particulate matter between 2.5 and 10 micrometres in diameter (PM<sub>2.5-10</sub>) indicates that evidence for health effects is inconsistent. However, studies of hospital admissions suggest that there may be health effects at concentrations within the range of those measured at Canadian sites. There are also indications that the United States may proceed toward developing a National Ambient Air Quality Standard for this size fraction in the near future.

### ***Recommendations***

Recognizing the review requirements of the existing Canada-wide Standards for Particulate Matter and Ozone, JAICC recommends that:

- The existing Canada-wide Standards for PM<sub>2.5</sub> and Ozone should be retained and implemented as planned by 2010; and
- In view of the evolving information, a plan be developed and initiated by 2005 to meet the requirements for the 2010 review of the Canada-wide Standards for PM<sub>2.5</sub> and Ozone.

JAICC also recommends that all work in support of future reviews of the existing and any new proposed Canada-wide Standards makes use of the improved tools and data available for the conduct of economic analyses.

There is evidence of health effects due to the coarse fraction; however, the available information is not sufficient to permit a recommendation on whether or not to develop a CWS at this time. JAICC recommends that:

- A plan be developed and initiated by 2005 to address the information gaps for this pollutant, and
- CCME revisit the question of whether or not to develop a CWS for the coarse fraction as part of the 2010 review of the CWS for PM<sub>2.5</sub> and ozone.

JAICC recognizes that current PM<sub>2.5</sub> initiatives will also reduce coarse fraction emissions. JAICC encourages jurisdictions to continue to pursue activities that will address this size fraction of particulate matter between now and 2010.

### 2005 Review of the Standards

This report also provides a summary of the status of the 2005 review of the Standards. The scope of the 2005 review was to provide, in 2004 and 2005, any technical and socio-economic analysis necessary to support CCME recommendations to “revise or supplement the PM and ozone CWSs as appropriate for year 2015.” Given that the recommendation from the 2003 science review is that “the existing Canada-wide Standards for PM<sub>2.5</sub> and Ozone should be retained and implemented as planned by 2010”, and since no alternative levels or forms have been proposed for the Standards, JAICC concludes that no additional analysis of the technical feasibility or socio-economic impact of alternatives is required and recommends that CCME retain the existing Standards in their current form for the year 2015.

## PART A – 2003 SCIENCE REVIEW

### 1. INTRODUCTION

Part A of this report summarizes several scientific reports completed since 2000 on ozone, particulate matter less than 2.5 micrometres in diameter (PM<sub>2.5</sub>), particulate matter between 2.5 and 10 micrometres in diameter (PM<sub>2.5-10</sub> or “the coarse fraction”) and an economics report in support of the Canada-wide Standards (CWSs). It supports the 2005 review of the CWSs, addressed in Part B of this report. Part A of this report presents the key findings, recommendations, and supporting rationale flowing from those scientific reports.

In June 2000, Environment Ministers from across Canada (except Quebec) signed the CWS for PM and Ozone. The province of Quebec has indicated that it intends to act within its area of jurisdiction in a manner consistent with the other CCME member jurisdictions regarding these standards and the deadlines for attaining them, although it did not sign the 1998 Canada-wide Accord on Environmental Harmonization or these standards.

Although some jurisdictions had issues with some parts of the 1997 Particulate Matter Science Assessment Document (1997 SAD) and 1999 Ground-Level Ozone Science Assessment Document (1999 SAD), these documents formed the starting point for the Canada-wide Standards. These standards were set at levels intended to protect human health, although it is recognized that they are not fully protective against all potential health and environmental effects.

The text of the CWS acknowledges this, along with the fact that uncertainty exists and new data and information will become available as advancements are made in scientific, technical and economic information and analysis. Consequently, the CWS provides for the review of the CWSs as follows:

- a) by the end of year 2005, complete additional scientific, technical and economic analysis to reduce information gaps and uncertainties and revise or supplement the particulate matter (PM) and ozone CWSs as appropriate for year 2015; and report to Ministers in 2003 on the findings of the PM and ozone environmental and health science, including a recommendation on a PM<sub>2.5-10</sub> CWS.
- b) by the end of year 2010, assess the need, and if appropriate, revise the CWSs for PM and ozone for target years beyond 2015.

In support of the reviews, a number of analyses of ozone, PM<sub>2.5</sub> and PM<sub>2.5-10</sub> were conducted:

- Human Health Effects of Ozone: Update in Support of the Canada-wide Standards for Particulate Matter and Ozone (Time period covered: April 1997 – End of 2001)\*;
- Human Health Effects of Fine Particulate Matter: Update in Support of the Canada-wide Standards for Particulate Matter and Ozone (Time period covered: 1997 – Oct. 2002)\*;

- Human Health Effects of the Coarse Fraction of Particulate Matter: Update in Support of the Canada-wide Standards for Particulate Matter and Ozone (Time period covered: 1997 – 2001)\*;
- Atmospheric Science of Ozone in Canada: Update in Support of the Canada-wide Standards for Particulate Matter and Ozone (Time period covered: 1997 – 2002);
- Atmospheric Science of PM in Canada: Update in Support of the Canada-wide Standards for Particulate Matter and Ozone (Time period covered: 1997 – 2002);
- State of Science Update — Effects of Ozone on Vegetation (Time period covered: 1999 – March 2002);
- State of Science Update — Effects of Ozone on Materials (Time period covered: 1999 – December 2001);
- Rationale Document for CCME Decision on the Need for a Canada-Wide Standard (CWS) for Coarse Particulate Matter (PM<sub>2.5-10</sub>); and
- Economic Analysis: Update in Support of the Canada-Wide Standards for Particulate Matter and Ozone.

\* Due to their dates of preparation, these updates did not include the Health Effects Institute reanalysis of 21 studies published in May 2003.

## 2. Ozone

### 2.1 Recommendations

Recognizing the review requirements of the existing Canada-wide Standards for Particulate Matter and Ozone (see reproduction in the Introduction to this report), JAICC recommends that:

- The existing Canada-wide Standard for Ozone should be retained and implemented as planned by 2010; and
- In view of the evolving information, a plan be developed and initiated by 2005 to meet the requirements for the 2010 review of the Canada-wide Standards for PM<sub>2.5</sub> and Ozone.

### 2.2 Findings

- In order to meet the objective of protecting human and ecosystem health, the Canada-wide Standard for Ozone sets a numerical limit and a specific way in which data are treated to compare them to the limit in determining achievement (data treatment), as well as deadlines for achievement based on a socio-economic assessment. Health and environmental science findings, while not the only factors used in deciding on these elements of the Canada-wide Standard, are very important inputs to the standard development process.
- This standard was set at a level<sup>1</sup> intended to protect human health, although it is recognized that it is not fully protective against all potential health and environmental effects. Science developments since the 1999 Science Assessment Document support the numerical limit, data treatment and deadline for achievement of the current ozone CWS. Recent science shows continuing and stronger evidence of the negative impacts of ground-level ozone on human health and the environment.
- JAICC undertook a peer review process to further define the directions suggested by the new and developing health science information. As a result of this peer review process, JAICC re-confirmed its original recommendations based on the 2003 science reviews.
- New information supports and is beginning to provide additional guidance jurisdictions could use in developing their management strategies. For example, recent Demonstration Projects in Alberta and Quebec carried out to determine background and transboundary influences have provided useful new information to jurisdictions for use in their management planning. CWS achievement will require substantial reductions in the precursors, nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds (VOC). Comparison of levels and trends in ozone precursor emissions and ambient measurements suggests that the general direction of existing management activities is correct, and further emission reductions of the precursors are expected to result in further reductions in ambient levels of ozone. There is

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<sup>1</sup> The CWS related provisions for ozone are: a CWS of 65 ppb, 8-hour averaging time, to be achieved by 2010. Achievement to be based on the 4<sup>th</sup> highest measurement annually, averaged over 3 consecutive years.

some indication that relative chemical reactivity may be a useful factor in dealing with VOC in some circumstances.

- While progress in atmospheric science continues, enabled by advances in the capacity of software and computers, no quantitative refinement for management strategies is available. There is evidence that global emission patterns coupled with climate change may increase background ozone levels and therefore complicate achievement of the CWS in the long-term.
- While the current CWS does provide some protection of ecosystems and vegetation, there is more and stronger evidence to support the introduction of a longer-term ozone CWS, based on the need to protect ecosystems (particularly vegetation, including some crops) from harmful effects. While there does not appear to be a strong human health effects basis for a long-term ozone standard, there is some evidence of chronic effects in studies at high levels of exposure and concerns about the impact of continuing low exposure. Suggestions for a vegetation-based standard were considered during the development of the CWS, based on an exposure index (SUM60), however, it was judged that the evidence was not as compelling as that for health impacts at that time.

## **2.3 Rationale**

### **2.3.1 Emissions and Ambient Levels**

- At the national level, there is evidence of increases in ozone precursor emissions (NO<sub>x</sub> and VOC based on 1995 emission estimates), but trends in ambient ozone levels are more ambiguous. There is uncertainty in this analysis. Ambient measurement networks may not capture the true situation since measurements of NO<sub>x</sub> and VOC in rural areas are sparse. Further, trend calculation is complicated by weather variations between years. In the United States, there is evidence of ozone declines at urban locations but increases at rural sites. Emission inventories are undergoing continued refinement, and national totals reflect a changing regional pattern. Ambient ozone reductions in the Lower Fraser Valley, where ozone episodes are now very rare, appear to reflect successful management efforts. Increased NO<sub>x</sub> emissions in Western Canada are creating localized ozone problems.

### **2.3.2 Ozone Atmospheric Science**

- Since 1996, there has been improvement in scientific understanding and assessment tools, but this has not pointed to a need to change earlier guidance informing the ozone CWS or for management efforts as the broad picture has not changed. Improvement on that guidance is possible over the next several years due to ongoing work in all aspects. For example, recent Demonstration Projects in Alberta and Quebec carried out to determine background and transboundary influences have provided useful new information to jurisdictions for use in their management planning. There is evidence that global emission patterns coupled with climate change may increase background ozone levels and therefore complicate achievement of the CWS in the long-term.

### **2.3.3 Ozone Health Effects**

- A considerable body of additional health science information has come forward since the CWS for Ozone was endorsed in June 2000. This information provides continued and stronger support for the current CWS limit.
- JAICC undertook a peer review process to further define the directions suggested by the new and developing health science information. As a result of this peer review process, JAICC re-confirmed its original recommendations based on the 2003 science reviews.

### **2.3.4 Ozone Environmental Effects**

#### **2.3.4.1 *Vegetation Effects***

- Scientific work continues to indicate that ground-level ozone is a serious toxic pollutant to vegetation. While there are some effects from short-term exposure (i.e., for averaging times similar to those for the current CWS), a measure of cumulative exposure over a period of months or seasons best reflects the damage measurements from field experiments. These effects depend on the species, cultivar within the species, and climatic and local soil conditions. Recent scientific work has extended the range of species for which impact estimates are available. There has been some further progress in understanding the processes by which ozone damage is done, such as the potential for overnight ozone damage.
- As indicated in the 1999 Science Assessment Document, critical or target concentration levels can be set to protect vegetation. There has also been significant work towards the development of dose-response relationships, which permits a better determination of the economic impacts of ground-level ozone and may provide a better form for a standard to protect vegetation.

#### **2.3.4.2 *Materials Effects***

- Published literature on materials effects since 1996 provide little new indication of a need to revise either the form or the level of the existing ozone CWS. Effects are seen at low levels. One study did find a very low threshold for ozone effects for a particularly sensitive material (a form of rubber sensitive to 1 part per billion). In general, adaptation and selection of materials are addressing the impact. Other work leading to empirical dose-response relationships can provide insight into future cost and benefit analysis, which may permit future standard refinement.

### 3. PM<sub>2.5</sub>

#### 3.1 Recommendations

Recognizing the review requirements of the existing Canada-wide Standards for Particulate Matter and Ozone (see reproduction in the Introduction to this report), JAICC recommends that:

- The existing Canada-wide Standard for PM<sub>2.5</sub> should be retained and implemented as planned by 2010; and
- In view of the evolving information, a plan be developed and initiated by 2005 to meet the requirements for the 2010 review of the Canada-wide Standards for PM<sub>2.5</sub> and Ozone.

#### 3.2 Findings

- In order to meet the objective of protecting human and ecosystem health, the Canada-wide Standard for particulate matter sets a numerical limit and a specific way in which data are treated to compare them to the limit in determining achievement (data treatment), as well as deadlines for achievement based on a socio-economic assessment. Health and environmental science findings, while not the only factors used in deciding on these elements of the Canada-wide Standard, are very important inputs to the standard development process.
- This standard was set at a level<sup>2</sup> intended to protect human health, although it is recognized that it is not fully protective against all potential health and environmental effects. Science developments since the 1997 Science Assessment Document support the numerical limit, data treatment and deadline for achievement of the current PM<sub>2.5</sub> CWS. Recent science supports the findings of the effects of short-term changes in PM<sub>2.5</sub> air pollution and adverse health effects. There has been a significant amount of research concerning ambient particulate matter, both supporting and strengthening the science base of the existing CWS.
- JAICC undertook a peer review process to further define the directions suggested by the new and developing health science information. As a result of this peer review process, JAICC re-confirmed its original recommendations based on the 2003 science reviews.
- New information supports and is beginning to provide additional guidance jurisdictions could use in developing their management strategies. For example recent Demonstration Projects in Alberta and Quebec carried out to determine background and transboundary influences have provided useful new information to jurisdictions for use in their management planning. In addition sophisticated, regional, multi-pollutant atmospheric models for smog pollutants are emerging and beginning to be used. These tools should be further refined so that they can provide guidance to science-based implementation planning on an eastern (or western) North American scale.

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<sup>2</sup> The CWS related provisions for PM<sub>2.5</sub> are: a CWS of 30 µg/m<sup>3</sup>, 24-hour averaging time, to be achieved by 2010. Achievement to be based on the 98<sup>th</sup> percentile measurement annually, averaged over 3 consecutive years.

- CWS achievement will require substantial reductions in precursor pollutants such as sulphur dioxide and nitrogen oxides, as well as action to reduce emissions of primary particulate matter.
- Work on chronic health effects indicates that long-term exposure is implicated in additional effects, and the utility of an additional long-term (e.g., annual) standard should be examined in the Canadian context. The impact of implementation activities on annual average concentrations should be considered in the 2010 review of the CWSs in order to establish the need for additional work in this area.

### 3.3 Rationale

#### 3.3.1 Emissions and Ambient Levels

- Evaluation of ambient levels of PM<sub>2.5</sub> requires assessment of several different measures in order to fully understand trends in air quality. The 98<sup>th</sup> percentile levels (i.e., levels which will be used to judge attainment of the CWS) exhibit a significant decline over the years 1984-2000. Although mean PM<sub>2.5</sub> levels do not exhibit a significant change over the same timeframe, they declined between 1984 and the mid-1990s. After the mid-1990s, the average mass of PM<sub>2.5</sub> appeared to stabilize. It is thought that reductions in emissions of sulphur dioxide, in support of acid rain management, may be responsible for the observed decline in PM<sub>2.5</sub> between 1984 and the mid-1990s. The first indication that PM<sub>2.5</sub> mass may change is often observed in changes in the chemical constituents of particles rather than total PM mass. This reflects our need to consider not only emissions of “primary” particulates in this size range (i.e., emissions which are already present as particulate matter at the time they are emitted to the atmosphere), but also precursor pollutants which form fine particulate matter after undergoing reactions in the atmosphere when designing CWS implementation measures and tracking progress.
- At sites across Canada, levels of PM<sub>2.5</sub> are below the CWS of 30 micrograms per cubic metre (ug/m<sup>3</sup>) most of the time. Data indicate that levels of PM are generally higher in eastern Canada (east of Manitoba) compared to western Canada. In eastern Canada, levels are highest at urban and ‘point-source influenced’ sites such as Toronto, Windsor, Egbert, and Quebec City. Although levels of PM<sub>2.5</sub> are below the CWS most of the time, it is likely that we are not reporting all occasions on which the CWS is exceeded, as a result of several factors including the sampling schedule for many PM measurement stations across Canada. Changes underway to the National Air Pollutant Surveillance network (especially the move to continuous monitoring technology) will partially aid in addressing this.
- Open sources of PM<sub>2.5</sub> (e.g., dust, forest fires, and agricultural processes) account for more than 70% of PM<sub>2.5</sub> emissions in Canada. ‘Closed’ sources (e.g., industrial, non-industrial fuel combustion, transportation, power generation, and other sources) account for the other 30% of PM<sub>2.5</sub> emissions.
- Precursor gases contribute significantly to secondary formation of PM. The most significant precursor gases are sulphur dioxide, NO<sub>x</sub> and ammonia. The extent to which VOCs contribute to PM<sub>2.5</sub> formation is unknown.

- Long-range transport of PM<sub>2.5</sub> and its precursors is significant in several areas of Canada, including the Windsor-Quebec City corridor through to eastern Canada, and the Lower Fraser Valley.

### **3.3.2 PM<sub>2.5</sub> Atmospheric Science**

- Significant progress has been made in the last several years in the atmospheric science of particulate matter, especially with respect to composition, monitoring, source-receptor relationships and modelling. Such information, considered in combination, is beginning to provide guidance to jurisdictions in implementation of the CWS. Additionally, recent Demonstration Projects in Alberta and Quebec carried out to determine background and transboundary influences have provided useful new information for use in such management planning.

### **3.3.3 PM<sub>2.5</sub> Health Effects**

- This standard was set at a level intended to protect human health, although it is recognized that it is not fully protective against all potential health and environmental effects. Science developments since the 1997 Science Assessment Document support the numerical limit, data treatment and deadline for achievement of the current PM<sub>2.5</sub> CWS. Recent science supports the findings of the effects of short-term changes in PM<sub>2.5</sub> air pollution and adverse health effects. There has been a significant amount of research concerning ambient particulate matter, both supporting and strengthening the science base of the existing standard.
- While there is still much to learn about PM<sub>2.5</sub> health effects, especially with respect to the toxicity of its components, toxicological and clinical work has advanced greatly with the advent of new study designs. Epidemiological advances have been provided from various types of study, but are most pronounced in the understanding of groups at risk and the influence of long-term exposure and chronic effects. Addressing the impact of statistical issues in time-series epidemiology is an ongoing project. However, results to-date indicate that the underlying associations observed in these types of study continue to be valid. The increased use of other study designs has lent additional support to the association of PM<sub>2.5</sub> with significant adverse health effects.
- JAICC undertook a peer review process to further define the directions suggested by the new and developing health science information. As a result of this peer review process, JAICC re-confirmed its original recommendations based on the 2003 science reviews.

### **3.3.4 PM<sub>2.5</sub> Environmental Effects**

- Research on the environmental effects of PM (i.e., visibility and materials corrosion) in Canada has been limited to date. The international body of evidence confirms that visibility is significantly reduced under elevated particulate concentrations and that materials corrosion resulting from the dry deposition of PM is of considerable economic impact. However, this evidence is not more significant than when the current CWS was established.

## 4. PM<sub>2.5-10</sub>

### 4.1 Recommendations

There is evidence of health effects due to the coarse fraction; however, the available information is not sufficient to permit a recommendation on whether or not to develop a CWS at this time. JAICC recommends that:

- A plan be developed and initiated by 2005 to address the information gaps for this pollutant, and
- CCME revisit the question of whether or not to develop a CWS for the coarse fraction as part of the 2010 review of the CWS for PM<sub>2.5</sub> and ozone.

JAICC recognizes that current PM<sub>2.5</sub> initiatives will also reduce coarse fraction emissions. JAICC encourages jurisdictions to continue to pursue activities that will address this size fraction of particulate matter between now and 2010.

### 4.2 Findings

- There is evidence of health effects of PM<sub>2.5-10</sub>, however the type and extent of these effects are much different from those of PM<sub>2.5</sub> and ozone.
- There is little evidence of mortality due to this size fraction; most of the reported impacts appear to be related to sublethal respiratory effects. Even so, the evidence is inconsistent; studies of hospital admissions show evidence of effects while clinical studies have sometimes found effects and other times not. Additional information needs to be gathered before health professionals can begin work toward defining a numerical indicator reflecting health risk. One issue is whether particular substances present as part of the particulate matter are causing the observed effects, in which case there could be regional or even source-specific variations to be considered in addressing the health risks.
- It is noteworthy that where effects have been reported (particularly in acute respiratory studies) they occur at PM<sub>2.5-10</sub> concentrations within the range of those currently experienced in Canada.
- A decision on whether to pursue an ambient concentration standard for this size fraction of particulate matter will be informed by a variety of decisions by jurisdictions in Canada and abroad:
  - Federal, Provincial and Territorial Environment departments are preparing their CWS implementation plans which will have implications for the management of PM<sub>2.5-10</sub>.
  - As well indications are that the USEPA National Air Quality Objectives will be proposed by the end of 2004 with a final decision on a standard, if any, by the end of 2005.

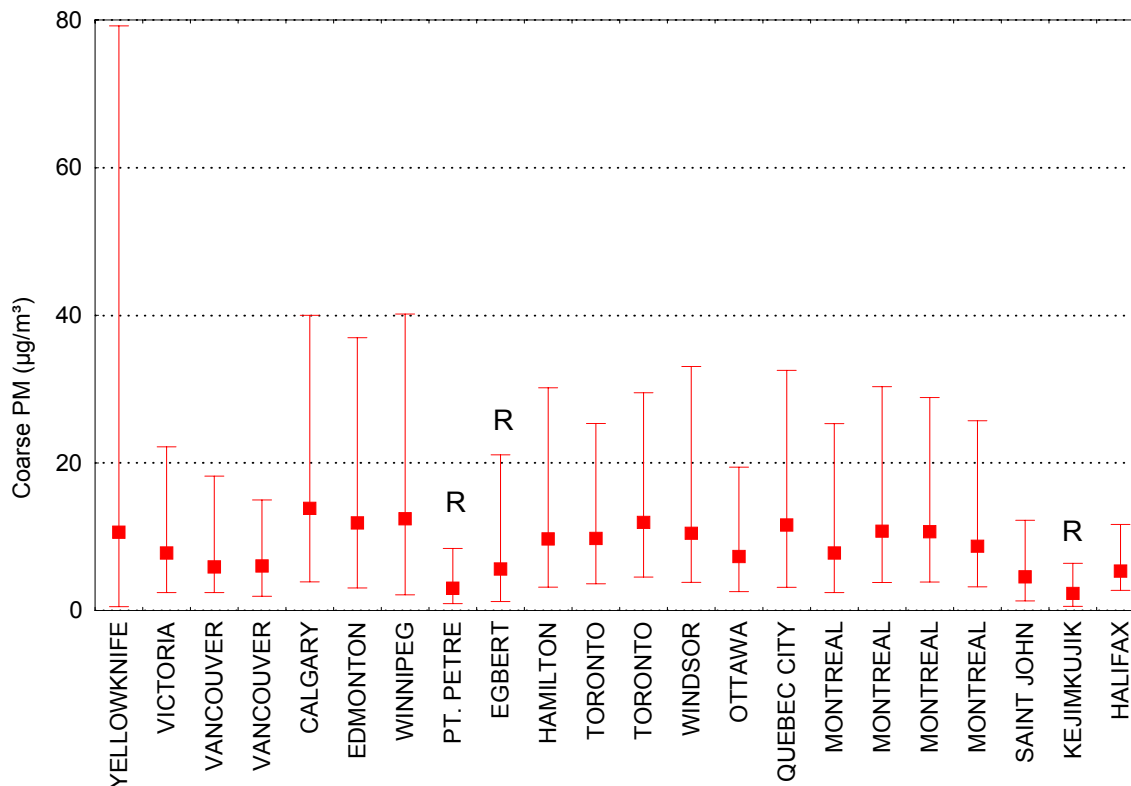
### 4.3 Rationale

#### 4.3.1 Emissions and Ambient Levels

- Most PM<sub>2.5-10</sub> in the atmosphere originates from direct PM<sub>2.5-10</sub> emissions, the primary anthropogenic sources being open sources, including paved and unpaved roads, agriculture, construction and prescribed burning. Industrial sources such as cement plants and transportation sources also emit significant quantities of PM<sub>2.5-10</sub>.

- Some PM<sub>2.5-10</sub> in the atmosphere is also of secondary origin, being formed through transformation processes in the atmosphere from the same precursor pollutants that contribute to the secondary formation of PM<sub>2.5</sub>: NO<sub>x</sub>, VOCs, sulphur dioxide, and ammonia.
- Current ambient levels of PM<sub>2.5-10</sub> at locations across Canada are summarized in Figure 1 below.

**Figure 1: Ambient Five-year Mean, 10th and 98th Percentile PM<sub>2.5-10</sub> Concentrations at Canadian Dichotomous Sampler Sites.** (Data are from the period 1996-2000, except for Halifax which is for 1994-1996. The data are from urban sites except for the three rural sites marked with an "R".)



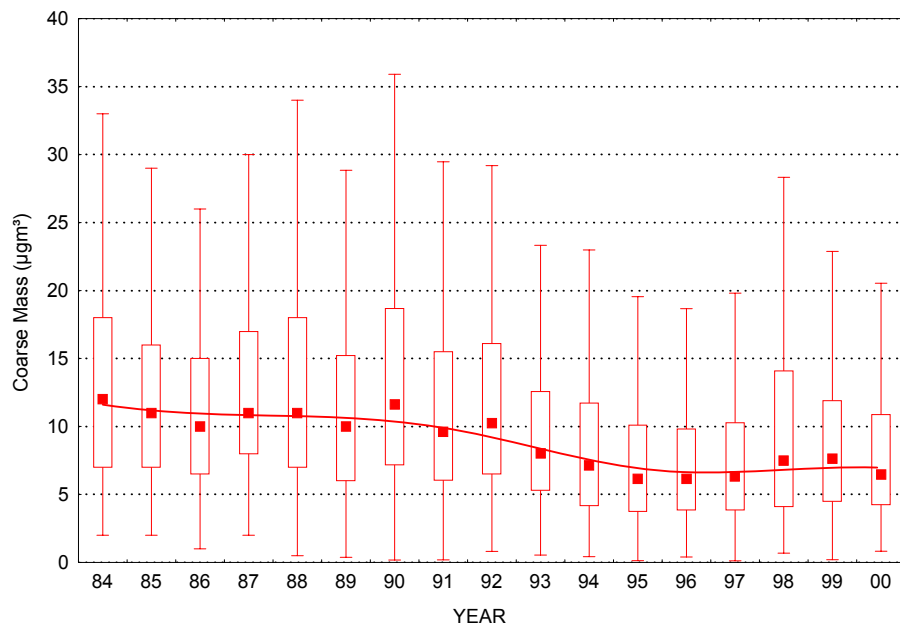
The projected growth rates in PM<sub>2.5-10</sub> emissions nationally between 1995 and 2015/2020 are:

	<u>By 2015</u>	<u>By 2020</u>
Industrial sources (not including open sources)	72%	87%
All Sources (with open sources included)	45%	60%

[Note: There are significant regional variations in the projected growth rates (e.g., for non-open sources in Newfoundland (589%) and NWT/Nunavut (852%); whereas Saskatchewan and New Brunswick show a decline.)]

Figure 2 below shows a generalized view of long-term ambient coarse fraction levels in Canada. Levels were relatively flat in the 1980's, dropped in the early 1990's and have levelled out in recent years.

**Figure 2: Trend in Canadian Composite Annual Mean Ambient  $PM_{2.5-10}$  Levels, 1984 - 2000** (Source: Environment Canada, *Atmospheric Science Of Particulate Matter: Update In Support Of The Canada-Wide Standards For Particulate Matter And Ozone, Final Draft, March 2003*)



#### 4.3.2 $PM_{2.5-10}$ Health Effects

- $PM_{2.5-10}$  is associated with a number of morbidity endpoint effects, in particular effects in the upper respiratory tract, with such symptoms as cough, phlegm, rhinitis and indications of asthma. While the most robust studies are those that examine respiratory symptoms in groups of asthmatics (i.e., clinical studies), additional support for this type of effect is provided by studies of respiratory hospital admissions (population studies). The reported effects occur at  $PM_{2.5-10}$  concentrations currently experienced in Canada.
- Overall, the evidence of a role for  $PM_{2.5-10}$  in increased incidence of mortality is not compelling. Though a small number of epidemiological studies have noted an increased risk of mortality for this PM size fraction, most studies have not. While it is unclear why there is such a dichotomy, some of the authors of these studies have speculated that the effects may be attributable to the presence of biogenic materials, or of metals from local industrial sources. Additionally, studies, which appear to indicate an effect, are largely sited in locations with hot and arid conditions and may have limited applicability in Canada. Uncertainty as to the existence of an association is compounded by ambient measurement problems for this size fraction, and the small number of studies available.

#### 4.3.3 $PM_{2.5-10}$ Environmental Effects

- $PM_{2.5-10}$  causes adverse effects, particularly near major sources, on vegetation and materials/structures, and contributes to visibility impairment during episodes.

## **5. ECONOMIC ANALYSIS**

### **5.1 Recommendations**

JAICC recommends that all work in support of future reviews of the existing and any new proposed Canada-wide Standards makes use of the improved tools and data available for the conduct of economic analyses.

### **5.2 Considerations**

- The emerging economic evidence does not, in itself, make any predictions as to whether the CWSs should be revised. All relevant new economic and scientific evidence must be considered in the next round of economic analysis.
- In evaluating any potential new standards, a comprehensive economic analysis must be performed in which the costs and benefits for various scenarios should be examined and compared.
- Particular attention should be focussed on the selection of appropriate risk descriptors taking into account the latest advances in this field, including such developments as the reanalysis of epidemiological studies conducted using the GAM and new information developed from studies conducted using other methods.

### **5.3 Rationale**

- Progress in economic analysis has been made since the CWSs for PM and ozone were signed in June 2000. Recent initiatives include exploring various tools and assessment of data needs for conducting improved costs analysis, improving the Air Quality Valuation Model for benefits and valuation work, and developing a framework for competitiveness analysis. The work being done will contribute significantly toward improving the knowledge for PM and ozone CWSs.
- However, at this point the emerging economic evidence does not, in itself, make any predictions as to whether the CWSs should be revised. The new economic evidence must be considered within a comprehensive economic analysis of potential new standards, in which costs and benefits for potential scenarios will be examined and compared.
- Efforts to improve the quantitative information and economic analysis are continuing. The best available information will continue to be used to support the CWSs.

## **PART B – 2005 REVIEW OF THE STANDARDS**

### **1.1 Recommendation**

The scope of the 2005 review was to provide, in 2004 and 2005, any technical and socio-economic analysis necessary to support CCME recommendations to “revise or supplement the PM and ozone CWSs as appropriate for year 2015.” Given that the recommendation from the 2003 science review is that “the existing Canada-wide Standards for PM<sub>2.5</sub> and Ozone should be retained and implemented as planned by 2010”, and since no alternative levels or forms have been proposed for the Standards, JAICC concludes that no additional analysis of the technical feasibility or socio-economic impact of alternatives is required and recommends that CCME retain the existing Standards in their current form for the year 2015.

### **1.2 Rationale**

The CWSs for PM and Ozone include requirements for their review in 2005 and 2010. As noted above, the requirement relevant to the 2005 review states the CWSs will be reviewed as follows:

by the end of year 2005, complete additional scientific, technical and economic analysis to reduce information gaps and uncertainties and revise or supplement the PM and ozone CWSs as appropriate for year 2015; and report to Ministers in 2003 on the findings of the PM and ozone environmental and health science, including a recommendation on a PM<sub>10-2.5</sub> CWS.

JAICC finalized the science review in December 2003. A subsequent peer review process was undertaken to further define the directions suggested by the new and developing health science information. As a result of this peer review process, JAICC re-confirmed its original recommendations based on the 2003 science reviews.

The two key recommendations of the 2003 science review are:

- for PM<sub>2.5</sub> and Ozone:  
The existing Canada-wide Standards for PM<sub>2.5</sub> and Ozone should be retained and implemented as planned by 2010
- for the coarse fraction (PM<sub>10-2.5</sub>):  
There is evidence of health effects due to the coarse fraction; however, the available information is not sufficient to permit a recommendation on whether or not to develop a CWS at this time

In addition, it was observed that measures undertaken by jurisdictions to achieve the CWS for PM<sub>2.5</sub> are expected to yield reductions in ambient levels of the coarse fraction, but this will only be verifiable as PM<sub>2.5</sub> emissions reductions are implemented over the next several years.