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International Air Quality Advisory Board. Progress Report to the International Joint Commission. 23, April 1997

International Air Quality Advisory Board

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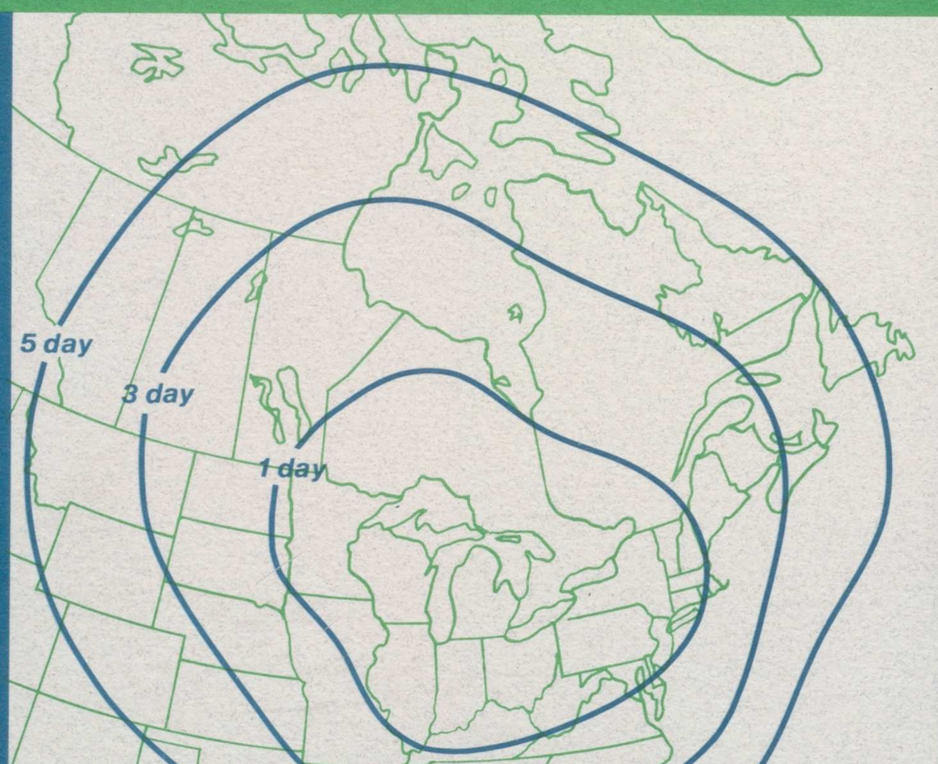
Progress Report 23
to the International Joint Commission



Airshed of the Great Lakes

April 1997

International Joint Commission
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INTERNATIONAL AIR QUALITY ADVISORY BOARD

Progress Report 23

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Acronyms

AELs	alternative (higher) emissions limits
AIRS	Aerometric Information Retrieval System
ANC	Acid Neutralizing Capacity
AOI(s)	Areas of Influence
AOV(s)	Areas of Violation
AQO	Air Quality Objective
ARB	Air Resources Board
CAAA	Clean Air Act Amendments
CASAC	Clean Air Scientific Advisory Committee
CASTNet	Clean Air Status and Trends Network
CEC	Commission for Environmental Cooperation
CEPA	Canadian Environmental Protection Act
CFCs	chlorofluorocarbons
CO_2	carbon dioxide
COP	Conference of Parties
DDT	Dichloro-Diphenyl-Trichlorethane
ECTSIG	Eastern Canadian Transboundary Smog Issue Group
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
FERC	Federal Environmental Regulation Commission
FPAC	Federal/Provincial Advisory Committee
FY	Fiscal Year
IAQAB	International Air Quality Advisory Board
IPCC	Intergovernmental Panel on Climate Committee
JPAC	Joint Public Advisory Committee
LNB	low NO_X burner
LRTAP	Long-Range Transboundary Air Pollution
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NAFTA	North American Free Trade Agreement
NAPAP	National Acid Precipitation Assessment Program
NARSTO	North American Research Strategy for Tropospheric Ozone
NAWQA	National Water Quality Assessment Program
NESCAUM	Northeastern States for Co-ordinated Air Use Management
NOAA	National Oceanic and Atmospheric Administration
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
NRC	National Research Council
NSMP	National Smog management Plan
NTN	National Trends Network
OAQPS	Office of Air Quality Planning and Standards

OTAG	Ozone Transport Assessment Group
OTR	Ozone Transport Region
PM	particulate matter
RAMPs	Regional Air Management Partnerships
RAP(s)	Remedial Action Plan(s)
RIPs	Regionally Integrated Plans
ROSA	Regional Ozone Study Area
RSMP	Regional Smog Management Plans
SO_2	Sulphur dioxide
SO_4	Particulate sulfate
SOMA	Sulphur Oxides Management Area
TSP	Total Suspended Particles
UAM	Urban Airshed Model
UK	United Kingdom
USGS	U.S. Geological Survey
VOCs	volatile organic compounds
WGAQOG	Working Group on Air Quality Objectives and Guidelines
WGSMC	Working Group on Sound Management of Chemicals
WHO	World Health Organization

1.0 OVERVIEW

In this 23rd Progress Report, as in the last several reports, the International Air Quality Advisory Board considers the sources, ambient concentrations, effects and available management tools for what are often called the primary or criteria pollutants (sulphur dioxide (SO_2), nitrogen oxides (NO_X), particulate matter (PM), and ozone). Concerns regarding carbon dioxide, a greenhouse gas, and volatile organic compounds (VOCs), are also reviewed.

Sulphur dioxide and sulphates have a role in acid rain. While sulphur dioxide emissions have been reduced significantly in the United States and Canada over the last 15 years, the associated environmental insult has not been eliminated.

Nitrogen oxide emissions in North America, the other principal component of acid rain, notwithstanding increased controls over the past several years, and more stringent requirements in the next several, are predicted to increase after the turn of the century. Precipitation in sensitive portions of our two countries remains sufficiently acidic to preclude ecosystem recovery, and indeed to perhaps do further damage. The Board offers to provide a more extensive review of this situation in subsequent reports.

Sulphate also forms a significant portion of fine particulate matter (diameter less than 2.5 microns), which is associated with loss of visibility, particularly noticeable in park lands, and respiratory distress in humans. This size of particle is the subject of regulatory activity and reflection in both countries.

Nitrogen oxides are a precursor, along with VOCs, to the formation of ozone, a pollutant which reaches concentrations in various transboundary regions producing a discernable negative effect on the otherwise healthy individuals engaging in vigorous exercise, and pronounced distress in the sensitive portion of the population.

In the early 1970's, the same numerical goal for ambient ozone was established in both the United States and Canada (.08 ppm over one hour). Subsequently a standard of .12 ppm over one hour was introduced in the United States. During this time, however, the United States has been more aggressive in the development and implementation of control programs to attempt to address excess ozone concentrations.

In recognition of the negative effects associated with such concentrations, the U.S. Environmental Protection Agency is now considering an ozone standard (.08 ppm over 8 hours) closer to, but not identical with, the current Canadian objective. In response to established health impacts, Canada may further tighten its .08 ppm/one hour objective.

With regard to climate change, the accumulated weight of evidence indicates that human activities are contributing to significant change in the global climate, with definite implications for humankind. Carbon dioxide is a principal greenhouse gas; much of its production is the result of human activity.

Indeed, nitrogen oxides and carbon dioxide (CO_2), and, to a lesser extent, sulphur dioxide, are associated with transportation (as is VOC production) and electrical energy generation (particularly coal fired utilities) sectors. Figure 1 is a simplified illustration of the sources and products of these pollutants in the environment.

It is clear that further reduction in emissions from these two sectors, and others, will be necessary if ecosystem damage is to be curtailed and ecosystem quality is to be preserved and sustained.

Consideration also is given to a number of regional, largely bilateral air management initiatives, ranging from co-operation between Washington State and the province of British Columbia, to transboundary efforts in the Northeastern States and the Atlantic Provinces. The effectiveness of the Paso del Norte Task Force in the El Paso Texas/Cuidad Juarez Chihuahua bilateral region, other United States/Mexico initiatives and the work of the Commission for Environmental Co-operation are also examined.

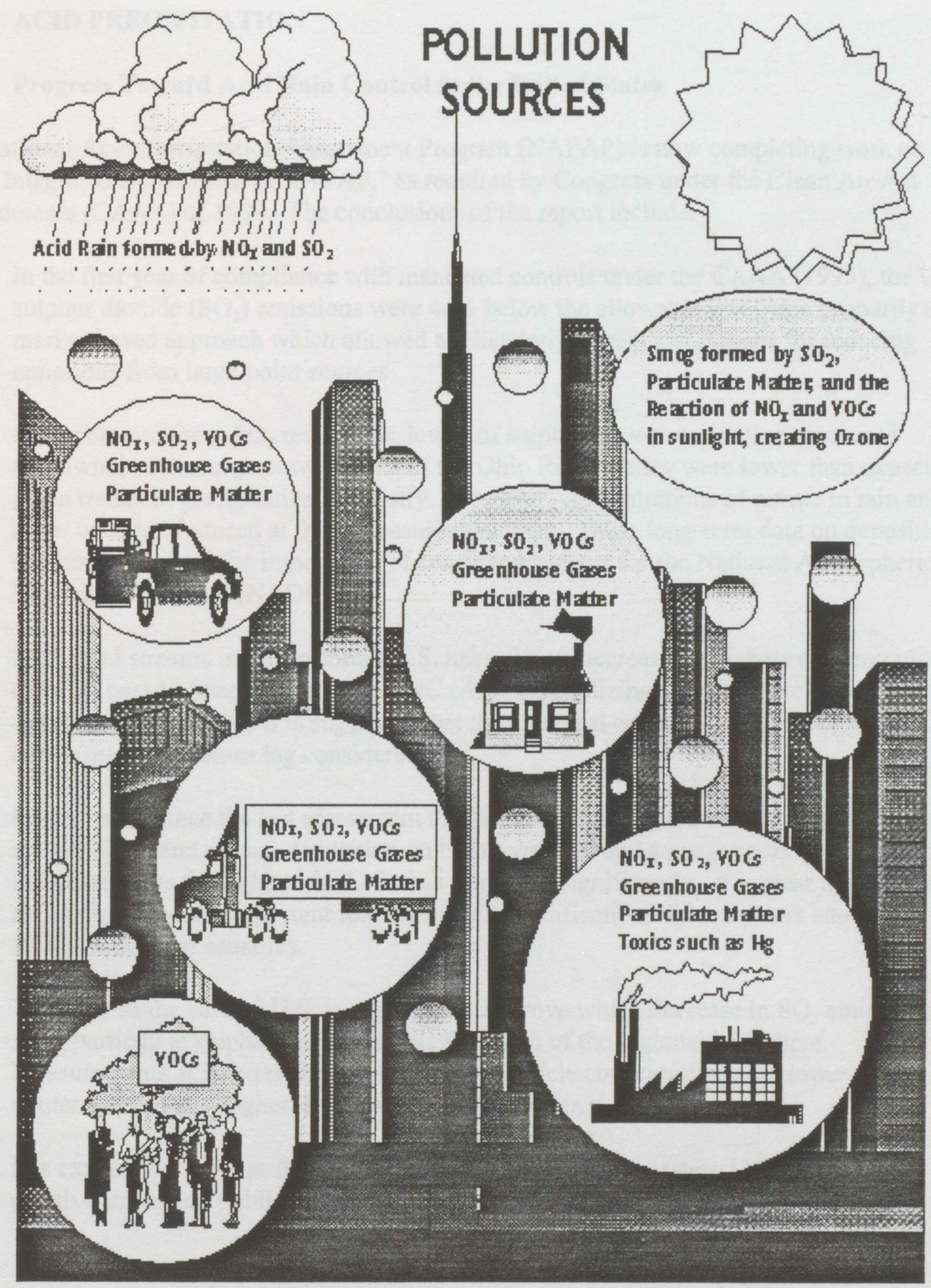


Figure 1. View of Pollutant Sources and Effects

2.0 ACID PRECIPITATION

2.1 Progress Toward Acid Rain Control in the United States

The National Acid Precipitation Assessment Program (NAPAP) is now completing work on the "1996 Integrated Assessment of NAPAP," as required by Congress under the Clean Air Act Amendments (CAAA) of 1990. The conclusions of the report include:

- In the first year of compliance with mandated controls under the CAAA (1995), the U.S. sulphur dioxide (SO_2) emissions were 40% below the allowable level, due primarily to a market-based approach which allowed application of least-cost options for reducing emissions from large point sources.

- In response to these SO_2 reductions, levels of sulphate in wet deposition measured downwind of the large power plants of the Ohio River Valley were lower than expected, given trends in precipitation chemistry. However, concentrations of nitrate in rain and snow were not reduced at these measurement sites. These long-term data on deposition chemistry point up the importance of continued support for the National Atmospheric Deposition Program (NADP).

- Lakes and streams in the northeast U.S. have shown decreasing sulphate concentrations over the past 15 years, but pH and ANC (Acid Neutralizing Capacity) measures have not changed significantly. It is suggested that the chemical and biological responses to decreases in emissions lag considerably.

- In the period since the last assessment (1990), knowledge of the effects of nitrogen species (NO_2 and others) deposition on both terrestrial and aquatic ecosystems, especially in upland areas throughout the U.S., has improved significantly. It is clear that nitrogen deposition plays an important role in episodic acidification of freshwaters and in the eutrophication of estuaries.

- Visibility in the eastern U.S. is expected to improve with a decrease in SO_2 emissions, since particulate sulphate is responsible for much of the regional haze there. Measurements at 13 sites show that sulphate particle concentrations are lower in the winter and fall and higher during spring and summer.

- It is expected that the reduction of sulphate particles in the eastern U.S. will have a positive impact on public health.

2.2 Need for Continuing Support of the National Atmospheric Deposition Program/National Trends Network (NADP/NTN) by the United States Geological Survey (USGS)

For nearly 20 years, the NADP/NTN has provided scientific information on spatial and temporal changes in the chemistry of precipitation throughout the nation. The USGS provides more than half of the total costs for coordination and data management, as well as all sample collection and chemical analysis costs for about 70 of the nearly 200 monitoring sites in the network.

This USGS ongoing commitment has guaranteed a stable financial platform from which nearly 100 other organizations have been able to build. Eleven (11) other federal agencies, along with 70 universities and state agricultural experiment stations, the Canadian government, and nine private companies provide additional financial support to the NADP/NTN program.

In the U.S., the amount of precipitation is measured daily at about 4000 weather stations. At 200 sites, weekly determination of the amount and diversity of chemical substances in precipitation are made. This continuous, uninterrupted record represents the only reliable source of critical data and information for:

- Monitoring precipitation chemistry as required under the Bilateral Air Quality Agreement between the Government of the United States and the Government of Canada;
- Verifying the effectiveness of the Clean Air Act Amendments of 1990;
- Determining degradation and recovery of air quality in Class I Wilderness Areas and National Parks;
- Identifying geographical patterns and temporal trends in acid deposition;
- Estimating the atmospheric component of the biogeochemical cycles of important mineral elements;
- Providing data for more than 600 scientific studies of the health of terrestrial and aquatic ecosystems;
- Developing cost-effective recovery plans for estuaries such as Chesapeake Bay;
- Serving more than 500 school and college science-education projects annually throughout the nation;
- Providing industry with data to assess materials damage from chemical deposition.

In the fiscal year (FY) 1998 budget category of the USGS, the funds previously designated for "Acid Rain" (including those that sustain the 70 stations in the NADP/NTN program) have been eliminated and the program merged with the National Water Quality Assessment Program (NAWQA). At the same time, the U.S. Department of Agriculture has proposed adding an 8% administrative charge on the operations of all the stations. These two actions, if implemented in the FY 98 budget cycle, will result in great uncertainty regarding the continued operation of this national, long-term network. Sustaining this unique federal, state, industry and binational cooperative program is important because routine measurement of the chemistry of rain and snow is one of the most cost-effective means of determining the general health of the atmosphere.

Recommendation:

The Board encourages the Commission to seek assurances from the U.S. government that the NADP/NTN network, and its associated consortium, will continue to be supported without any significant reduction in the generated data.

2.3 Trends in Acid Rain Precursors

The components (largely sulphate and nitrate) of what is commonly referred to as 'acid rain' are deposited in both dry and wet forms onto the earth's surface; these two forms require two different measurement technologies. In the United States, wet deposition associated with rain and snow is measured by the NADP, a consortium led by the USGS (see previous discussion).

Dry deposition is not measured directly, but is calculated from measurements of pollutant concentrations in air. Total deposition is determined through a combination of the measurements of wet and dry deposition.

The U.S. Environmental Protection Agency (EPA) has been operating a network of approximately 50 sites since the late 1980's called CASTNet (the Clean Air Status and Trends Network) to measure the dry deposition of ozone, sulphur and nitrogen compounds. This is a rural background network, located to minimize the direct impact of urban areas and individual industrial plumes on the measurements.

The material presented here focuses on seven-year trends for these air concentration measurements from ten of the CASTNet sites closest to the U.S./Canada border (see Figure 2). The time frame was from the fall of 1989 to September 1995.

The graphs (Figures 3, 4, and 5) show that, for the seven year period, sulphur compounds in the rural ambient air near the border have been reduced by about 30%, whereas nitrogen compounds (Figure 6) and ozone (Figure 7) have been reduced approximately 10%. These are direct measurements of the concentrations in ambient air of these gaseous materials. Figure 8 presents the sulphur dioxide concentration data in a different format. Smoothed trend data are

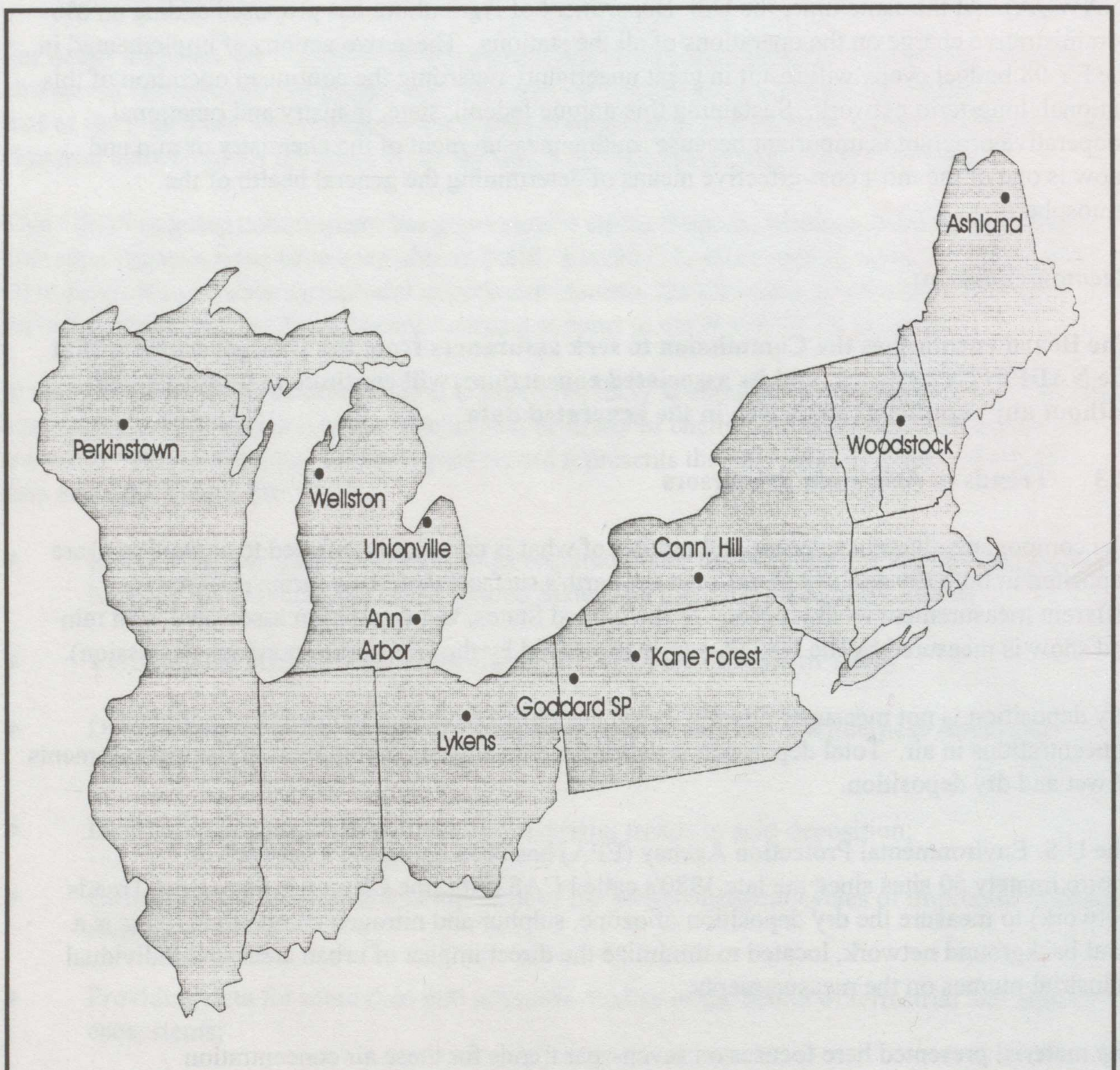


Figure 2. Current CASTNet Sites near the U.S.-Canada Border with a 1989-1995 Trend Record

Figure 3. Change in SO_2 Concentration from 1989 through Sept. 1995
(As percent of mean 1989 site model outputs)

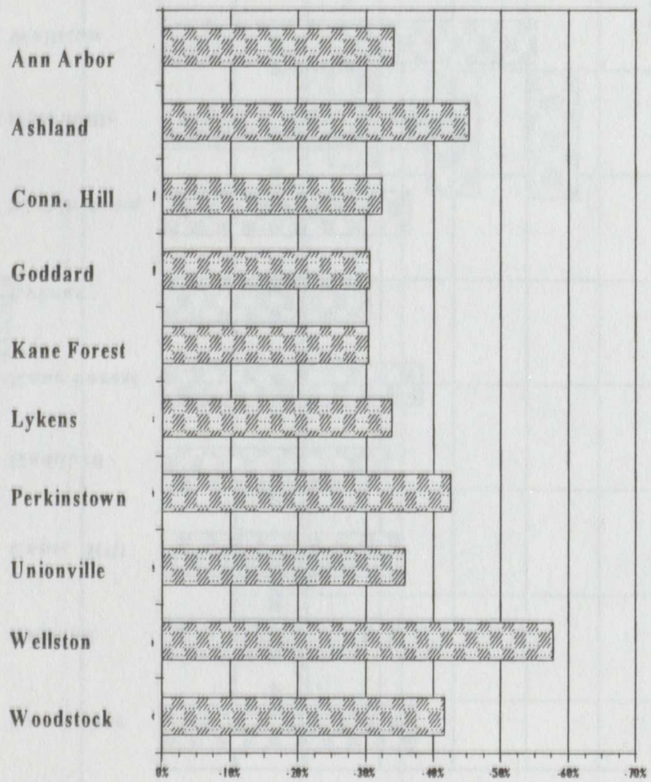


Figure 4. Change in SO_4 Concentration from 1989 through Sept. 1995
(As percent of mean 1989 site model outputs)

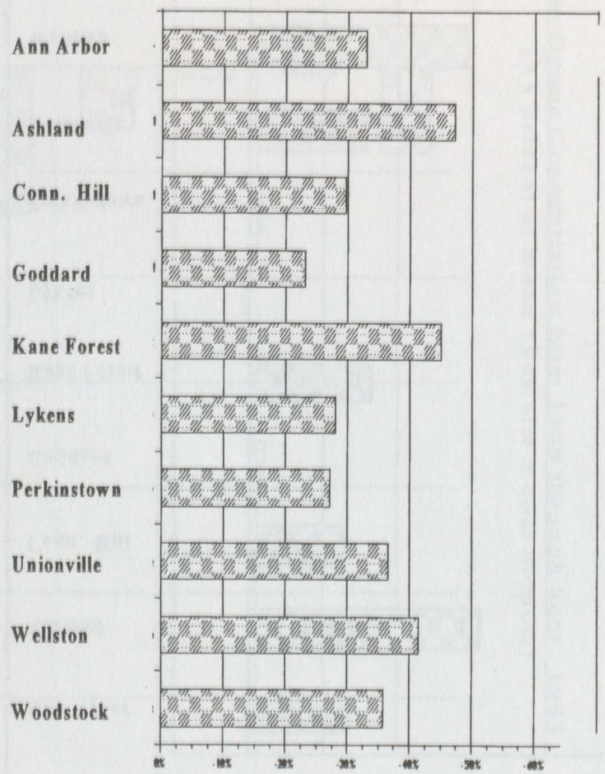


Figure 5.
Change in Total Sulfur Concentration from 1989 through Sept. 1995
(As percent of mean 1989 site model outputs)

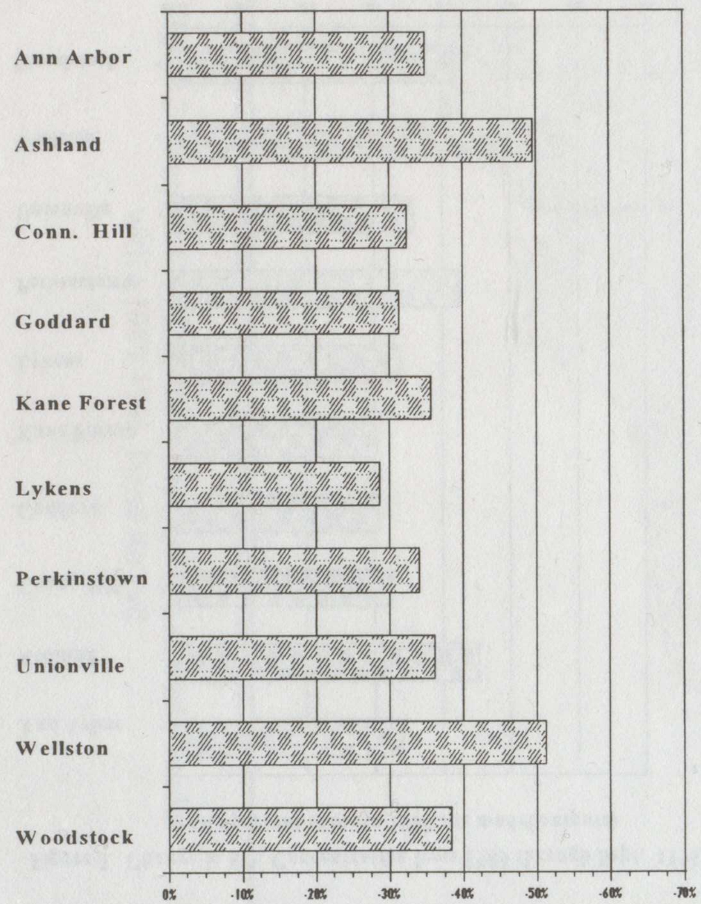
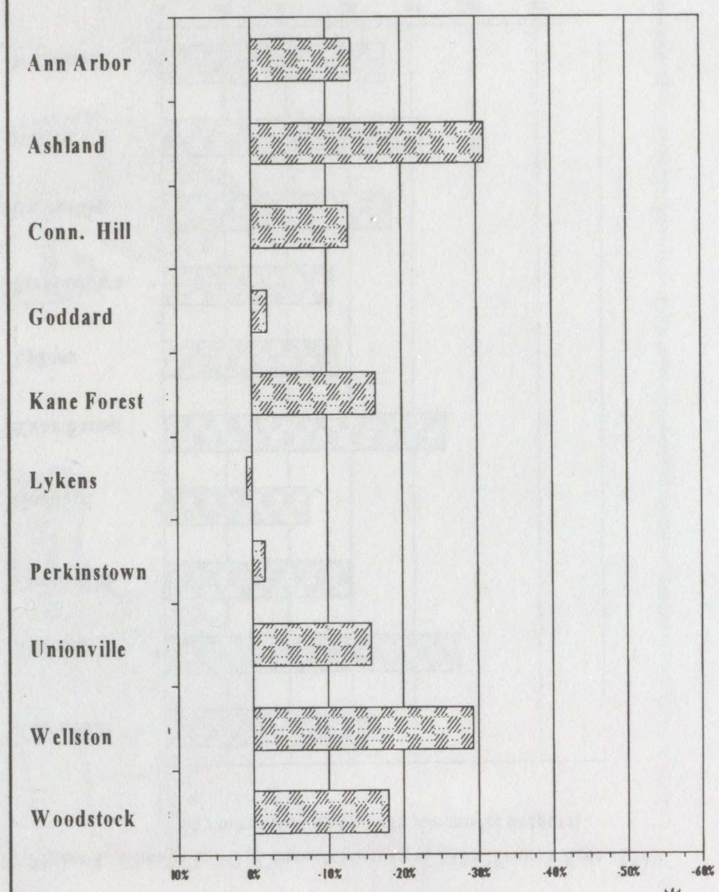


Figure 6. Change in Total Nitrogen Concentration from 1989 through Sept. 1995
(As percent of mean 1989 site model outputs)



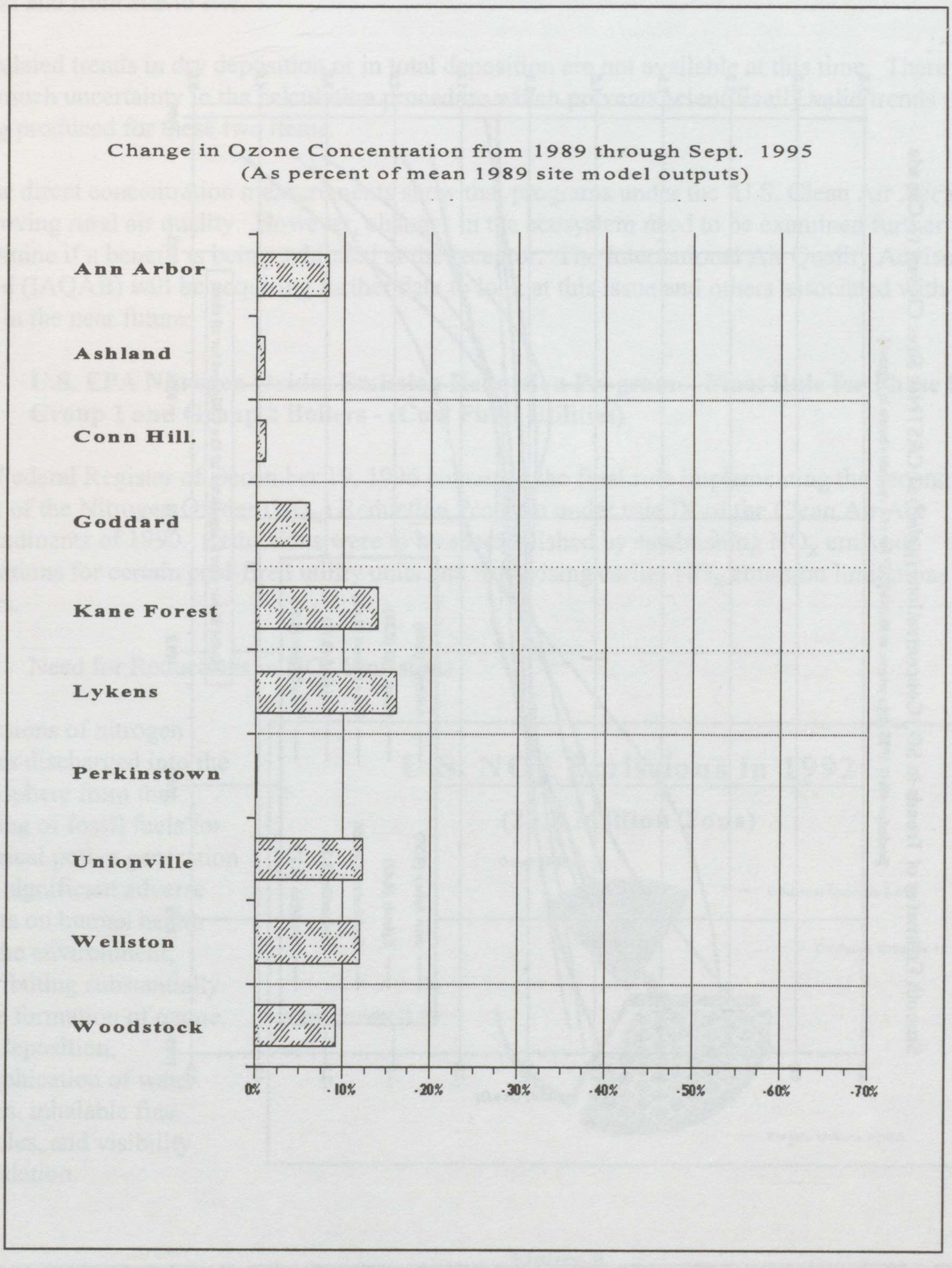
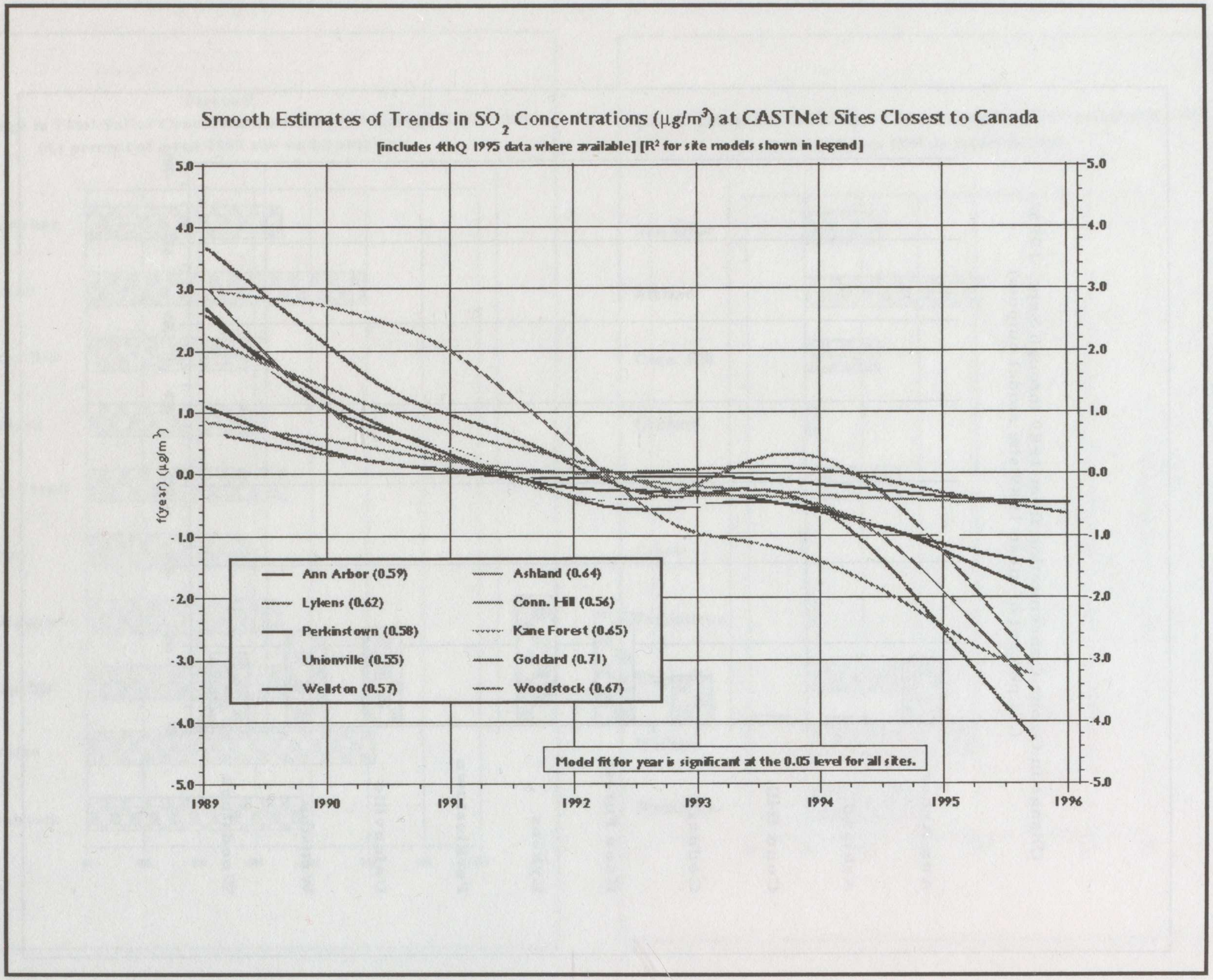

Change in Ozone Concentration from 1989 through Sept. 1995
(As percent of mean 1989 site model outputs)
Ann Arbor
Ashland
Conn Hill.
Goddard
Kane Forest
Lykens
Perkinstown
Unionville
Wellston
Woodstock
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%

Figure 7.



Smooth Estimates of Trends in SO2 Concentrations (µg/m3) at CASTNet Sites Closest to Canada
[includes 4thQ 1995 data where available] [R2 for site models shown in legend]
f(year) (µg/m3)
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
1989
1990
1991
1992
1993
1994
1995
1996
Ann Arbor (0.59)
Lykens (0.62)
Perkinstown (0.58)
Unionville (0.55)
Wellston (0.57)
Ashland (0.64)
Conn. Hill (0.56)
Kane Forest (0.65)
Goddard (0.71)
Woodstock (0.67)
Model fit for year is significant at the 0.05 level for all sites.

Figure 8.

presented for each of the 10 sites. This format shows the variability in the trends across the time period and from site to site.

Calculated trends in dry deposition or in total deposition are not available at this time. There is still much uncertainty in the calculation procedure which prevents scientifically valid trends from being produced for these two items.

These direct concentration measurements show that programs under the U.S. Clean Air Act are improving rural air quality. However, changes in the ecosystem need to be examined further to determine if a benefit is being exhibited at the receptor. The International Air Quality Advisory Board (IAQAB) will be acquiring further data to look at this issue and others associated with 'acid rain' in the near future.

2.4 U.S. EPA Nitrogen Oxides Emission Reduction Program - Final Rule for Phase II, Group 1 and Group 2 Boilers - (Coal Fired Utilities)

The Federal Register of December 19, 1996 contained the final rule implementing the second stage of the Nitrogen Oxides (NO_X) Reduction Program under title IV of the Clean Air Act Amendments of 1990. Reductions were to be accomplished by establishing NO_X emission limitations for certain coal-fired utility units and by revising earlier NO_X emission limitations for others.

2.4.1 Need for Reductions in NO_X Emissions

Emissions of nitrogen oxides discharged into the atmosphere from the burning of fossil fuels for electrical power generation have significant adverse effects on human health and the environment, contributing substantially to the formation of ozone, acid deposition, eutrophication of water bodies, inhalable fine particles, and visibility degradation.

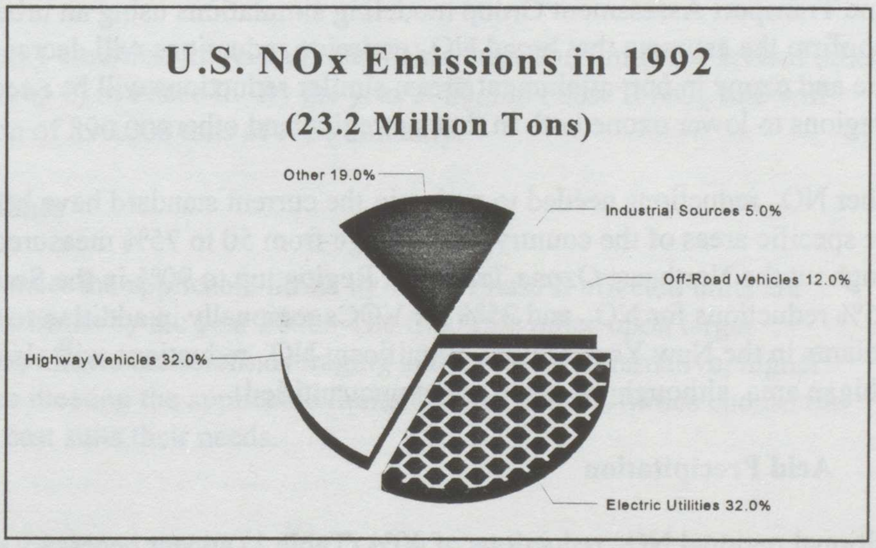


Figure 9.
U.S. Federal Register, December 19, 1996
(Vol. 61, Number 245)-Rules and Regulations

As shown in Figure 9, electric utilities are a major contributor to the nationwide NO_X burden, emitting approximately 32% of total atmospheric NO_X in 1992 (1994 data confirm this distribution). Approximately 90 percent of electric utility NO_X comes from coal-fired power plants.

The reductions achieved by this rule, while substantial, represent only about 5% of total NO_X emissions. The U.S. EPA has determined that additional reductions are needed to maintain compliance with the current ambient ozone standard (120 ppm over one hour), to stabilize or, perhaps, to reduce the number of acidified lakes in the Northeastern States, and to control eutrophication in some regions of the country, such as Chesapeake Bay.

The EPA projections indicate reductions due to rules such as this will be more than offset as the number of sources and emissions from source categories, including transportation, increase. After the year 2002, when implementation of the NO_X control programs is largely complete, growth in source use is expected to continue and NO_X emissions will also increase for the foreseeable future.

2.5 Ozone

With regard to ozone, the EPA has projected that additional regional NO_X reductions of at least 50% (see Table 1) from current levels may be necessary over large portions of the United States to attain and maintain the current ozone ambient air quality standard of .12 ppm over one hour; modeling results indicate that reductions of approximately 75% could be necessary over much of the nation to reduce ozone concentrations to levels below the current standard.

Ozone Transport Assessment Group modeling simulations using an urban airshed model (UAM-V) confirm the estimate that broad NO_X emission reductions will decrease regional ozone, high ozone and ozone in non-attainment areas; similar reductions will be needed in particular subregions to lower ozone both in that subregion and others.

Further NO_X reductions needed to maintain the current standard have been estimated for several other specific areas of the country; these range from 50 to 75% measured against 1990 levels throughout the Northeast Ozone Transport Region, up to 90% in the Southeast and a combination of 75% reductions for NO_X and 25% for VOCs regionally in addition to local reductions of both pollutants in the New York region. Significant NO_X reductions will also be required in the Lake Michigan area, although these are as yet unquantified.

2.6 Acid Precipitation

Additional regional NO_X reductions of 40% (Table 1) appear necessary to mitigate acid deposition effects. Additional 40 to 50% reduction mandated in the current Clean Air Act may be required in the Eastern U.S. to maintain the number of acidified lakes in the Adirondacks at 1984 levels. Without these reductions, the number of acidic lakes are projected to rise by 40% by the year 2040.

Table 1. Estimated Regional Reductions Necessary to Mitigate Various Environmental Effects			
	Ozone	Acid Deposition	Eutrophication
Regional NO_X Reductions Necessary	>50%	>40%	up to 40

Note: No_x reductions achieved from the Final Rule as percentage of total No_x emissions ± 5%

2.6.1 First Stage of the NO_X Reduction Program

Title IV of the U.S. Clean Air Act specifies a two-part strategy to reduce emissions from coal-fired electric power plants. The first stage of the program, promulgated April 13, 1995 would reduce annual NO_X emissions in the United States by over 400,000 tons per year between 1996 and 1999 (Phase I), and by approximately 1.17 million tons per year beginning in the year 2000 (Phase II). These reductions are achieved by coal-fired dry bottom wall-fired boilers and tangentially fired boilers (Group 1).

2.6.2 Second Stage of the NO_X Reduction Program

In developing its requirements for a second stage of the title IV Program U.S. EPA has: (1) determined that more effective low NO_X burner (LNB) technology is available to establish more stringent standards for Phase II, Group 1 boilers (approximately 600 units) than those established for Phase I; and (2) established limitations for other boilers known as Group 2 (wet bottom boilers, cyclones, cell burner boilers, and vertically fired boilers - 145 units), based on NO_X control technologies that are comparable in cost to LNBs.

The final rule sets lower Group 1 emission limits and establishes emission limits for several other types of coal-fired boilers (Group 2) in Phase II. By the year 2000, the Phase II NO_X rule will achieve an additional reduction of 890,000 tons of NO_X annually.

2.6.3 Compliance and Deadlines

Phase I affected units were to meet the applicable limits by 1996; Phase II affected units are required to meet the applicable limits by the year 2000. The final rule relies upon target performance standards, but also allows emissions averaging and the use of alternative, higher emissions limits (AELs) where meeting the applicable limits is unfeasible. Utilities choose the method of compliance which best suits their needs.

2.6.4 Addition of Limited Cap and Trade Option[1]

As a more flexible emissions trading approach, an option allowing a state (or group of states) to petition U.S. EPA to accept an emissions cap and trade program as a substitute for compliance with limits and reductions made final in this rule is available. Under this option, the Administrator can provide relief for boilers from emission limitations established in the final rule subject to a cap and trade program under Title I. The relief is contingent on the Administrator finding that alternative compliance through the cap and trade program will achieve lower total NO_X emissions from the Group 1 and Group 2 boilers in the state (or group of states) than if the new emission limitations remained applicable.

This added flexibility is meant to encourage states and utilities involved in the Ozone Transport Assessment Group region, where approximately 87% of the boilers covered by this rule are located, to move forward on a more cost-effective regional cap and trade program for NO_X reduction.

2.7 The Acid Rain Issue in Canada

The Eastern Canada Acid Rain Program, which began in 1985, has achieved many of its objectives. However, acid deposition continues to have the potential to cause damage to ecosystems in regions of Canada and additional reductions of sulphur dioxide and other acidifying emissions are needed.

2.7.1 Deposition

Wet sulphate deposition has diminished; the area in Canada receiving more than the target of 20 kg/ha/year (kilograms per hectare per year) was reduced by 46 percent in the decade since the early 1980's. Data on the changes in deposition resulting from the 1995 reductions in emissions are not yet available, but model predictions indicate that, by the year 2010, when the provisions relating to acid rain in the U.S. Clean Air Act are fully in place, virtually all of Canada will receive less than 20 kg/ha per year in sulphate deposition.

2.7.2 Environmental Response

There has been positive, albeit slow, improvement in the response of Canada's lakes to the reductions in sulphur dioxide emissions. Sulphate levels are declining in most lakes in Ontario and Quebec, and are stable in Atlantic Canada. Acidity levels remain high, in part because reductions in sulphur dioxide emissions are too recent in many regions for lakes to respond noticeably.

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[1]U.S. Federal Register, December 19, 1996. (Vol. 61, Number 245) - Rules and Regulations

Neither NO_X emissions or nitrate deposition have changed significantly since the inception of the acid rain program. There are disturbing signs that, in time, this situation may undermine some of the benefits achieved through the control of sulphur dioxide emissions.

2.7.3 The Future

The target load of 20 Kg/ha/yr of sulphate in precipitation was an early objective of the Canadian efforts to reduce acid rain. The value was derived from limited data available in the early 1980's, based mainly on the loss of sport fish which occurs at approximately pH 5.3. It was recognized at that time that very sensitive areas would not be protected by this target and that further evaluation would be needed when more information became available. An SO_2 control plan that would lower the maximum deposition in any sensitive area to 20 Kg/ha/yr would mean that most other sensitive areas would receive substantially less wet sulphate deposition.

New information gathered in the past few years has been analyzed to determine the "critical load" for aquatic systems. The critical load is the highest deposition of acidifying compounds that will not cause chemical changes leading to long term harmful effects on the overall structure or function of a specific aquatic ecosystem. In the case of aquatic ecosystems, the critical load determined will be exceeded by up to 10 kilograms per hectare of wet sulphate in parts of central Ontario and southern Quebec. This same area is where sulphate and nitrate deposition most exceeds critical loads for forests. Models predict that forested and aquatic ecosystems in Ontario, Quebec, New Brunswick and Nova Scotia will continue to receive annual deposition amounts in excess of the critical loads.

This deposition rate appears to pose serious risks to forested ecosystems, both in terms of reduced productivity and decreased forest health. Field studies suggest that deleterious effects are already occurring but, for the moment, the symptoms are limited to forests that are subjected to other stresses such as harsh climatic and soil conditions. It appears that reductions in both sulphate and nitrate deposition will be needed to reduce the risk for those forested ecosystems most sensitive to acid deposition. Reductions in either sulphate or nitrate deposition may be sufficient elsewhere. In the case of aquatic ecosystems, the deposition rate after implementation of control programs is expected to result in approximately 10 percent of the lakes in central Ontario remaining acidic. This compares to the 20 percent of lakes in that region which were acidic before the Canadian and American controls on sulphur dioxide. Approximately 20 percent of lakes in Nova Scotia and New Brunswick are also expected to remain acidic, down from 25 percent, and 10 percent of the lakes in southern Quebec; down from 12 percent. As stated above, nitrogen deposition poses an additional threat and it may, in time, undermine the ecological benefits resulting from reductions of sulphur dioxide emissions.

3.0 STANDARDS SETTING

3.1 Overview

The process of setting a standard varies among jurisdictions. The procedure used by the U.S. Environmental Protection Agency (EPA) involves the following steps:

1. Preparation of a Criteria Document[2], which summarizes the existing scientific data base and is reasonably complete. A large number of individuals assist in the preparation and approval of this document.

2. Approval of the Criteria Document by Clean Air Scientific Advisory Committee (CASAC), an arm of the Science Advisory Board of U.S. EPA.

3. Preparation of a Staff Paper by U.S. EPA[3] which attempts to synthesize the data base and interpret major results. It may extend the data base by calculations of populations at risk etc. and it makes a recommendation of possible limits (upper and lower) for a standard. The economic impact of a possible standard is then reviewed within the government.

4. A proposal for a standard is then made by the Administrator of U.S. EPA, comments are accepted and reviewed, and a final proposal after 60 days of input.

5. In October of 1996, the U.S. EPA confirmed its decision not to alter the existing national ambient air standard for nitrogen dioxide, retaining the primary and secondary standard at an identical level of 0.053 parts per million measured on an annual basis. Concerns were raised about the contribution of nitrogen dioxide (NO_2) to acidification in areas such as the Adirondack Mountains and the eutrophication of Chesapeake Bay. However, the Agency determined that these issues were better addressed through the acid rain control programs and ozone reduction plans.

The next review of the standard is required in the year 2001. This process is quite open, with public and lobbying interests intervening at various stages. Minutes of meetings discussing the criteria document, and of the meetings of CASAC, are available for public review.

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[2]Air Quality Criteria for Ozone and Related Photochemical Oxidants. 3 Volumes: Office of Research & Development, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, USA. EPA/600/P-93/004cF. July 1996.

[3]Review of the National Ambient Air Quality Standards for Particulate Matter; Policy Assessment of Scientific and Technical Information: OAQPS Staff Paper. Office of Air Quality Planning & Standards, U.S. EPA. April 1996.

In Canada, the standard-setting process is comparatively closed. A basic document is produced, with usually only a small fraction of the available and relevant data referenced. A recommendation is made by a committee of civil servants representing different provinces. Drafts of proposals are not circulated, and the minutes of discussion meetings are not available. Occasionally discussion as to the basis for a standard is available; in the case of the sulphur dioxide review, this revealed that the committee had no epidemiologist on it, nor anyone capable of evaluating the current epidemiological data. This process is perhaps acceptable if the standard is only a "guideline" with no obligatory action should excessive levels occur.

On a multi-lateral basis, the World Health Organization (WHO) convenes meetings of experts from different countries. A brief review of current relevant data is conducted, with a focus on arriving at a consensus around a numerical standard. The final report is incorporated into the WHO Air Quality Guidelines for Europe. There is no coordinated public input into this process. Other jurisdictions, such as Australia, use a modified WHO process with some public input as discussions of scientific data are held.

3.2 Standards & Guidelines

There are several important points to note about some standards (infringement of which carries a penalty) and guidelines (which may perform an alerting function), currently under discussion.

1. The present epidemiological data on particulate pollution do not indicate a threshold below which no adverse human health impacts occur. A recent mortality analysis of $PM_{2.5}$ (particulate matter) in 6 locations in the U.S.[4] looked specifically for a threshold, but could not demonstrate one. A particulate standard therefore should acknowledge that some adverse effect may well occur in regions within the attainment of the standard. The new WHO guidelines for Europe recognize this.[5]

2. The ozone standard has been much influenced by controlled exposure studies of normal individuals which have shown:

   - that lung function declines progressively over the duration of a six hour exposure:

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[4] Schwartz, J., D.W. Dockery, & L. Neas. Is Daily Mortality Associated Specifically with Fine Particles? J Air & Waste Manage. Assoc. 46, 927-939, 1996

[5] Update and Revision of the Air Quality Guidelines for Europe. Meeting of the Working Group "Classical" Air Pollutants, Bilthoven, The Netherlands, 11-14 October 1994. Regional WHO Office for Europe, Copenhagen. 1995.

- that decline in lung function is accompanied by evidence that lung inflammation has been induced (the magnitudes of the two phenomena are not closely related).
- that the loss of lung function and the increase in bronchial responsiveness induced by ozone may be particularly dangerous to asthmatics; and ozone may increase the penetration of allergens.

- that, with continuous exercise, as in agricultural field work, ozone exerts an adverse effect on lung function at levels below the current Canadian objective[6] of 80 ppb over one hour. This should be acknowledged if the standard is to be relaxed.

- Although the relationship of ozone to mortality is not firmly established, because it is not invariably found, the relationship to morbidity indices such as hospital admissions for acute respiratory disease, is well established.

- Associations between ozone and hospital admissions and emergency visits were emphasized in the proposed U.S. EPA ozone standard.

3. The Canadian guidelines have used the words: "maximum acceptable", "maximum desirable," "maximum tolerable" etc. These words are confusing and might best be avoided altogether. Australian guidelines use the word "*Detrimental*" which is perhaps clearer than the Canadian "*Maximum tolerable*." The U.S. EPA does not use such phrases.

4. In some situations, proper protection requires a very short-term standard. Thus, with very large point source emitters of sulphur dioxide (SO_2)(which do still exist) it is sensible to base a standard on a maximum 10 minute ground level concentration. Asthmatics are very sensitive to SO_2, and have been shown to be immediately affected by concentrations much above 0.25 ppm. They would not be adequately protected by an annual SO_2 standard. The WHO guidelines for Europe noted:

   "It appears reasonable to apply a protection factor of 2 for the protection of public health; a guideline value of 500 micrograms/m^3 (0.2 ppm) of SO_2 for 10 minutes, not to be exceeded, is recommended."

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[6] Brauer, M., J. Blair, & S. Vedal. Effect of Ambient Ozone Exposure on Lung Function in Farm Workers. Am J Respir Crit Care Med 154, 981-987, 1996

The U.S. EPA has not yet recommended a ten minute standard, but it did note the occurrence in the U.S. of a significant number of exceedances of 0.5 ppm for ten minutes, and even a few over 0.75 ppm close to major point sources of sulphur dioxide.

5. A recent detailed analysis of asthma costs in Canada[7] found that there was fairly close agreement with those in the U.S.; higher costs per capita in the U.S. being mainly attributable to more expensive hospital care and drugs.

FINDINGS

1) **As the Board has advocated in past, a bilateral objective should be the development of the same or similar standards for public exposure to air pollutants on either side of a political boundary.**

2) **There are however inherent difficulties in attempting to "harmonize" guidelines with standards. By their very nature "guidelines" are likely to be set at a lower numerical value than standards as the latter carry some penalty if infringed.**

3) **There is no doubt that the processes which precede the promulgation of a standard, as followed by the U.S. EPA, are very important in achieving consensus on the level of protection which should be afforded, and the possible benefits that might follow enforcement of stricter standards. This process should be in the public domain.**

3.3 Health Impacts: Statement on Asthma and Air Pollution

Asthma is a multifactorial disease; in children a genetic predisposition can often be identified through examination of a blood sample. An asthmatic response is presumed to develop after exposure to allergens within the home. Of these, house dust mites are very important in many parts of the world; cats and dogs are universal carriers of protein allergens; and, in tropical climates, cockroaches are probably unavoidable allergens.

The atopic asthmatic child will show sensitivities to some or all of these; in addition, the airway responsiveness to inhaled methacholine (a normal neurotransmitter), or to histamine (an enzyme present in certain cells and stored in the lung) will be increased. Responsiveness also increases to nonspecific stimuli such as cold air.

Adult asthmatics may be atopic, with a response of genetic origin, or may have acquired increased airway responsiveness without being atopic. It is believed that this may occur as a

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[7]Krahn, M.D., C. Berka, P. Langlois & A.S. Detsky. Direct and Indirect Costs of Asthma in Canada, 1990. Can Med Assoc J 154, 821-831, 1996

result of airway infections by viruses but the exact mechanism is unclear. What is known is that asthma with increased airway responsiveness can be acquired in adult life by occupational exposure to a wide variety of substances. The lengthy list includes platinum salts, di-isocyanates, plicatic acid (contained in Western Red Cedar), bakers flour, and many others. Prior atopy does not seem to be a factor for the development of this kind of asthma. Removal from the sensitizing environment leads to reduction in airway responsiveness in about half the people so affected. As far as the role of air pollution is concerned, the following points summarizes the Board's present understanding:

- Asthma prevalence is not increased in countries such as those in Eastern Europe, where there has been exposure to high levels of pollution, particularly sulphur dioxide and large particulate, from uncontrolled coal-burning.
- Asthma exacerbations have been shown to be inflammatory in nature
- Ozone induces lung inflammation at very low concentrations, and the degree of inflammatory response is greater in asthmatics
- Ozone increases airway responsiveness in normal subjects and in asthmatics. This may be of more consequence in the asthmatics in whom it is already increased.
- Levels of ozone pollution have been shown to be related to hospital emergency visits for asthma in Atlanta, Montreal and Mexico City and the state of New Jersey.
- Levels of ozone pollution have been shown to be associated with increased hospital admissions for asthma in Toronto and other parts of Southern Ontario and Buffalo and Albany, New York.
- Ozone increases the effect of an allergen administered to the nose in asthmatic subjects.

Ozone exposures may have declined in some urban areas, but the total population exposed to significant levels of ozone may have increased or remained stationary. In the developing world, wherever automobile usage has increased (as in Bangkok for example) downwind ozone has increased.

There are strong reasons for suggesting that asthmatic subjects may be at increased risk from ozone inhalation. Ozone causes both inflammation in the lung, and enhanced airway responsiveness, and both of these are hallmarks of asthma. While initial studies have shown that the percentage decline in lung function was not much different between the normal population and asthmatics, and it has been inferred that asthmatics were no more sensitive to ozone than non-asthmatics, the decline in function occurs in the asthmatic whose function is already lowered, and is therefore of more significance in terms of that individual's airflow limitation and symptomatology. There is also evidence that asthmatics have a greater inflammatory response to ozone than non-asthmatic subjects.

It is clear from these observations that asthmatics are at greater risk from ozone inhalation than are non-asthmatic subjects. It has recently been shown that prior ozone exposure (to levels of 0.12 ppm in one case) may enhance the penetration, and hence the effect of, a subsequently administered allergen. This has been convincingly shown in detailed experiments on the nasal mucosa.

Increased PM_{10} and $PM_{2.5}$ levels may also be important in the aggravation of asthma, since acidic aerosols have been shown to worsen asthmatics (in Denver), and PM_{10} levels have been shown to be associated with decrements in lung function in children with respiratory symptoms in Utah, and with asthma hospital emergency visits in Seattle. Woodsmoke (typically containing $PM_{2.5}$) has been shown to worsen the status of asthmatic children in the Pacific Northwest. The data are at the moment too nonspecific for any definite dose/response conclusion to be drawn in the case of PM_{10} or $PM_{2.5}$.

PARTICULATE MATTER

Table 2. Comparison of Various National and International Air Quality Tools

U.S. EPA Proposal (1996)	PM_{10} $PM_{2.5}$	Annual mean 50 micrograms/m^3 24-hour maximum 50 micrograms/m^3
United Kingdom (UK) Objective	PM_{10} $PM_{2.5}$	24-hour max 50 micrograms/m^3 as 97^{th} percentile to be achieved by the year 2005. No objective
Canadian		Under consideration
WHO Guideline for Europe (1995)		No numerical standard*

- The WHO 1995 Revisions, instead of suggesting a guideline standards for particulates, provided tables of effects on which different jurisdictions could base their standards.

Table 3. Relationship Between Changes in Concentrations of Air Pollutants and Percentage Change in Human Health Indicator

Health Effect Indicator	% change	Estimated Change in Daily Average Concentration needed for given effect (in micrograms/cubic meter ($\mu g/m^3$))		
		SO_4 (particulate sulphate)	$PM_{2.5}$	PM_{10}
Daily Mortality	5	8	29	50
Hospital Admissions Respiratory Distress	5	8	10	25
Asthmatic B'dilator Use	5			7
Asthma Exacerbation	5			10
PEFR (mean population Change)	-5			200

Table 4. Subjects Per Million Population Affected by 3-Day Exposure to Specific Concentrations of PM_{10}

	Number of Subjects per million population affected by 3 day exposure to PM_{10} at various concentrations		
	$50\mu g/m^3$	$100\mu g/m^3$	$200\mu g/m^3$
Mortality	4	8	16
Hospital Admissions Respiratory Distress	6	12	24
B'dilator use Asthmatics	1400	2800	5600
Asthma Exacerbations	1000	2000	4000

OZONE

Table 5. Comparison of Selected National and International Targets – Ozone

U.S. EPA Proposed Standard	0.08 ppm measured over 8 hours
UK Proposal	0.05 ppm as 8-hour mean, measured as the 97th percentile to be achieved by the year 2005.
Canadian Objective	82 ppb for one hour
WHO Guideline (1987 edition) (1995 Revision)	0.076 – 0.1 ppm for 1-hour 0.05 – 0.06 ppm for 8 hours 0.06 ppm for 8 hours

SULPHUR DIOXIDE

Table 6. Comparison of Selected National and International Targets – Sulfur Dioxide

Current U.S. EPA	0.03 ppm Annual arithmetic mean 0.14 ppm 24 hour mean	
UK Proposal	15 minute mean: 100 ppb measured as the 99.9th percentile, to be achieved by the year 2005	
Canadian: (1971)	Maximum Acceptable:	0.02 ppm Annual 0.11 ppm 24 hour 0.34 ppm 1-hour
	Maximum Desirable:	0.01 ppm Annual 0.06 ppm 24 hour 0.17 ppm 1-hour
WHO 1987 Guidelines (unchanged in 1995)	10 minutes 1 hour	0.2 ppm 0.12 ppm

3.4 Ozone

3.4.1 Formation

Ozone is formed in the presence of sunlight when oxides of nitrogen (NO_X) and volatile organic carbons (VOCs) undergo a series of reactions. NO_X and VOCs have numerous anthropogenic and biogenic sources. NO_X are primarily formed by the incomplete combustion of fossil fuels. Electric power generating plants, particularly those fired by coal, and highway vehicles are the largest single emission sources of NO_X. Figure 9 indicates major NO_X sources in the United States.

VOC emissions, on the other hand, have a significant biogenic component, being produced by trees and other vegetation. However, in many population centers, anthropogenic sources of VOCs are primary contributors, due to industrial and transportation processes with highway vehicles accounting for as much as 75% of the emissions from the transportation sector (Figure 10).

The Air Quality Analysis workgroup of Ozone Transport Assessment Group (OTAG) has studied regional emission sources of NO_X and VOCs. Point sources tend to be tall stack NO_X- rich emissions in non-urban industrial regions, such as the Ohio River Valley, being relatively invariant with time. Major urban metropolitan centers are considered as 'area' sources and are composed of emissions rich in VOCs as well as NO_X. Area sources display a diurnal and seasonal cycle. Primary examples of area sources of NO_X are the Washington-New York Corridor, Chicago, Atlanta, Dallas-Fort Worth, Houston, and St. Louis. Reductions are needed in the emission of both NO_X and VOCs in order to effectively control excessive ozone concentrations.

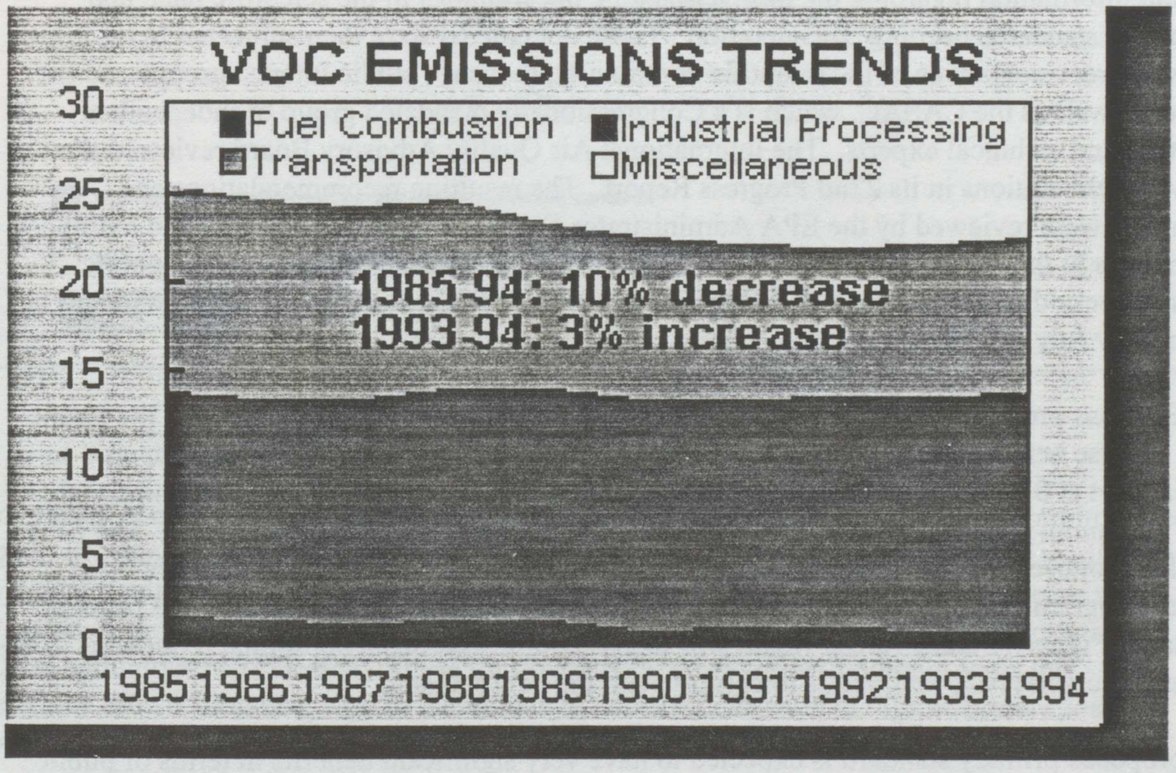

Figure 10.

3.4.2 U.S. EPA Proposed Ozone Standard

Both the primary pollutants (VOCs and NO_X), particularly NO_X, and the secondary pollutant ozone, have been the subjects of on-going monitoring, modeling studies and control under the 1971 Clean Air Act. Under that act, in 1971, EPA set a one hour National Ambient Air Quality Standard for ozone at 0.08 parts per million (ppm). Canada had the same numerical value for its one hour ambient ozone objective (.08 ppm). Thus, the United States and Canada were in harmony on their numerical goal at that time. In 1979, however, the one hour standard for ozone in the United States was relaxed to 0.12 ppm, with one allowable exceedance per year. This remains the current standard.

The EPA is required by the Clean Air Act to review and make any necessary revisions to the National Ambient Air Quality Standards for six air pollutants once every five years. The ozone standard is currently due for review and revision. For this purpose, the EPA compiled an extensive assessment of scientific data pertaining to health and environmental effects associated with ozone. This "criteria document" was then distilled into a "staff paper" containing the most relevant information regarding the primary factors, uncertainties in the scientific data, and alternative standards needing consideration. These documents were then subjected to rigorous review by representatives of the scientific community, industry, public interest groups and the public, as well as the CASAC, which is a Congressionally mandated group of independent scientific and technical experts. The International Air Quality Advisory Board reviewed the CASAC deliberations in its 22nd Progress Report. The resulting recommendations and comments were reviewed by the EPA Administrator Carol Browner who then framed a proposal for changes to the ozone standard. This proposal then was released for an extended public comment period, which concluded on March 12, 1997. A final ruling on the ozone standard is required by July 19, 1997.

The EPA has proposed that the primary ozone standard, which is required to protect the public from adverse health effects, be changed from the current 0.12 ppm 1-hour standard to an 8-hour standard set at 0.08 ppm; an area would be considered in non-attainment when the third highest daily maximum 8-hour concentration, averaged over three years, is above 0.08 ppm. The EPA has also proposed that the secondary standard, which is required to protect the environment, including agricultural crops, national parks, and forests, be changed to agree with the primary standard. Figure 11 shows areas which will likely require significant additional reductions in the ozone precursors, NO_X and VOCs to comply with the new standard.

The proposed primary standard is expected to have very significant benefits in terms of public health and the economy, including the reduction of significant breathing problems (those which involve a 20% reduction in lung function) by 1.5 million cases; the reduction of needed hospital admissions, missed school and work days; fewer instances of restricted activities and emergency

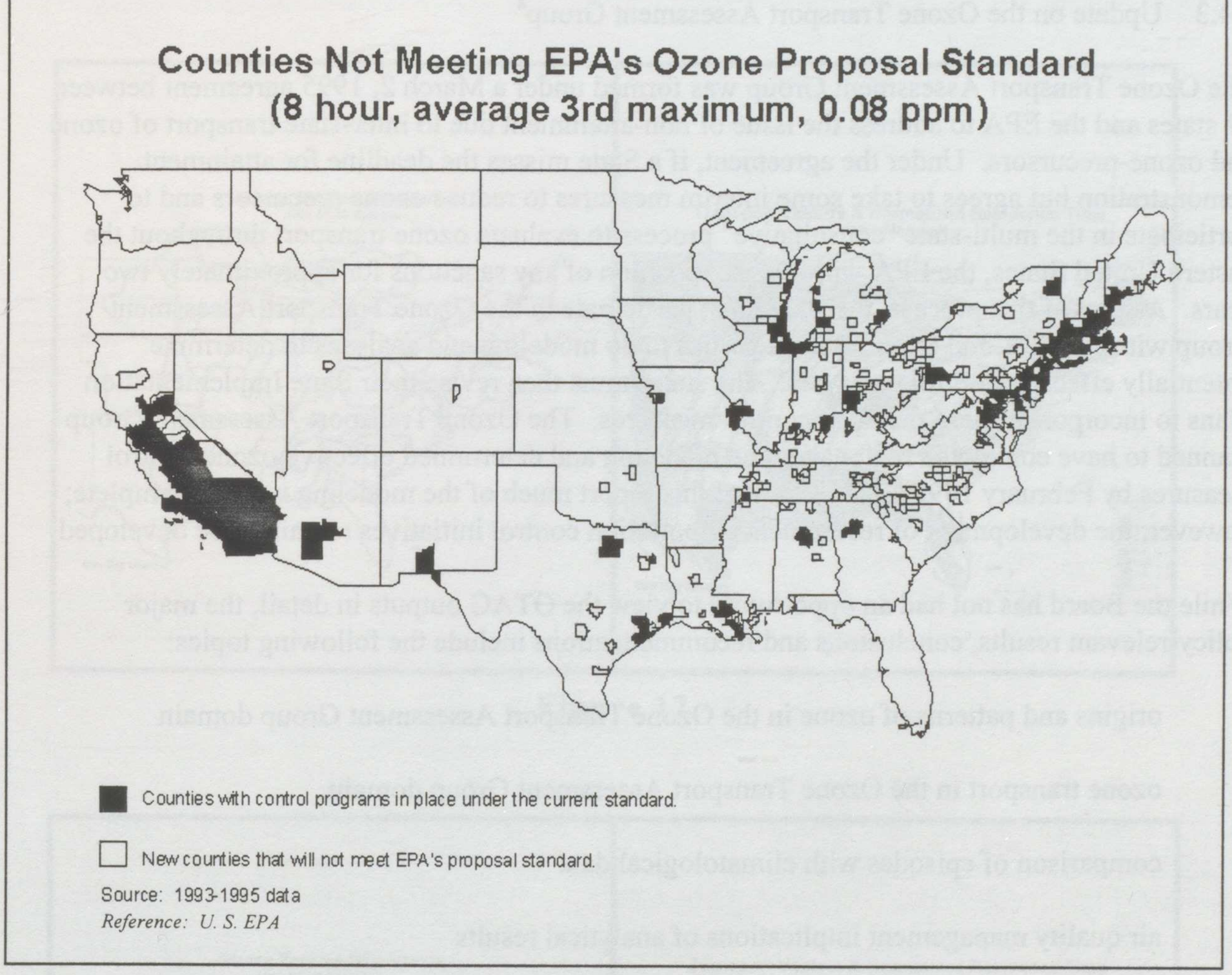

Figure 11.

room visits for respiratory problems; the reduction of childhood illnesses ranging from inflamed lungs to irreversible lung damage; and the reduction of asthmatic episodes requiring medication or medical treatment in children. The proposed secondary standard will greatly increase the protection of the environment, including an expected savings of nearly one billion dollars in reduced agricultural crop losses. These improvements, however, will not eliminate the deleterious effects of ozone, as it will continue to occur on occasion in high concentrations throughout North America.

Attainment of the standard is not required before the year 2004, seven years after promulgation. Furthermore, areas with severe pollution and limited control measures would have the ability to gain a 5 year extension. In these cases, the new standard would not necessarily be attained until 12 years after its promulgation.

3.4.3 Update on the Ozone Transport Assessment Group[8]

The Ozone Transport Assessment Group was formed under a March 2, 1995 agreement between 37 states and the EPA to address the issue of non-attainment due to inter-state transport of ozone and ozone-precursors. Under the agreement, if a State misses the deadline for attainment demonstration but agrees to take some interim measures to reduce ozone precursors and to participate in the multi-state "consultative" process to evaluate ozone transport throughout the eastern United States, the EPA will delay imposition of any sanctions for approximately two years. As part of this process, the state must participate in the Ozone Transport Assessment Group with the EPA and other affected parties to do modeling and analyses to determine potentially effective control measures. The states must then revise their State Implementation Plans to incorporate these resultant control measures. The Ozone Transport Assessment Group planned to have completed regional ozone modeling and determined effective ozone control measures by February 1997. At the time of this report much of the modeling work is complete; however, the development of recommended pollution control initiatives remain to be developed.

While the Board has not had an opportunity to view the OTAG outputs in detail, the major policy-relevant results, conclusions and recommendations include the following topics:

- origins and patterns of ozone in the Ozone Transport Assessment Group domain
- ozone transport in the Ozone Transport Assessment Group domain
- comparison of episodes with climatological data
- air quality management implications of analytical results
- recommendations to foster future analyses

3.4.4 Ozone Transport in the Ozone Transport Assessment Group Domain

The Air Quality Analysis workgroup of the Ozone Transport Assessment Group has completed its background assessment of the current ozone problem and its characteristics. The results are intended to give a broad perspective in which to place the more focused modeling results of individual ozone episodes and control strategy impacts.

The Air Quality Analysis workgroup has modeled the regions of influence of sources of ground level ozone in the OTAG domain. Some of these source regions contribute to excessive ozone concentrations across the Canada-U.S. border. Figures 12, 13, and 14 show the distance ozone could travel in one day based on the data for monitored ozone, meteorological conditions, and

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[8]More detailed information may be obtained on the World Wide Web at "http://capita.wustl.edu/OTAG".

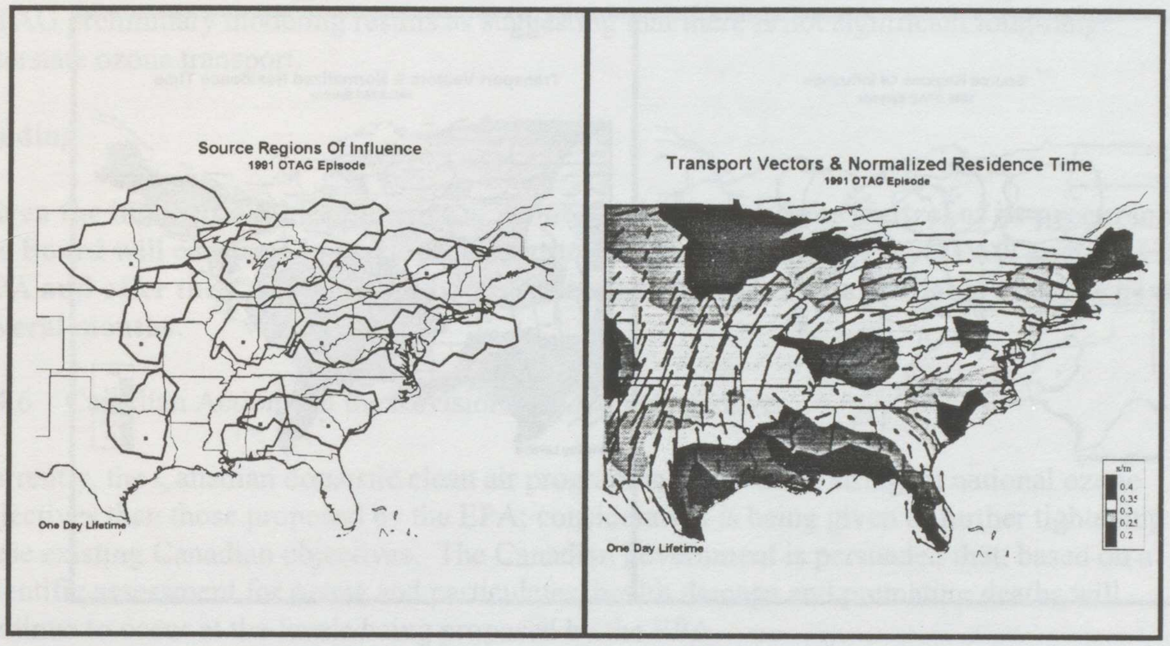

Figure 12.

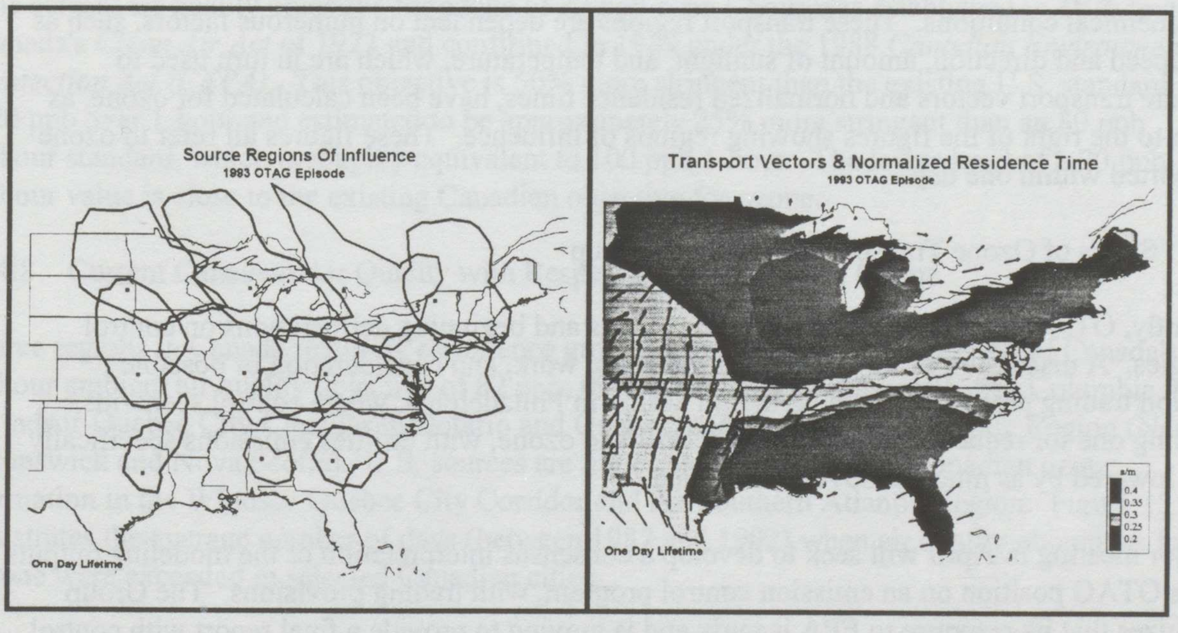

Figure 13.

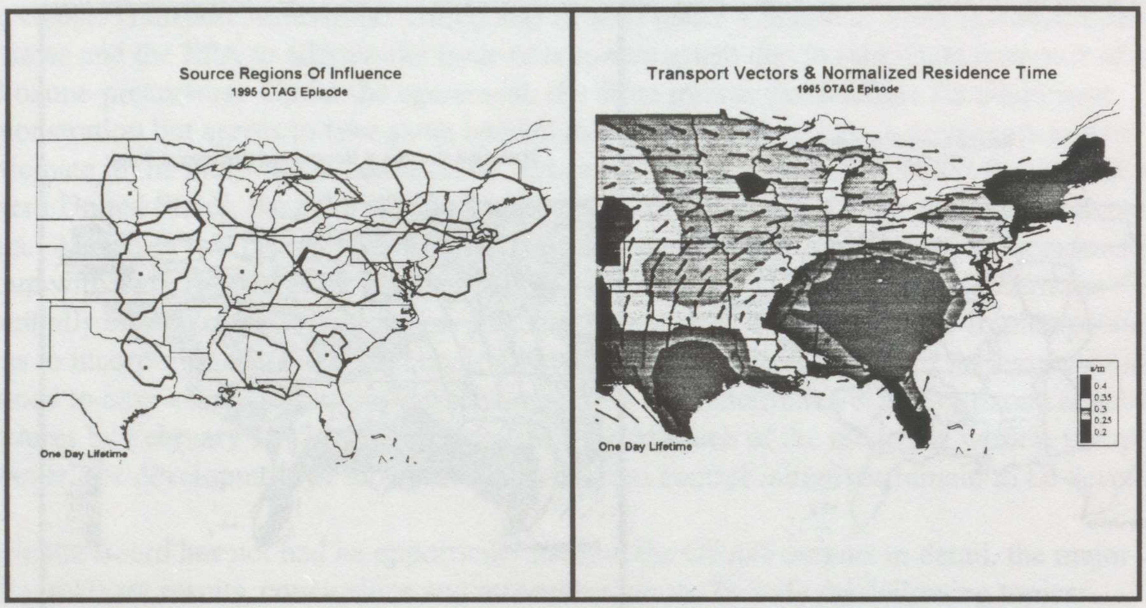

Figure 14.

photochemical conditions. These transport regions are dependent on numerous factors, such as wind speed and direction, amount of sunlight, and temperature, which are in turn used to calculate transport vectors and normalized residence times, have been calculated for ozone, as shown to the right of the figures showing regions of influence. These figures all refer to ozone transported within one day.

3.4.5 Status of Ozone Transport Assessment Group

Currently, OTAG is concluding its modeling efforts and beginning deliberations on control strategies. A discussion of further refined modeling work, and consideration of possible emission trading proposals was held in mid March in Philadelphia, where control scenarios, including one for reductions of 40% in precursors to ozone, with utilities emissions specifically being lowered by as much as 85%, were tabled.

A major meeting in April will seek to develop a consensus interpretation of the modeling outputs and an OTAG position on an emission control program, with trading provisions. The Group recognizes that its response to EPA is tardy and is moving to provide a final report with control recommendations in the near future.

In anticipation of these discussions, the NESCAUM (Northeastern States for Co-ordinated Air Use Management) in March released a report entitled "The Long-Range Transport of Ozone and

Its Precursors in the Eastern United States," which, using a weight-of-evidence approach, calls for 'regional NO_X reductions and local hydrocarbon control to reduce elevated ozone levels through the Eastern United States.' The midwestern interests, in turn, have interpreted the OTAG preliminary modeling results as suggesting that there is not significant long-range interstate ozone transport.

Finding

Given the international importance of ozone attainment and the control of its precursors, the Board will continue to track the evolution of control strategies by OTAG and the U.S. EPA and offer the Commission advice as these strategies become available over the next several months.

3.4.6 Canadian Actions on the Revisions of Ozone Objectives

Currently, the Canadian domestic clean air program includes more stringent national ozone objectives than those proposed by the EPA; consideration is being given to further tightening these existing Canadian objectives. The Canadian government is persuaded that, based on a scientific assessment for ozone and particulates, health damage and premature deaths will continue to occur at the levels being proposed by the EPA.

3.4.7 Current Canadian Ground-Level Ozone Objectives

The current air quality objective for ozone of 82 ppb over 1-hour was established in 1976 under Canada's *Clean Air Act* of 1973 and confirmed in 1989 under the 1988 *Canadian Environmental Protection Act (CEPA)*. This objective is 50% more stringent than the existing U.S. standard of 120 ppb over 1-hour and estimated to be approximately 25% more stringent than an 80 ppb 8-hour standard, which is roughly equivalent to 100 ppb 1-hour. The lower level of a 70 ppb 8-hour value is close to the existing Canadian objective for ozone.

3.4.8 Current Canadian Air Quality with Respect to Ground-Level Ozone

Three regions in Canada regularly experience ground-level ozone levels in excess of Canada's 1-hour ambient air quality objective of 82 ppb; the Lower Fraser Valley in British Columbia, the Windsor-Quebec City Corridor in Ontario and Quebec, and the Southern Atlantic Region (New Brunswick and Nova Scotia). U.S. sources are important contributors to Canadian ozone formation in the Windsor-Quebec City Corridor and the Southern Atlantic Region. Figure 15 illustrates the average number of days (between 1987 and 1992) when air quality objectives for ozone were exceeded in selected Canadian cities.

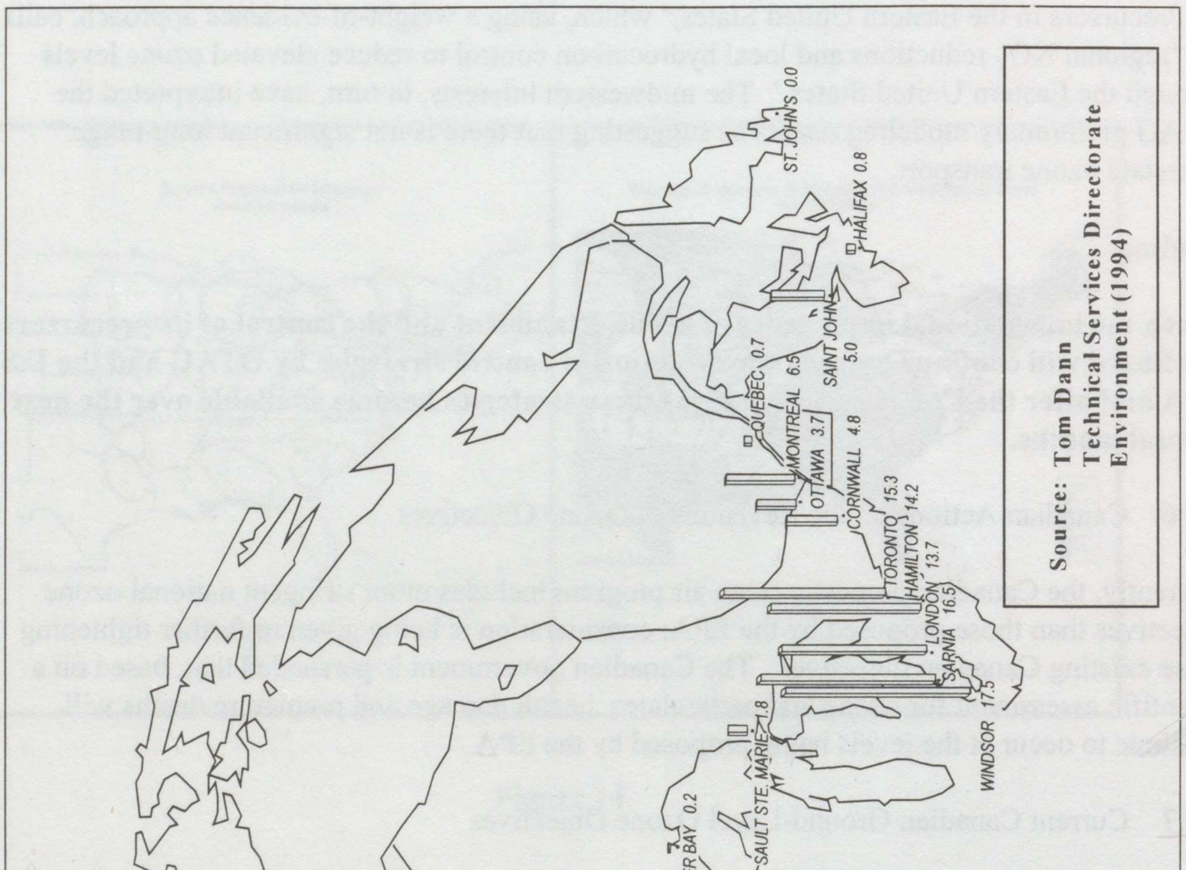

Figure 15. Average Number of Days when 1h Ozone AQO (Air Quality Objective) (82 ppb) was Exceeded (1987 - 1992) at Selected Cities

To control the number of days of excessive ozone concentrations, the Canadian Council of Ministers of the Environment agreed to a three phase NO_X/VOC Management Plan in 1991. The second phase of the Plan is being developed by federal and provincial governments for presentation to Canadian Governments in Fall, 1997. The associated science assessment is comprised of seven scientific reports and a summary for policy makers. Included are a review of the current ozone objectives based on health and vegetation effects, analysis of ambient ground-level ozone and its precursors, monitoring guidelines and implementation, emissions inventories, and modeling of ground-level ozone in the Windsor-Quebec City Corridor, the Southern Atlantic Region and the Lower Fraser Valley of the British Columbia. The NO_X/VOC Science Assessment reports are to be published in the late spring of this year.

The NO_X/VOC Science Assessment Health Objectives reports review the current ozone objectives in Canada based on health and vegetation effects. The conclusions regarding the health impact of ozone are :

- There is clear evidence of associations between daily variations in ozone at ambient concentrations commonly encountered in Canada and acute adverse health effects. These effects range from small lung function changes, increases in symptoms of respiratory discomfort, increases in medication use, increased doctor's and hospital Emergency Department visits, through to increased hospitalizations. The evidence is less clear that there is an association between ozone and increases in mortality.

- In terms of human health, a "safe" level cannot be distinguished. The concentration-response relationship observed in the epidemiological studies provided no evidence of a threshold, monotonically increasing from an ozone concentration as low as 20 ppb up to 95 ppb.

- The vast majority (>95%) of the Canadian population was exposed at least once during 1988 (the year studied) to 1-hour daily maximum ozone levels above 50 ppb, a range associated with adverse health effects in the epidemiological studies. It is clear that these ozone-associated increases in adverse effects are occurring below the current 1-hour Canadian National Ambient Air Quality Objective of 82 ppb. The mean and 95th percentile of the 1-hour daily maximum, averaged over an 11 year period from April to September in the 16-city Canadian study, were 39 and 70 ppb, respectively. Summertime 1-hour maximum ozone levels have been recorded in Canada up to 213 ppb.

- In considering the question of "who is at risk," the clinical studies provide evidence that normal individuals very actively exercising outdoors in summer constitute a susceptible group, due to increased ventilation rates and corresponding increased doses of ozone to the respiratory tract. Children are expected to be more susceptible due to their high activity levels during play and greater exposure at peak outdoor ozone concentrations.

- There is some evidence that asthmatics and "hyper-responders," when under stress of exercise, constitute another group more susceptible than the normal population, though this has been difficult to establish.

- The clinical results for asthmatics, combined with the epidemiological evidence of hospitalizations, emergency room visits and reduced activity days, suggest the likelihood that the subpopulation defined by pre-existing respiratory and lower baseline respiratory function is most susceptible to exacerbation of effects by ozone.

- A principal question for consideration is whether the associations observed between adverse respiratory effects and environmental ozone is causal. The coherence of effects seen in all the studies including the epidemiological studies on hospitalizations, field study results, the controlled chamber/clinical studies, and even mortality lend support to an assumption of causality.

- Strong evidence for the biological plausibility of the hypothesis of a causal relationship between ozone and adverse respiratory health effects is obtained in the findings from animal toxicology studies, supported by clinical studies, of a strong inflammatory response mechanism resulting from ozone exposure. This response is known to occur in asthmatic individuals, who are at increased risk of hospitalizations and other adverse health effects due to exposure to ozone.

In light of these considerations, the Canadian government has urged the U.S. EPA to adopt an 8-hour standard for ozone at the 0.07 ppm level.

3.4.9 North American Research Strategy for Tropospheric Ozone (NARSTO)

The North American Research Strategy for Tropospheric (Ground level) Ozone (NARSTO) program is a public/private partnership, whose membership spans government, the utilities, industry, and academia throughout Mexico, the United States, and Canada. Its primary mission is to coordinate and enhance policy-relevant scientific research and assessment of tropospheric ozone behaviour, with the central goal of determining workable, efficient, and effective strategies for local and regional ozone management.

In accomplishing this goal, NARSTO is charged with establishing and maintaining effective communication channels between its scientific effort and its client community of planners, decision-makers, stakeholders, and strategic analysts. It is also charged with providing a cross-organization planning process, which determines the most effective strategies for scientific investigation. NARSTO coordinates the allocation of financial resources to implement these strategies, and monitors progress of its effort toward fulfillment of its programmatic goal.

3.4.10 Historical Summary

The origins of the NARSTO program stem from a 1991 report, entitled *Rethinking the Ozone Problem in Urban and Regional Air Pollution* (National Research Council (NRC), 1991). In addition to providing a technical description of the chemistry and meteorology associated with tropospheric ozone formation, this report presents a historical overview of North American tropospheric ozone trends and control measures since the 1963 enactment of the original United

States Clean Air Act. It notes that, despite major regulatory programs over the past 20 years, efforts to attain North American ozone standards have been only marginally successful throughout major portions of the continent.

Multiple factors contribute to this slow progress in resolving the ozone issue. Such factors include uncertainties in characterizing local meteorological influences, reaction chemistry, deposition, and the contribution of stratospheric ozone, as well as the present inability to quantify anthropogenic emissions in a satisfactory manner. These are combined with the uncertain but often important role of naturally emitted pollutants and the propensity of ozone and its nitrogen-oxide and organic-compound precursors to travel several hundreds of kilometers in the atmosphere prior to their removal by chemical reaction or deposition. It is noteworthy within this context that only one of these factors – anthropogenic emissions – is subject to control under any practical management – strategy; but the effective and wise design of such control depends heavily on the joint behaviour of the others.

All of these effects vary markedly with geographical location, and all complicate regulatory considerations appreciably. The above-noted long-range transport feature limits the efficacy of local emission-control strategies in many regions of the continent, because large quantities of ozone and its precursors are likely to be introduced from remote upwind sources that lie beyond the local control domain in question. This situation is particularly troublesome in the United States owing to interstate transport, which is essentially ignored by the basic state-level regulatory strategy under the U.S. Clean Air Act. Natural emissions are problematic both because they are extremely difficult to quantify and because several elements of their atmospheric chemistry are not well understood at the present time.

Reflecting on these features and on the number of ozone studies conducted on a somewhat mutually uncoordinated basis, the NRC report concluded that "Progress toward reducing [tropospheric urban and regional] ozone concentrations... has been severely hampered by the lack of a coordinated national program directed at elucidating the chemical, physical, and meteorological processes that control ozone formation and concentrations over North America." The NARSTO program is a direct response to this NRC conclusion.

The NARSTO concept was initiated through a series of technical workshops conducted with joint efforts of the U.S. National Oceanic and Atmospheric Administration (NOAA), the Electric Power Research Institute (EPRI), the California Air Resources Board (ARB), and the U.S. Environmental Protection Agency (EPA). These workshops are aimed at producing a general NARSTO strategy document, and culminated in a 1994 Boulder, Colorado meeting, which set the basis for the NARSTO Research Strategy and Charter (NARSTO 1994), a formal report published in November of 1994. In addition to setting forth the functional structure of the NARSTO organization, this report documents the program's basic rationale, itemizes key science and policy questions to be addressed by the program, and summarizes the scientific activities required for fulfillment of the NARSTO goals.

3.4.11 Current Developments

During the summer of 1996 a joint U.S./Canada field experiment took place in the eastern half of the continent (NARSTO-NE in the U.S.A. and NARSTO-CE in Canada). The project was undertaken to gather data to improve and verify models for the prediction of tropospheric ozone. Presently data collected during these experiments are being analyzed. The next major event is the completion of the 1998 NARSTO assessment. The 1998 Assessment will compile and evaluate the state of knowledge of tropospheric ozone and related chemical and physical processes and will be the first major synthesis report produced by NARSTO. Prior to publication of the assessment, a symposium is planned for November 1997 where the peer reviewed reports making up the assessment will be presented for comment.

3.5 Particulate Matter

3.5.1 Formation

Total suspended particles (TSP) have been divided into two categories, fine and course, as defined by size, sources, formation mechanisms, and chemical composition. Table 7 shows these different characteristics for both fine and coarse particles.

Coarse particles are referred to as PM_{10}, and have a diameter ranging between 2.5 and 10 micrometers (microns). Sources include windblown dust from deserts, agricultural fields, and unpaved roads with vehicle traffic.

Fine particles are referred to as $PM_{2.5}$, having a diameter less than 2.5 micrometers. Fine particles may be emitted by industrial and residential combustion of fossil fuels, as well as vehicle exhaust. They may also be formed in the atmosphere by chemical transformations of gases such as sulphur dioxide, nitrogen oxides, and volatile organic compounds, which are largely associated with combustion activities.

3.5.2 EPA Proposed Particulate Standard

The EPA is proposing to revise the current primary and secondary national ambient air quality standards (NAAQS) for particulate matter.

The primary standard is required under the Clean Air Act to protect against adverse health effects among sensitive populations, with an adequate margin of safety. The secondary standard, also required under the Clean Air Act, is to protect against welfare effects, including impacts on vegetation, crops, ecosystems, visibility, climate and man-made materials.

Currently the standards for particulate matter are measured in terms of the concentration of PM_{10} over a 3-year averaging period. The primary standard is attained if there is one day or less per year (averaged over 3 years) when the PM_{10} concentration is greater than 150 micrograms per cubic meter ($\mu g/m^3$). The secondary standard is attained if the annual average (averaged over 3 years) of the daily average PM_{10} concentration is less than or equal to 50 $\mu g/m^3$.

Table 7. Comparison of Ambient Fine And Coarse Mode Particles

	Fine	Coarse
Formed from:	Gases	Large solids/droplets
Formed by:	Chemical reaction Nucleation Condensation Coagulation Evaporation of fog and cloud droplets in which gases have dissolved and reacted	Mechanical disruption (crushing, grinding, abrasion of surfaces, etc.) Evaporation of sprays Suspension of dusts
Composed of:	Sulfate, $SO_4^=$ Nitrate, NO_3^- Ammonium, NH_4^+ Hydrogen ion, H^+ Elemental carbon, Organic compounds (e.g., PAHs, PNAs) Metals, (e.g., Pb, Cd, V,	Resuspended dusts (Soil dust, street dust) Coal and oil fly ash Oxides of crustal elements, (Si, Al, Ti, Fe) $CaCO_3$, NaCl, sea salt Pollen, mold, fungal spores Plant/animal fragments
	Ni, Cu, Zn, Mn, Fe) Particle-bound water	Tire wear debris
Solubility:	Largely soluble, hygroscopic and deliquescent	Largely insoluble and non-hygroscopic
Sources:	Combustion of coal, oil, gasoline, diesel, wood Atmospheric transformation products of NO_X, SO_2, and organic compounds including biogenic organic species, e.g., terpenes High temperature processes, smelters, steel mills, etc.	Resuspension of industrial dust and soil tracked onto roads and streets Suspension from disturbed soil, e.g., farming, mining, unpaved roads Biological sources Construction and demolition, coal and oil combustion, ocean spray
Atmospheric half-life:	Days to weeks	Minutes to hours
Travel distance:	100s to 1000s of km	<1 to 10s of km

Source: Adapted from Wilson and Suh (1996) U.S. EPA

The proposed standard for particulate matter includes $PM_{2.5}$ as well as PM_{10}.

The proposed PM_{10} primary standard retains the current annual standard; the standard is met if the 3-year average of the annual arithmetic mean PM_{10} concentration, spatially averaged across designated air quality monitors in an area, is less than or equal to 50 micrograms per cubic meter. The 24-hour primary PM_{10} standard would be revised such that the standard is attained if the 98th percentile of 24-hour PM_{10} concentrations in a year (averaged over 3 years), based on the single population-oriented monitoring site with the highest measured values in an area, is less than or equal to 150 ($\mu g/m^3$).

It is proposed that the secondary PM_{10} standard match the primary standard PM_{10}, as described above. Again, there would also be both an annual standard and a 24-hour standard for PM_{10}. Figure 16 reflects the areas expected to be impacted by the proposed PM_{10} standard.

The proposed standard for particulate matter is also to include $PM_{2.5}$. According to the proposed primary standard, attainment requires that the annual $PM_{2.5}$ level be less than or equal to 15 micrograms per cubic meter, and that the 24-hour $PM_{2.5}$ level be less than or equal to 50 micrograms per cubic meter, based on the 98th percentile form, as proposed for the revised PM_{10} standard.

It is proposed that the secondary $PM_{2.5}$ standard also be set equal to the primary $PM_{2.5}$ standard. The public would thereby be protected from welfare effects of $PM_{2.5}$ and PM_{10} to the same degree as the primary standard protects the public from health effects.

The proposed primary particulate matter standard is expected to reduce premature deaths by 50%, or approximately 20,000 individuals; reduce aggravated asthma episodes by more than a quarter million cases each year; reduce incidents of acute childhood respiratory problems by more than a quarter million occurrences each year; reduce chronic bronchitis by an estimated 60,000 cases each year; and reduce hospital admissions due to respiratory problems by 9,000 each year.

The proposed secondary standard for particulate matter would cut haze and visibility problems by as much as 77% in some areas, such as national parks. The possible benefits in the mitigation of acid rain and ground-level ozone pollution are unquantified.

The time line for the implementation allows as much as 13 years following promulgation, including possible extensions in particularly severe regions.

3.5.3 Monitoring Requirements

Changes in the ambient air quality monitoring network are needed in order to determine the compliance of states with the proposed standard for particulate matter. While PM_{10} has been monitored since the 1980s, $PM_{2.5}$ has not been extensively and consistently monitored. A $PM_{2.5}$ monitoring network will need to be established. On the other hand, PM_{10} monitoring may be required at a reduced frequency and at fewer sites. PM_{10} and $PM_{2.5}$ monitoring locations are to be

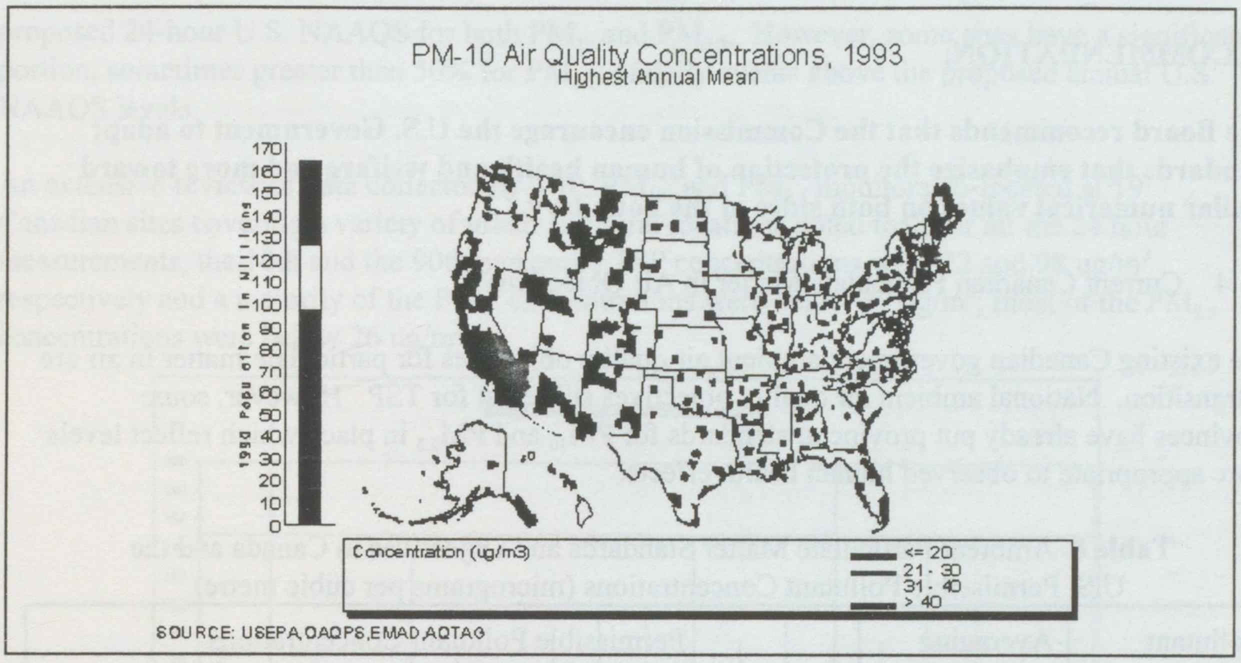

Figure 16. PM_{10} Concentrations Correlated with Population

collocated at key population-oriented stations in order to allow better understanding of the relationships between them and thereby promote effective emission monitoring and control strategies. The most extensive changes of current monitoring procedures will be required in order to create a $PM_{2.5}$ monitoring network.

Currently, site data for long-term collocated PM_{10} and $PM_{2.5}$ measurements in the United States are limited. EPA's Aerometric Information Retrieval System (AIRS) contains data collected between 1989 and 1994 at rural, suburban, and urban locations across the United States. The AIRS database also contains PM_{10} and $PM_{2.5}$ measurements taken between 1989 and 1995 at a number of sites in California. The Harvard Six-City Study provided data between 1980 and 1986 for Steubenville, St. Louis, Harrison, Topeka, Watertown, and Portage. Fine and coarse particulate matter has also been measured in Philadelphia between 1980 and 1990. A more extensive network is needed for measuring PM_{10} and $PM_{2.5}$.

Included with the proposed standard for particulate matter is a proposal on network design and sampling methodology to further monitor particulate matter. The monitoring system would be phased-in over a 3-year period, and focused in heavily populated areas. Special purpose monitors would also be utilized as needed for special studies and for days having high concentrations of $PM_{2.5}$. The methodology specifications include sampling devices, data collection and reporting, quality assurance, and comparison of the collected data with the standards. The methodology for achieving the proposed PM_{10} and $PM_{2.5}$ standard has been designed on the national level with a high degree of detail.

RECOMMENDATION:

The Board recommends that the Commission encourage the U.S. Government to adapt standards that emphasize the protection of human health and welfare and move toward similar numerical values on both sides of the boundary.

3.5.4 Current Canadian Particulate Matter in Air Objectives

The existing Canadian government ambient air quality objectives for particulate matter in air are in transition. National ambient air quality objectives still exist for TSP. However, some provinces have already put provincial standards for PM_{10} and $PM_{2.5}$ in place which reflect levels more appropriate to observed human health effects.

Table 8. Ambient Particulate Matter Standards and Objectives in Canada and the U.S. Permissible Pollutant Concentrations (micrograms per cubic metre)

Pollutant	Averaging Time	Permissible Pollutant Concentrations (micrograms per cubic metre ($\mu g/m^3$)			
		Canadian Objectives Acceptable Level	Some Provincial Standards		U.S. Standards Proposals
			Newfoundland	British Columbia	
TSP*	24-hour Annual	120* 70*	120	12070	
PM_{10}	24-hour Annual		50	50	150 50
$PM_{2.5}$	24-hours Annual		25		5015

3.5.5 Current Canadian Air Quality with Respect to Particulate Matter in Air

In 1993, there were 36 monitoring sites across Canada measuring particulate concentrations. As in the United States, Canadian cities tend to be well above the background estimates. Concentrations of particulates in the ambient air of major cities across the country are illustrated in Figures 17 and 18. The levels for the proposed annual and 24-hour U.S. NAAQS are indicated by solid lines at 50 $\mu g/m^3$ and 150 $\mu g/m^3$ for PM_{10} and 50 $\mu g/m^3$ and 15 $\mu g/m^3$ for $PM_{2.5}$, respectively.

Evidence from nearly 20 years of research in acidic deposition indicates that the U.S. is a significant contributor to Canadian particulate concentrations in regions experiencing transboundary air pollution. Most Canadian cities have daily concentrations that are below the proposed 24-hour U.S. NAAQS for both PM_{10} and $PM_{2.5}$. However, some sites have a significant portion, sometimes greater than 50% for $PM_{2.5}$, of daily events above the proposed annual U.S. NAAQS levels.

An extensive review of data collected by TSP, PM_{10}, and $PM_{2.5}$ monitors co-located at 19 Canadian sites covering a variety of urban and rural locations noted that, for all the 24 hour measurements, the 10th and the 90th percentile TSP concentrations were 22 and 98 ug/m^3 respectively and a majority of the PM_{10} concentrations were below 47 ug/m^3; most of the $PM_{2.5}$ concentrations were below 26 ug/m^3.

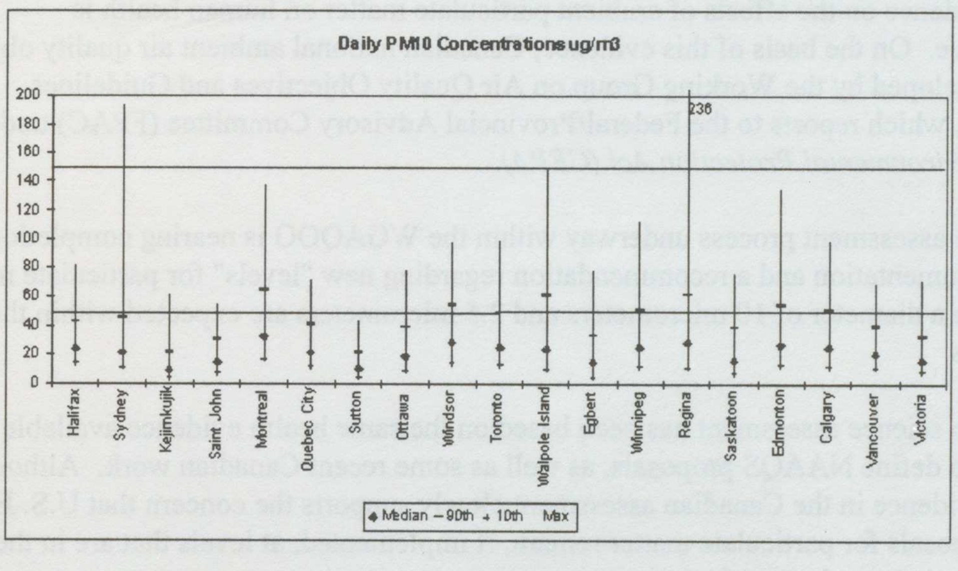

Figure 17. Average Daily PM_{10} Concentrations for Major Canadian Cities

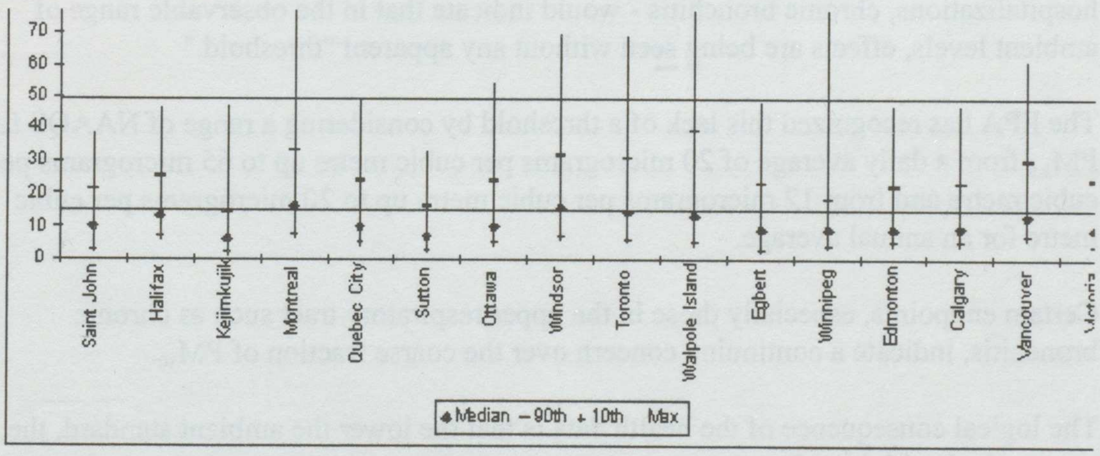

Figure 18. Average Daily $PM_{2.5}$ Concentrations for Major Canadian Cities

On average, $PM_{2.5}$ accounts for 49% of the PM_{10} and PM_{10} accounts for 44% of the TSP. Excluding one site strongly influenced by local sources, particle levels were highest in Southwestern Ontario. Particulate concentrations also tended to increase from winter to summer in that region, in contrast to the balance of the sites. Fine particle sulphate dispersed over long distances and originating from sources on both sides of the boundary were a significant contributing factor to these phenomena.

3.5.6 Particulate Matter in Air: The Science

Scientific evidence on the effects of ambient particulate matter on human health is comprehensive. On the basis of this evidence, Canadian national ambient air quality objectives are being developed by the Working Group on Air Quality Objectives and Guidelines (WGAQOG), which reports to the Federal/Provincial Advisory Committee (FPAC) under the *Canadian Environmental Protection Act (CEPA).*

The scientific assessment process underway within the WGAQOG is nearing completion. Peer-reviewed documentation and a recommendation regarding new "levels" for particulate matter with less than a diameter of 10 micrometers and 2.5 micrometers are expected within the next several weeks.

The Canadian science assessment has been based on the same health evidence available and used by the EPA to define NAAQS proposals, as well as some recent Canadian work. Although not yet public, evidence in the Canadian assessment clearly supports the concern that U.S. EPA NAAQS proposals for particulate matter remain, if implemented, at levels that are in the adverse effects range. Among the conclusions are :

- All the evidence for all of the end points that have been considered - mortality, hospitalizations, chronic bronchitis - would indicate that in the observable range of ambient levels, effects are being seen without any apparent “threshold.”

- The EPA has recognized this lack of a threshold by considering a range of NAAQS for $PM_{2.5}$ from a daily average of 20 micrograms per cubic metre up to 65 micrograms per cubic metre and from 12 micrograms per cubic metre up to 20 micrograms per cubic metre for an annual average.

- Certain endpoints, especially those in the upper respiratory tract such as chronic bronchitis, indicate a continuing concern over the coarse fraction of PM_{10}.

- The logical consequence of the health data is that the lower the ambient standard, the greater the health benefit.

- Although Canadian particulate concentrations are, on average, lower than American levels, recent Canadian studies show that health effects are consistently related both in type and magnitude to particulate concentrations even at the lower ambient levels observed in Canada.

As has been clearly noted in the U.S. assessment, the Canadian science assessment of particulate matter finds adverse health effects at the ambient levels of PM currently being experienced by the Canadian population. The debate on recommendations for particulate objectives currently underway in Canada is focusing on levels for Canada which span those in the full range considered by the U.S. EPA, with emphasis on values towards the lower end of that range. Canada has urged the U.S. EPA to adopt a more stringent standard for $PM_{2.5}$ at the lower end of the ranges under consideration by the Agency, along with a more stringent standard for PM_{10}.

Adapted from Submission by the Canadian Government under U.S. EPA Docket No. A-95-58 (Ozone), March 11, 1997

4.0 CLIMATE CHANGE

4.1 Overview

Greenhouse gases have played an important role in maintaining a hospitable climate on earth. It is estimated that, without their reflection of heat back to its surface, the earth would have been approximately 60ºF cooler. Now, however, there is concern that the buildup of these gases in the atmosphere will cause reflected heat to increase global temperatures, with negative impacts on human life and activity.

Water vapour is the gas with the largest greenhouse effect but its atmospheric concentration is not directly affected on a global scale by human activities. The other major greenhouse gases are carbon dioxide (CO_2), methane, nitrous oxide, and most halogenated substances, such as chlorofluorocarbons (CFCs).

The current focus at this time is on atmospheric concentrations of CO_2, which has a lifetime of between 50 and 500 years and is estimated to contribute to well over one half of the anticipated global warming.

As the global climate warms, a portion of the heating will go into evaporating larger quantities of water from the earth's surface. The warmer atmosphere can retain more water, creating circumstances which may lead to extreme precipitation events. However, the warming phenomenon can also cause droughts in areas not conducive to rain and snow, as the warmer environment will dry soils in such areas to a greater extent.

Since 1988, when a scorching summer thrust the "greenhouse effect" onto front pages, billions have been invested in climate research, including the development of computer models to predict and project climate change.

There are still major uncertainties about the magnitude of global warming and the role of anthropogenic emissions in it. However, some scientists believe that the temperature increase in the last century was likely the largest in 10,000 years, and coincides with a significant increase in CO_2 as result of fossil fuel combustion.

While concluding that the one-degree Fahrenheit temperature increase over the last century is at least partly the result of human fossil fuel burning, the Intergovernmental Panel on Climate Change (IPCC) also scaled back the predicted temperature increase by a third, to a "best" estimate of 3.6ºF by the year 2100 if emissions remain uncurbed. Forecasts of the rise in sea-level caused by melting ice and warming oceans, have also been reduced by 25 percent.

However, researchers suggest that higher temperatures will not be distributed evenly, bringing a greater risk of regional drought or coastal storms.[9]

A contrasting temperature record suggests the planet hasn't warmed, at least since 1979. The University of Alabama's Earth System Science Laboratory notes that satellites have detected a faint cooling in that time; however, other weather factors could be masking a broader warming trend.

The Weight of Evidence

- NASA's Goddard Institute for Space Studies predicts a "high likelihood" that the 1990s will be the hottest decade ever recorded, placing the 1980s as the second hottest.

- The National Oceanic and Atmospheric Administration has detected a 20 percent increase in "extreme precipitation events" since 1900, a trend consistent with global warming.

- Observations since 1900 indicate that intense precipitation events have already increased by about 20% and cold season precipitation has increased 10%. Precipitation totals for the October-December 1996 period exceed 150% of normal in the Northwest.

- The British Antarctic Survey contends that increasing temperatures have collapsed ice shelves on the Antarctic Peninsula. Two years ago, the northern section of the 620 mile long Larsen Ice Shelf collapsed after unusually warm temperatures. Deep holes and cracks several miles long are spreading through the balance of the shelf.

- Over the past 50 years, temperatures in the vicinity of Antarctica have warmed by 4.5°. The first rainfall ever observed was noted in coastal Antarctica in the past several years.

Finding

Nitrogen oxides (NO_X) and CO_2 are associated with transportation (as is VOC (volatile organic compounds) production) and electrical energy generation (particularly coal fired)

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[9]"Global Climate Change: an Overview of the U.S. and International Efforts to Reduce Greenhouse Gas Emissions," Dr. C.V. Mathai, EM Magazine, Air and Waste Management Association, February 1997, pgs. 25 to 33 March 3, 1997. Copyright (c) 1997 N.Y. Times News Service

sectors. Further reductions in emissions from these two sectors appear necessary during the next decade if ecosystem damage is to be curtailed and ecosystem quality preserved and sustained.

4.2 Control Scenarios

Many experts say that even the most ambitious and marginally feasible program will not be adequate to halt the increase in concentrations of carbon dioxide in the atmosphere, which is believed to be a major factor in the temperature increases.

Because carbon dioxide lingers for years after it is released, the IPCC notes that world releases must ultimately be cut in half to stop the buildup; this will require a fundamental shift in energy generation away from the direct combustion of coal and oil.

Environmentalists seek a commitment of a 10 percent reduction in U.S. emissions by the year 2010. Reductions could be achieved through encouraging use of wind, solar and other non-combustion power sources and increasing the fuel efficiency of new cars. The Intergovernmental Panel on Climate Change estimates that world greenhouse emissions can be cut by 10 to 20 percent through policies that actually assist the economy over the long term, such as better insulation to reduce energy consumption. Small-island states, most threatened by sea-level rise, want a 20 percent reduction by 2005.

In 1993, the Clinton Administration announced a Climate Change Action Plan, focused on three major sectors; transportation, industrial and residential/commercial. Major responsibilities were given to the Department of Energy, who has elicited Accords with over 600 utilities (two-thirds of the electric power generation capacity). The reduction mechanisms in these Accords exhibit flexibility and include assuming credit for emission reductions or preservation of greenhouse gas sinks, such as forests, outside the United States. Major reductions are envisaged, in order of increasing magnitude, through:

i) increased use of nuclear power
ii) emission reductions from fossil fueled fired units
iii) demand side management. and
iv) use of renewable resources

However, total carbon dioxide emissions from the United States increased by 5.5 percent from 1990 to 1995. Current projections show a 28% increase in greenhouse gas emissions by 2010. Energy deregulation (Federal Environmental Regulation Commission (FERC)) is viewed as possibly increasing demand and also emissions beyond this estimate. Further controls under the Clean Air Act to reduce emissions of NO_X, sulphur dioxide, and particulate matter should lower these projections.

Recognizing that the 1993 voluntary targets on energy reduction have not altered America's position as the largest global emitter of greenhouse gases, Administration officials are now promoting legally binding limits on greenhouse gas releases. As a result, the United States will be advocating an international agreement by December of this year that would require industrialized nations to control greenhouse emissions to a particular defined level. Limits will follow for those developing nations that may account for the majority of carbon emissions late in the 21st century.

The U. S. proposal would cap each country's emissions, but allow flexibility in meeting that cap including, for instance, reducing carbon dioxide releases in another country. As a result, the United States could meet its reduction goals by promoting energy efficiency in fast-growing China, which currently burns large amounts of coal.[10]

While Canada produces only about 2% of the gases that contribute to warming, production of carbon dioxide has increased 6% since 1990 and may increase to 12% by the year 2000. Canada's commitment at the Rio Summit in 1992 was to curtail CO_2 production to 1990 levels. There is concern that a 1995 voluntary plan involving 600 companies and public organizations responsible for more than half of Canada's emissions is inadequate to achieve the established target.

Unfortunately CO_2 emissions are expected to increase into the next century. By 2010, they are expected to be 19% above the current target; 36% by 2020, if significant and timely action is not taken to reduce greenhouse emissions.

The Canadian government also recognizes that emissions from the transportation sector must be further curtailed. The Transportation and Climate Change Collaborative has recommended full cost transportation pricing. It is anticipated that the Task Force on Cleaner Vehicle and Fuel will result in new standards for less polluting gasoline and diesel fuel and initiate a new program for low-emission vehicles by 2001.

4.2.1 The International Management Mechanism

At the 1992 Earth Summit in Rio, the leaders of 154 nations, including Canada and the United States, signed the United Nations Framework Convention on Climate Change, with the objective of "stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The desired concentrations are not stipulated. The framework further commits the developed countries (or Annex 1 Parties) to take the lead by limiting anthropogenic emissions of greenhouse gases (using 1990 as a base year) and protecting and enhancing greenhouse gas sinks and reservoirs (such as forests).

Since the Earth Summit, the United Nations has established an office for the Framework

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[10] Environmental News Service - http://www.envirolink.org/environews/ens/

Convention on Climate Change in Bonn, Germany and the Conference of Parties (COP) has met in Berlin in 1995, Geneva in June 1996 and will next meet in Japan in December. To date, only Britain, with the increased use of natural gas for power generation, and Germany, the Soviet Union and its former satellite nations in Eastern Europe (largely due to wholesale restructuring and modernization of their economies) appear to be in a position to meet their reduction commitments.[11]

Most recently, the United States has called for ongoing negotiations to set realistic, verifiable, and binding medium term emission targets, while moving forward on a longer-term goals. Such limits are to be discussed at the December meeting in Japan.

FINDING:

Concerns over global warming and associated current and projected increases in carbon dioxide emissions are an additional impetus to the development of further controls and alternatives in power generation and consumption, including that used for transportation.

RECOMMENDATION:

Recognizing the additional benefits to be achieved in other areas, the Commission advocates and promotes further control and change in the industrial, transportation and commercial/residential sectors required to reduce, in the short term, emissions of carbon dioxide and further research to identify a long term strategy for reducing these emissions.

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[11]Report of Canada to the United National Commission on Sustainable Development - Fourth Session of the Commission, April 18 to May 3, 1996.

5.0 JOINT MANAGEMENT OF TRANSBOUNDARY REGIONAL AIR QUALITY

5.1 Overview: What Will Be the Air Management Framework of the Future?

A variety of regional air quality management frameworks is being considered in the United States and Canada for managing air pollution. Some are designed to deal with a single issue, such as ground-level ozone or acid rain, or a single pollutant, for example sulphur dioxide. Others are evolving as regional multi-pollutant, multi-issue management regimes. In addition, attempts are being made to determine how the regional frameworks evolving on both sides of the border can be coordinated and applied in border regions.

In examining the various optional frameworks, it is important to distinguish between emission source regions and receptor regions where effects occur. Adverse effects can occur within the emission source regions or in other regions downwind from the primary contributing sources. For some air issues, (persistent toxic substances), the primary source regions and the primary receptor regions of concern may not be coincident; rather they can be quite remote from each other. However, the pollutants can only be controlled where they are emitted. Therefore the frequently referenced concept of "airshed" management may not be appropriate. Rather, the management by emission source region should be considered.

To better appreciate the evolving air management frameworks, it is useful to look at a few examples.

5.2 Single Issue Management Regimes

5.2.1 Management of Ground-Level Ozone

As illustrated in Figure 19, there are several geographic regimes in place or being considered for managing ozone in Eastern North America:

- the Ozone Transport Region (OTR), a formally designated ozone management region under the U.S. Clean Air Act covering 13 states along the U.S. Eastern seaboard
- the Ozone Transport Assessment Group (OTAG) region, a 37-state area covering the eastern half of the U.S., in which options, either applying to the region as a whole or to sub-regions within the OTAG domain, are being considered for managing ozone
- the Regional Ozone Study Area (ROSA), a region including 8 states and an area in southern Ontario which has been jointly delineated by the U.S. and Canada as a logical, scientifically defensible, geographic domain for managing ozone in a transboundary context

- the geographic domains for Regional Smog Management Plans (RSMPs) in southern Ontario, southern Quebec and southern Atlantic areas of central and eastern Canada (there is also a fourth Canadian RSMP in the Lower Fraser Valley of British Columbia)

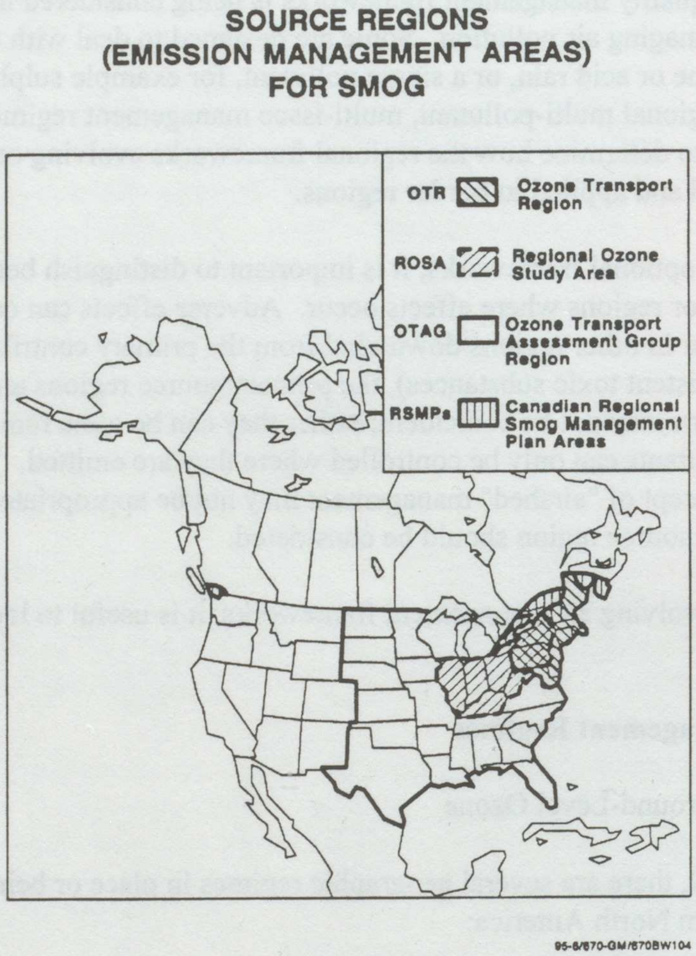


Figure 19.

5.2.2 Management of Acidifying Emissions

The Sulphur Oxides Management Area (SOMA) is formally designated by Canada in the second Sulphur Protocol under the UN Economic Commission for Europe's Convention on Long-Range Transboundary Air Pollution (LRTAP).

Whereas the management regime for the first phase of Canada's acid rain program, established in 1985, encompassed the entire territory of the 7 easternmost provinces in Canada, the second phase is honing in on the SOMA, which is the primary Canadian source region contributing to

SOURCE REGIONS (EMISSION MANAGEMENT AREAS) FOR ACID RAIN

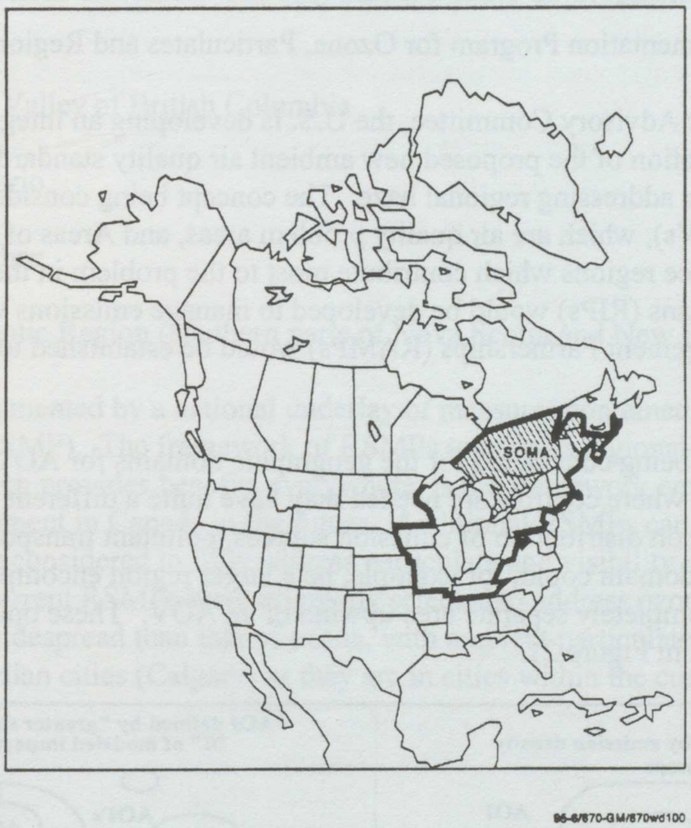


Figure 20.

residual acidification. This problem will continue to exist in Eastern Canada in the year 2010 after full implementation of the Canadian phase 1 program and the current U.S. Clean Air Act title IV acid rain program. The SOMA region was also recognized by the U.S. prior to Canada's signing of the second Sulphur Protocol as the only area of Canada contributing to acidification in the U.S. Hence it is a logical source region for managing sulphur dioxide (SO_2) emissions both from the domestic and transboundary perspectives. It is also being considered in Canada as an appropriate geographic domain for managing nitrogen oxide (NO_X) emissions, which contribute to acidification, and for ammonia emissions, which contribute to ambient air particulate loadings.

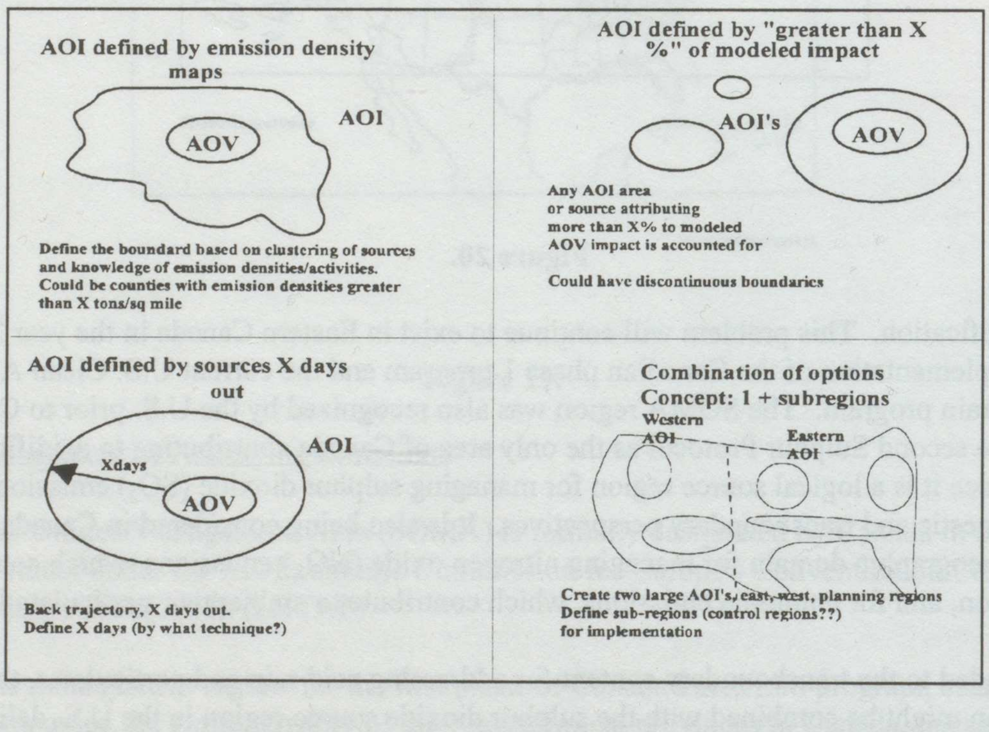
If fully extended to the transboundary context for addressing acid rain and particulates, the SOMA region might be combined with the sulphur dioxide source region in the U.S. delineated in Figure 20, which has been shown through modelling to be the primary U.S. source region contributing to the acid deposition region of concern in Eastern Canada.

5.3 Multi-Pollutant, Multi-Effect Management Regimes

5.3.1 U.S. Joint Implementation Program for Ozone, Particulates and Regional Haze

Under the Clean Air Act Advisory Committee, the U.S. is developing an integrated regional approach for implementation of the proposed new ambient air quality standards for particulate matter and ozone and for addressing regional haze. The concept being considered is to delineate Areas of Violation (AOVs), which are air quality problem areas, and Areas of Influence (AOIs), which are emission source regions which contribute most to the problem in the AOVs. Regionally Integrated Plans (RIPs) would be developed to manage emissions within the AOIs, and Regional Air Management Partnerships (RAMPs) would be established to develop these plans.

Various alternatives are being considered for the geographic domains for AOVs and AOIs, recognizing that an AOI where controls are needed may have quite a different geographic extent than an AOV depending on distribution of emission sources, pollutant transport distances and meteorology. The AOI domain could, for example, be a larger region encompassing a smaller AOV domain, or be a completely separate area upwind of an AOV. These options are schematically illustrated in Figure 21.



AOI = Area of Influence **AOV = Area of Violations**

Figure 21. Various Options for Defining AOI's with Preliminary Pros and Cons

Both Canada and the United States have national programs. The structure exists for an overall air management framework that would consist of a combination of national underlay programs designed to reduce emissions everywhere and source region management programs designed to further reduce emissions in key source regions.

An air management framework with a strong regional focus and a comprehensive multi-pollutant approach would seem to offer many advantages over single pollutant, single issue programs:

- improved efficiency for governments, industry, and the individual citizen
- more effective selection of emission control measures, i.e. to address a range of pollutants
- a single comprehensive package of measures for industry, allowing them to better plan for the future
- assurance of environmental integrity by providing geographic control
- introduction of regional orientation to greenhouse gas reduction programs so that measures to reduce greenhouse gases also help solve regional air quality problems
- design and implementation of programs by those directly affected, i.e. in the source regions
- potential joint application in a transboundary context, i.e. joint transboundary air management in selected border regions
- a potential for a common air management framework for North America

The IJC will continue to monitor the evolution of air management frameworks in Canada and the U.S. and make recommendations to governments on their applicability in a transboundary context as appropriate.

5.5 Great Lakes Air Quality Partnership

The U. S. National Park Service, Air Resources Division staff organized a charter gathering of the "Great Lakes Air Quality Partnership," held in Sault Sainte Marie, Ontario in December 1996. At this meeting, representatives from 15 organizations and Indian tribes in the United States and Canada met to discuss the goals of an organization focussed on air quality protection in parks and preserves along the border in the Great Lakes region. Among the participants at the December meeting were U.S. Federal Land Managers (National Park Service, U.S. DA-Forest Service, U.S. Fish and Wildlife Service), Parks Canada, Environment Canada, U.S. Environmental Protection Agency, Great Lakes Commission, International Joint Commission, state and provincial parks and air quality agencies, and Indian tribes. Those attending the December meeting agreed to form a Steering Committee to represent all of the partners and to organize a spring meeting to officially establish the group and its mission. It was proposed that this meeting be held at the Great Lakes Commission office in Ann Arbor, Michigan in early summer.

Should this group coalesce around a common set of objectives, then it will become the largest of the air quality protection groups formed to date.

5.6 The Paso del Norte Air Quality Task Force

In its deliberations of the Paso del Norte Task Force the Board noted some of the similarities between the Ciudad Juarez/El Paso region and locations on the boundary between the U.S. and Canada including:

- In the Paso del Norte region, as in locations along the U.S.-Canada boundary, nonattainment of ozone standards and elevated levels of carbon monoxide and particulate matter are a transboundary phenomenon.
- Sources are somewhat similar, including vehicles, larger industries and small sources of volatile organic compounds and other contaminants such as auto finishing shops. Unpaved roads and open burning are of greater significance to the Paso del Norte region.
- There are two Commissions overseeing environmental quality in the U.S. Mexican transboundary region, the International Boundary and Water Commission of 1884, (which deals with water quality and quantity issues) and the Border Environmental Cooperation Commission, created under the North American Free Trade Agreement (NAFTA).
- There is also an Agreement on U.S. Mexico Cooperation for the Protection and Improvement of the Environment in the Border Area (the La Paz Agreement of 1983). This Agreement has Annexes, one on sulphur dioxide pollution from copper smelters (a source in Juarez) and Annex V on international transport of urban air.
- The Paso del Norte Air Quality Task Force was instrumental in persuading the federal governments of the United States and Mexico to modify Annex V in 1996 to create the Joint Advisory Committee on Air Quality Improvement for the Paso del Norte Region.
- Creation of the binational Joint Advisory Committee and the opening of an U.S. Environmental Protection Agency (EPA) border office in El Paso are two of the major accomplishments of the Paso del Norte Air Quality Task Force, a multistakeholder group that has successfully influenced all levels of government, including the federal levels, while documenting pollution sources and sponsoring remedial actions.

- The Task Force is a leader in a study to determine the impact of these pollutants on human health through a co-relation with hospital admissions. Similar work has been completed in part of the United States and Canada.

- Nascent projects, such as the bilateral Clean Cities Corridor Agreement between Detroit and Toronto, (with participation by the U.S. Dept of Energy) and the unilateral Windsor Air Quality Study along U.S.-Canada border could achieve similar milestones.

Based on the Board's interactions in El Paso, the following elements contributed to the success to date of the Task Force in that region.

- effective transboundary linkages

  The Board noted strong bilateral linkages among the academic community, based at the University of Texas at El Paso and the Universidad Autoncoma de CD Juarez, which provided the initial impetus for the Task Force and the scientific justification for its activities, the industrial community, particularly the *maquiadores*, the political structure, both formal (at the municipal level) and among interest groups, including the Environmental Defense Fund. Strong ties to the academic and medical communities on both sides of the boundary were particularly fruitful.

- effective bilateral definition of the problem.

  An international epidemiological study (organized by Dr. Elaine Barron) examined the ties between high levels of air pollution and reported cases of respiratory disease. The study was linked to the Physicians for Social Responsibility (PSR) to gain support from hospital administrations on both sides of the border.

- commitment to a 'solution oriented' bilateral activity

  While the opportunity to portray one side of the border as the origin of the majority of the air quality insult exists, there has been recognition that significant sources exist on both sides of the boundary and a broadly-supported binational strategy advocating actions on both sides is most productive.

- effectively scaled solutions

  The Task Force advocated initiatives appropriate to the scale of the pollution sources, from research on modest auto spray painting booths, to a systematic monitoring of international bridge traffic, to oversight of major point sources, such as the copper smelter.

- Charismatic, Sensitive and Persuasive leadership

  The strong sense of commitment, demonstrated by their decade long involvement, and the persuasive abilities and the charisma of the Task Force leadership, particularly Danny Vickers, Dr. Carlos Rincon and Dr. Elaine Barron, were reflected in the response and support the Task Force garnered at the local, state, and federal levels on both sides of the boundary.

5.7 B.C./WA Environmental Cooperation Council Activities

In their meetings held in December 1995 and October 1996, the Council reviewed related work being conducted by the North American Commission on Environmental Cooperation established under NAFTA. It also considered aquifer, cross-border air quality management, and environmental conditions around the border in the Columbia Basin.

A Memorandum of Understanding to clarify the roles and responsibilities of the Department of Ecology (Washington State) and the Ministry of Environment, Lands and Parks (Province of British Columbia) under the 1992 Environmental Cooperation was completed. It commits the parties to:

- establish communications among staff members working on issues with cross-border impacts while providing opportunities for public review and comment
- designate liaison personnel
- establish working relationships with regional representatives of federal agencies to facilitate cooperation

5.7.1 Germane Activities

Columbia River Basin Environmental Protection:
Over the past three years, there has been continuing concern in the vicinity of Northport, Washington about the health impacts of discharges from the Cominco Lead and Zinc Smelter in Trail, B.C.

Cominco has applied to the B.C. Ministry of Environment for an amendment to its air emissions permit; the company held a public meeting in Northport as one method of seeking comment on the draft permit.

The Washington State Department of Ecology evaluated projected arsenic, lead and cadmium emissions from the smelter and concluded that the proposed technology and emissions will meet U.S. standards for all pollutants of concern and endorsed the Ministry's permit conditions. The two agencies are discussing the establishment of additional air monitoring stations in Washington to allow long term assessment of Cominco emissions' impacts. An amended wastewater discharge permit to Cominco will be issued later this year following a similar process.

It is anticipated that, within next few years, Cominco's discharge will meet BC Water Quality Criteria in the Columbia River at Trail.

The Air Quality Task Force continues to meet every six months and is focusing on visibility impairment. Regional haze is an emerging issue because of the proximity of Olympic National Park and North Cascades National Park to the boundary.

Low elevation ozone concentrations are leading to an evaluation of regional ozone levels to allow development of options and recommendations on the most cost-effective approach for dealing with ozone in the Northwest. Several Canadian agencies will be included in this review. There is an intent to formalize the Cascadia Ozone Forum to better coordinate research and planning efforts among Northwest agencies engaged in ozone work, including those in British Columbia.

Under the current MOU, the state and province have consulted on 10 major permits and shared information on 24 minor permits; a sub-committee has been created to reconcile differences between the Washington and British Columbia permitting processes.

5.8 North Eastern States for Coordinated Air Use Management (NESCAUM) and the Eastern Canadian Transboundary Smog Issue Group (ECTSIG) Joint Commission for Environmental Cooperation (CEC) Project[12]

With support from CEC, NESCAUM and ECTSIG propose to work with key policymakers and experts in both the U.S. and Canada to analyze airborne pollution (including ozone, NO_X and fine particulate) crossing the eastern portion of the Canada-U.S. border. Both are joining in a pilot project aimed at developing the scientific and policy basis for effective joint management of transboundary airsheds.

NESCAUM is a voluntary, non-profit association of the air quality agencies of eight Northeastern states, including Connecticut, Maine, Massachusetts, New Hampshire, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. NESCAUM has provided technical expertise and a forum for coordinating regional air quality management efforts to its member states since 1967.

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[12]Excerpts from "Assessing the Long-Range Transport of Airborne Pollutants Between the Eastern U.S. and Canada" (W. Draper)

The Eastern Canadian Transboundary Smog Issue Group (ECTSIG) is a workgroup of Environment Canada, with participants representing the environmental agencies of Ontario, Quebec, New Brunswick, and Nova Scotia (representatives from Newfoundland and the Prince Edward Islands have been invited to participate).

5.8.1 Objectives for the Pilot Project:

- Identifying the analytical tools and data sources available to characterize the sources and dynamics of long-range air pollution transport.
- Assessing the availability of monitoring and modeling data on both sides of the border and the potential for integrating these data.
- Initiating a dialogue between U.S. and Canadian air regulators, policymakers, and scientific experts as a first step toward sharing information, identifying data gaps and resource needs, and developing a common approach to addressing transboundary transport issues.
- Educating environmental commissioners and premiers in the U.S. and Canada and developing a detailed workplan addressing the longer term joint effort.

5.8.2 Deliverables:

- Complete a concise report synthesizing the best available information that has emerged from recent studies of ozone transport in the eastern United States and Canada. This report will summarize the analytical approaches and data sources available to assess pollution transport on both sides of the border; provide an example of how monitoring data and modeling tools can be integrated to develop quantitative measures of transport; and identify key data needs and information gaps.
- Organize two or more meetings of air regulators, key policymakers, and scientific experts from both sides of the border to educate environment commissioners and premiers, identify key transport concerns, data needs, and opportunities for cooperation and collaboration.
- Work with air regulators and high level policy officials (Eastern Canadian Premiers and New England Governors' Conference) to develop a detailed workplan for subsequent phases of the project by June of 1997.

5.8.3 Timeframe:

The pilot project is to be completed in approximately 6 months. NESCAUM and ECTSIG plan to complete a synthesis ozone transport report in the April-May, 1997 timeframe. A first meeting of U.S.-Canadian experts has been planned for March, 1997 with a follow-up meeting planned for May, 1997.

NESCAUM also has been a party to the nationwide debate in the United States (and to a lesser extent among utilities in Canada) on the potential environmental impacts of state and federal efforts to reshape the electric utility industry, a significant source of smog precursors and pollutants. In written and oral comments submitted to FERC on August 3rd, 1995, NESCAUM stressed the need for a careful assessment of the emissions impacts of restructuring and for the integration of necessary mitigation mechanisms. NESCAUM has investigated the merits of Old Source Review - essentially, bringing older utilities up to the same environmental standards as newer plants - coupled with emissions trading, as one option for levelling the environmental playing field within a competitive utility structure.

NESCAUM also has convened an Energy Workgroup in an effort to strengthen links between air and energy regulators. The workgroup is also seeking to integrate environmental objectives with energy policies in crucial areas such as utility restructuring, and to develop consensus around a comprehensive, region-wide energy plan.

5.9 Commission for Environmental Cooperation

5.9.1 Continental Pollutant Pathways Report

Volume I of the draft interim report prepared by the North American Expert Advisory Panel on Continental Pollutant Pathways, The Continental Pollutant Pathways Report, has been submitted to the Secretariat of the CEC. The Panel was established in the fall of 1996 and has met three times, to date. The meetings were used to a) consider terms of reference, to develop an initial outline of the Panel's report, and to agree on initial drafting assignments, b) to consider, revise and draft initial sections and case examples of the report, and c) to review and revise key sections of the report. The Report has not been reviewed by CEC to date; no executive summary is available to the public.

The purpose of the report was to develop a readable and informative document that provides the technical and non-technical reader with a sense of the nature, extent, complexity, and the importance of continental pollutant pathways, and to demonstrate and inform as to the importance of these pathways to the North American ecosystem and to the health and well-being of its citizens. The goal is to contribute to informed and responsible decisions and actions at the national, corporate, and local levels to prevent and reduce the exposure of humans and the environment to pollutants released to, formed within, or transported through the atmosphere. The report recognizes the cross-media nature of pollutant pathways and focuses on the atmospheric pathways which carry chemical pollutants across boundaries and continents. A number of case studies are presented that, collectively, are broadly representative of many of the unique and generic characteristics of continental pollutant pathways.

The report examines ways of harmonizing the relationship between ecological and economic interdependence for societies and governments and begins with a statement that the three countries (Canada, Mexico and the U.S.) will work together to avoid the risk of national policies that adversely affect neighbours. The report stresses a need to reflect life-cycle (cradle to grave) considerations when establishing a framework of transport and fate analysis of chemical pollutants and adopts a multimedia approach to design methods of preserving overall environmental quality. A number of emerging concerns are considered, including the airborne transport of biological pests and pathogens, exportation of goods and manufacturing technologies, endocrine disruptors, climate change impacts, and the need to endorse the concept of integrated monitoring on a continental scale through the establishment of compatible sampling protocols and scientific approaches. The report acknowledges the complexity of multiple-pollutants and multiple stressors, endorses continuing vigilance to deal with these critical issues, and suggests that the CEC provides a forum for debate and examination of options regarding pollutants on a continental basis.

Section B of the report addresses specific pollutants of concern. Various volatile organic compounds, persistent organic pollutants, mercury, ozone, particulates and oxides of sulphur and nitrogen are all on the list and all are considered in some depth. For each of these pollutants, major problems associated with their release, generic characteristics, sources, pathways, and receptors are discussed.

An updated summary of this report will be included in a future report to the Commission following public release.

5.9.2 The Program on Sound Management of Chemicals

In 1995, the Council, consisting of the three ministers of the environment of the North American Commission for Environmental Cooperation, passed Resolution 95-5 on "Sound Management of Chemicals." Recognizing:

- a common ecosystem;
- that transport of toxic substances across national boundaries is a major and shared concern because of living organisms' immune system dysfunction, reproductive deficits, developmental abnormalities, neurobehavioral impairment and cancer, some of them irreversible effects;
- that their remediation can often place considerable strain on the economies as well as the important contribution that producers and/or users can make to the sound management of chemicals;

- the Rio Principles on discouragement of transfer to other states of harmful substances as well as the precautionary approach, as well as the commitments of the Great Lakes Water Quality Agreement of 1978;
- the unique circumstances of NAFTA;
- prevention of pollution and reduction of risk is desirable.

The Council committed to cooperate on sound management of the full range of chemicals, through their life cycle. This cooperation would begin with the development of a regional action plan for PCBs and additional substances, and then consider national timetables, establish a working group aimed to develop recommendations for improving capacity, exchange information, technical cooperation, incorporate pollution prevention principles, encourage public participation, and assess progress.

The Council agreed that the initial work plan for this trilateral program would focus on developing Regional Action Plans (RAP) for PCBs, Mercury, two pesticides (DDT and Chlordane), and the development of Criteria for future regional action plan selection. Working with the Secretariat of NACEC, the countries formed a Working Group on Sound Management of Chemicals (WGSMC) and four sub-groups. By Autumn 1996, the WGSMC and its sub-groups had produced four draft Remedial Action Plans (RAPs) and a draft report on Criteria for Future RAP Selection.

The main objectives of the Regional Action Plan on PCBs are to: (a) work toward the virtual elimination of PCBs in the environment, which the task force is interpreting as no measurable release to the environment, and the phase-out of uses for which release cannot be contained; and (b) propose environmentally sound steps for the management and control of existing PCBs, throughout their life cycles, with special emphasis given to transboundary shipment of PCBs for disposal/destruction purposes.

The main objectives of the Regional Action Plans on DDT and chlordane are to: (a) reduce the risks to human health and the environment associated with the use of these pesticides; and (b) provide baseline information on the status of DDT and chlordane stockpiles, manufacture, trade and use in the region.

The main objectives of the Regional Action Plan on Mercury are to: (a) assess the mass balance of mercury on the North American continent, including sources: (b) inventory risk-reduction activities to determine how/where they might be applicable to the three Parties; and (c) based on (a) and (b), identity opportunities for continental approaches to reducing risks to human health and the environment. Activities addressed in the draft included the status of mercury monitoring and use; risk management mechanisms and approaches; assessment activities, regional initiatives, and capacity building initiatives.

The program's objectives are extensive and are outlined in the final "U.S.-Mexico Border XXI Framework Document." They include:

- working in conjunction with state, tribal and local health, environmental and agricultural agencies; reduce and respond to health problems arising from exposure to chemical, physical and biological agents;
- build or upgrade wastewater and drinking water systems;
- reduce air pollution in innovative ways, including expansion of monitoring and control programs;
- improve cross-border collaboration between natural resource and public health entities;
- expand the tracking program for shipments of hazardous and toxic substances across the border;
- promote economic incentive programs for reducing pollution more quickly and cost-effectively;
- promote pollution prevention and recycling in cooperation with industries;
- improve emergency response procedures including free movement of equipment and personnel across the border (in both directions) to deal with chemical emergencies;
- improve and expand protection of species and habitat along the border;
- intensify enforcement of the environmental and health protection laws of both countries, and
- increase public accessibility to desired information, including environmental data.

Reflecting the dynamics of the area, the innovative and flexible program will continue to evolve while addressing the increasingly difficult problems brought on by rapid population and industrial growth in the region, an area extending for almost 2,000 miles and 62 miles on each side of the border. The region encompasses parts of four U.S. states (California, New Mexico, Arizona and Texas) and six Mexican states (Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon and Tamaulipas).

Annual reviews of the program will include a reassessment of priorities and implementation plans developed by nine workgroups, progress made toward meeting the five-year goals and development of needed new projects. In conjunction with these reviews, comments will be solicited from public advisory boards. A biennial public comment period is planned to assure further community input.

Building on a long history of bilateral cooperation, the new plan aims to achieve sustainable development along the border by integrating the work of institutions created under the North America Free Trade Agreement and its environmental side agreement, the Border Environment Cooperation Commission, the North American Development Bank, and Commission for Environmental Cooperation, as well as the International Boundary and Water Commission. The need to focus on regional solutions prompted the organization of the plan into five bilateral regions, California-Baja California, Arizona-Sonora, New Mexico-Texas-Chihuahua, Texas-Coahuila-Nuevo Leon, and Texas-Tamaulipas.

The plan reflects resolutions made at the last meeting of the U.S./Mexico environmental commission of the 10 border states concerning binational cooperation on economic growth and environmental issues.

The "U.S.-Mexico Border XXI Framework Document," with the Executive Summary and the working groups' 1996 Implementation Plans, is available on the U.S.-Mexico Home Page at http://www.epa.gov/usmexicoborder. Copies also are available from EPA's Border Offices: 610 West Ash St., Suite 703 (Att: Border XXI) San Diego, Calif., 92101, phone 619-235-47645; and 4050 Rio Bravo, Suite 100 (Att: Border XXI) El Paso, Texas 79902, phone 915-533-7273.