Border Air Quality Strategy

Great Lakes Basin Airshed Management Framework Pilot Project

Canada–United States Air Quality Agreement

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Great Lakes Basin Airshed Management Framework Pilot Project

The Great Lakes Basin Airshed Management Framework Pilot Project partners include:

Government of Canada (Environment Canada & Health Canada)
United States Environmental Protection Agency
Ontario Ministry of the Environment
Michigan Department of Environmental Quality
International Joint Commission
Canadian Consulate General (Detroit)
Southeast Michigan Council of Governments
City of Windsor
City of London
City of Sarnia
The Corporation of the Municipality of Chatham-Kent

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Executive Summary

INTRODUCTION

This report has been prepared by the Canada–United States Steering Committee of the Great Lakes Basin Airshed Management Framework Pilot Project under the Canada–United States Border Air Quality Strategy.

The purpose of this report is to summarize actions and initiatives undertaken by the partners involved in this pilot project since it was announced in June 2003. The report provides an overview of the initiatives undertaken in the past two years, lessons that were learned, opportunities for future collaboration, significant results, and a summary of recommendations for further work in the Southwest Ontario/Southeast Michigan border region.

OVERVIEW

Canada and the United States have been cooperating on air quality issues for more than two decades. In 1980, the two governments signed a Memorandum of Intent on transboundary air pollution that eventually led to the signing of the Canada–United States Air Quality Agreement in 1991. This Agreement addressed acid rain and scientific/technical cooperation, as well as economic research. In 2000, an amendment to this Agreement, known as the Ozone Annex, addressed ground-level ozone, an important component of smog. These two efforts resulted in the reduction of millions of tons of air emissions in the transboundary region.

The governments recognize that work on a broad range of air quality issues, including technical areas such as air monitoring and emission inventories, policy issues such as control strategy development, and communications, is critical in order to set further reduction targets and to reduce air pollution. In June 2003, the governments of Canada and the United States committed to continue their cooperative efforts to reduce air pollution with the announcement of three joint pilot projects under the Canada–United States Border Air Quality Strategy. One of these, the Great Lakes Basin Airshed Management Framework, was intended to explore the feasibility of a coordinated airshed management approach in the Southwest Ontario/Southeast Michigan region.

An "airshed" is a geographic area within which air pollution is freely and routinely transported and that is influenced by shared sources of pollutants, weather, and terrain. The Southwest Ontario/Southeast Michigan airshed is an excellent study area, because the region has a high concentration of sources that contribute to domestic and transboundary air quality issues.

Coordinated management of the airshed can result in a common understanding of the airshed, so that actions and cooperation on both sides of the border can be better directed and more effective in achieving increased air quality gains.

THE GREAT LAKES BASIN AIRSHED MANAGEMENT FRAMEWORK PILOT PROJECT

Led by Environment Canada and the United States Environmental Protection Agency (U.S. EPA), this pilot project was aimed at exploring opportunities for greater cross-border cooperation that could improve air quality in the area. The intention of the project was to enhance information exchange on air pollution and associated health-related impacts, as well as to examine the non-technical issues that influence air quality management in the region.

Environment Canada and the U.S. EPA recognized that there was a need to bring together health, environment, and policy experts from government agencies and binational organizations to lead this feasibility study. At an early stage, experts from both sides of the border convened to establish the scope of the project. They identified four main areas that would need to be addressed:

1) Before any improvements could be made, there was a need to **first assess the current**

available technical information on both sides of the border.

2) While the individual partners were aware of their own systems, it was important to gather a **collective understanding of air quality management systems** on both sides of the border and recognize the institutional and regulatory mechanisms that impact these.
3) Although regulatory approaches were available in both countries, it was important to **assess and implement voluntary initiatives** that go beyond-compliance, such as using innovative technologies and the adoption of best management practices. The sectors for voluntary action could include stationary industrial sources, mobile sources (diesel trucks and school buses), non-point sources (dust from agricultural operations and road traffic), and the general public.
4) Enhancing information exchange would require an **analysis of communications and outreach strategies** needed to maintain ongoing dialogue between the two countries and support coordinated air management in the region.

As well, targeted health research projects were identified to be conducted under the pilot framework to generate knowledge of the health impacts of air pollution specific to the airshed, which would provide valuable data to assist in future risk management decision-making.

Consequently, a Steering Committee and four workgroups were established. The Steering Committee provided an oversight and leadership role and was responsible for the overall implementation, approval, and guidance of workgroup activities. The Steering Committee was led by Canadian and U.S. co-chairs and was composed of membership from each of the workgroups.

The four workgroups were 1) Airshed Characterization, 2) Policy Needs, 3) Voluntary/ Early Action, and 4) Communications and Outreach. Each of these workgroups was also led by Canadian and U.S. co-chairs and had representation from agencies and organizations on both sides of the border.

A summary of the activities undertaken by each workgroup is contained within this report. Although health experts were members of the Airshed Characterization and Policy Needs workgroups, a separate section on health is contained within this report to reflect its importance and to enable a comprehensive discussion of the considerable research undertaken on the health effects of air pollution.

Geographic Description of the Airshed

The Detroit/Port Huron area in Southeast Michigan shares a border with the Windsor/ Sarnia area in Southwest Ontario (see Figure 1). At these locations, the United States and Canada are separated by the St. Clair River to the north, Lake St. Clair, and the Detroit River. There are border crossings at the Bluewater Bridge linking Port Huron and Sarnia and at the Ambassador Bridge and the Detroit-Windsor Tunnel connecting Detroit and Windsor. These crossings are the busiest international crossings between Canada and the United States. They represent nearly 50 percent of the traffic volume crossing the entire border between Canada and the United States, with over 75,000 vehicles traveling between the two countries each day.

The Southwest Ontario region is located within this corridor and includes the counties of Windsor-Essex, Sarnia-Lambton, Chatham-Kent, London-Middlesex, and Elgin. This geographic region covers an area of roughly 15,416 square kilometers (5,952 square miles), with a population of more than 1 million people. The major cities include Windsor, Sarnia, London, and Chatham. Several large industries, including Windsor's auto manufacturing and Sarnia's petroleum and petrochemical facilities, are also located in this region.

The study area in Southeast Michigan is the largest urban area in Michigan, with a population of more than 4.5 million people. This geographic area covers roughly 11,655 square kilometers

Figure 1 Map of geographic area

(4,500 square miles) and includes the cities of Detroit, Ann Arbor, and Port Huron. The area includes the following eight counties: Lenawee, Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne. The area is treated as a single airshed for most pollutants regulated by the U.S. EPA and has traditionally been considered as such for purposes of air quality and transportation planning. Southeast Michigan is a key industrial and commerce center in the region and has substantial interaction across the border with Canada.

Air Quality within the Airshed

The pollutants of concern for this project are ground-level ozone, fine particulate matter up to 2.5 microns in diameter ($PM_{2.5}$), and their precursors. Both Canada and the United States operate their own ambient air monitoring networks in this region. In general, locations in the Southwest Ontario/Southeast Michigan region exceed the air quality standards for ozone and $PM_{2.5}$. Elevated smog levels in the airshed are due to emissions from a variety of sources both within and outside the area. Work is currently under way in both countries to better understand the variety of sources that contribute to air pollution problems in the airshed.

Canada–wide Standards (CWS) for $PM_{2.5}$ and ozone were developed in June 2000. For $PM_{2.5}$, the target is to achieve a concentration of 30 micrograms per cubic meter ($\mu g/m^3$), 24-hour average, by year 2010, based on the 98th-percentile ambient measurement annually, averaged over three consecutive years. For ozone, the target is to achieve a concentration of 65 parts per billion (ppb), eight-hour average, by year 2010, based on the fourth-highest measurement annually, averaged over three consecutive years.

In the United States, the National Ambient Air Quality Standards (NAAQS) for particulate matter and ozone were revised in 1997. The $PM_{2.5}$ annual standard is to achieve a concentration of 15 $\mu g/m^3$, averaged over three consecutive years. The 24-hour standard is to achieve a concentration of 65 $\mu g/m^3$, based on the 98th-percentile ambient measurement annually, averaged over three consecutive years. The annual standard addresses total annual risk, while the 24-hour standard protects against exposure in localized "hot spots" and seasonal

emissions. For ozone, the standard is to achieve a concentration of 0.08 ppm, eight-hour average, based on the fourth-highest measurement annually, averaged over three consecutive years.

The United States and Canada also have air quality indices (AQI) for $PM_{2.5}$ and ozone for purposes of informing the public about air quality in their respective geographic areas. These AQI are obtained from the measurement of several air pollutants and can be attributed to any one of these pollutants; however, ground-level ozone and $PM_{2.5}$ are normally the pollutants that are elevated to threshold levels. The AQI are calculated differently for Canada and the United States.

The AQI used in Ontario reaches the poor category (50 or greater) when the hourly averaged concentration of ground-level ozone exceeds 80 ppb or a three-hour running average of fine particulate matter exceeds 45 µg/m³. Values are obtained for each of the monitors in the Southwest Ontario region, thus giving a range for the number of days on which the AQI reached the poor level throughout the region.

The AQI used in Michigan reaches the unhealthy category (at first for sensitive populations, then for everyone as the AQI values get higher) when the eight-hour average ground-level ozone concentration exceeds 84 ppb or a 24-hour average $PM_{2.5}$ concentration exceeds 40.4 µg/m³. AQI values are calculated for each monitor in the Southeast Michigan region. It should be noted that the use of longer averaging times tends to lower the reported concentration.

I. Canada

Residents of Southwest Ontario, comprising five counties, are exposed to the highest number of days in the country on which the air quality is considered to be poor (i.e., the AQI is greater than 49 for at least one hour).

Number of Days where the AQI is greater than 49 for at Least 1 Hour (Poor Category)

The number of days on which communities within the Southwest Ontario region experienced poor air quality (i.e., AQI > 49 for at least one hour) is shown in Table 1.

Canada–wide Standards (CWS) Reference Levels

The various levels of government in Canada have agreed to a set of reference levels known as the Canada–wide Standards (CWS), which will be coming into force in the next few years. The CWS are calculated based on a statistical approach using three years of monitoring data. This approach helps to compensate for the fact that variations in meteorological conditions can greatly affect air pollution levels. The meteorology influences the formation, dispersion, and transport of pollutants; because of the year-to-year variability in meteorology, the $PM_{2.5}$ and ozone concentrations observed in a particular year cannot be assumed to be reflective of the levels in past or future years (Table 2).

II. United States

On the U.S. side of the border, the Detroit area has made a great deal of progress in reducing air pollutants. With the implementation of numerous control programs over the past two decades, monitors have shown attainment for the one-hour ozone, carbon monoxide (CO), and coarse particulate matter (PM_{10}) standards, and the area has been redesignated as attainment for each. The U.S. EPA has recently gone through the process of designating areas across the country as either attainment or nonattainment for the new eight-hour ozone and $PM_{2.5}$ NAAQS. The Detroit area is nonattainment for both pollutants and is working at identifying and implementing control strategies that will ultimately provide for attainment.

Table 1 Poor air quality days in the Southwest Ontario region, 2002–2003

Year	Days with an AQI > 49 for ozone [1] and/or for $PM_{2.5}$ [2]
2002	21-47
2003	17-23

[1] One-hour average ozone greater than 80 ppb.

[2] Three-hour running average $PM_{2.5}$ greater than 45 µg/m³

Table 2 Range of days exceeding CWS reference levels for $PM_{2.5}$ and ozone in the Southwest Ontario region, 2001–2003

Year	Range of days when daily mean $PM_{2.5}$ concentration exceeded CWS reference level [1]	Range of days when the daily maximum eight-hour ozone concentration exceeded CWS reference level [2]
2001	5-9	23-35
2002	9-17	34-49
2003	4-13	10-45

Note: $PM_{2.5}$ exceedance days may coincide with ozone exceedance days, and vice versa.

[1] Twenty-four-hour $PM_{2.5}$ greater than 30 µg/m³.

[2] Eight-hour ozone greater than 65 ppb.

Poor Air Quality Days

Table 3 shows the number of days in Southeast Michigan with at least one air quality monitor with high AQI values (values greater than 100) due to ozone and/or fine particulate matter concentrations. In the 2002-2004 period, a total of 27 "Ozone Action! Days" were called in Southeast Michigan to notify the public that air quality levels were likely to be above the health-based standards.

National Ambient Air Quality Standard Comparison

Table 4 shows the maximum current design values for the Southeast Michigan region for the applicable ozone and particulate matter NAAQS. A design value is a mathematically determined concentration at a particular monitoring site and is a number that can be compared with the NAAQS. The region is meeting the short-term $PM_{2.5}$ NAAQS but is exceeding the standard for annual $PM_{2.5}$ and eight-hour ozone. Data collected between 2002 and 2004 show violations of the eight-hour NAAQS at five of the nine ozone monitors in the area, with the highest concentrations occurring at the New Haven monitor in Macomb County, downwind of most of the major industrial and mobile source emissions.

The situation is similar for the $PM_{2.5}$ standard. Based on monitoring data collected in Southeast Michigan between 2002 and 2004, monitors in the area measure some of the highest $PM_{2.5}$ concentrations in the region. Four monitors in the Detroit area are showing three-year annual averages above the NAAQS of 15 µg/m³.

Preliminary analyses performed by the U.S. EPA and regional modeling organizations showed that it will be a significant challenge for Southeast Michigan to attain the eight-hour ozone and $PM_{2.5}$ NAAQS. Even with the implementation of significant regional control strategies, such as the nitrogen oxides (NO_X) State Implementation Plan (SIP) Call, the Tier 2/low-sulfur gasoline standards, heavy-duty diesel regulations, national nonroad engine controls, and even the recently promulgated Clean Air Interstate Rule (CAIR), the area is still predicted to violate the NAAQS. An active program to examine the ozone and $PM_{2.5}$

Table 3 Poor air quality days in the Southeast Michigan region in 2002-2004

Year	Days with high ozone [1]	Days with high $PM_{2.5}$ [2]
2002	23	15
2003	8	17
2004	1	35

1 Eight-hour ozone greater than 84 ppb.

2 Twenty-four-hour $PM_{2.5}$ greater than 40.4 µg/m³.

Table 4 Maximum current design values for the ozone and $PM_{2.5}$ NAAQS in the Southeast Michigan region, 2002-2004

Years	Eight-hour ozone current design value [1]	24-hour $PM_{2.5}$ current design value [2]	Annual $PM_{2.5}$ current design value [3]
2002-2004	92 ppb	42.6 µg/m³	18.6 µg/m³

1 Eight-hour ozone NAAQS violation is a design value exceeding 84 ppb.

2 Twenty-four-hour $PM_{2.5}$ NAAQS violation is a design value exceeding 65 µg/m³.

3 Annual $PM_{2.5}$ NAAQS violation is a design value exceeding 15 µg/m³.

problems, the Southeast Michigan Ozone Study (SEMOS), is under way in the area to improve understanding of the nature of the air quality problem and to recommend possible control scenarios to bring areas within the health-based standards.

Key Sources of Air Pollutants in the Airshed

In the Southwest Ontario/Southeast Michigan area, sources of air pollutants include industry, transportation, and other sources.

I. Canada

In Southwest Ontario, the major industrial sources are auto and auto parts manufacturing, petroleum refining, chemical manufacturing, and coal-fired power plants. Urban sources such as transportation and area sources such as residential fuel combustion are also key sources of air pollution in this region. Annual emissions of criteria air contaminants that can contribute to poor air quality in Southwest Ontario — volatile organic compounds (VOCs), NO_X, sulfur oxides (SO_X), and $PM_{2.5}$ — are summarized in Table 5 and illustrated in Figure 2.

II. United States

The major local industrial sources in Southeast Michigan include large coal-burning power plants (including the largest in Michigan), auto and auto parts manufacturers, steel mills, coke ovens, plastics facilities, waste incinerators, and an oil refinery. Mobile sources are also a significant source of air pollution in the area. Major annual emissions for VOCs, NO_X, SO_X, and $PM_{2.5}$ are summarized in Table 6 and illustrated in Figure 3. VOCs and NO_X contribute to ozone formation. VOCs, NO_X, and sulphur dioxide (SO_2) contribute to $PM_{2.5}$ formation.

SUMMARY OF PILOT PROJECT

Workgroup Findings

I. Airshed Characterization

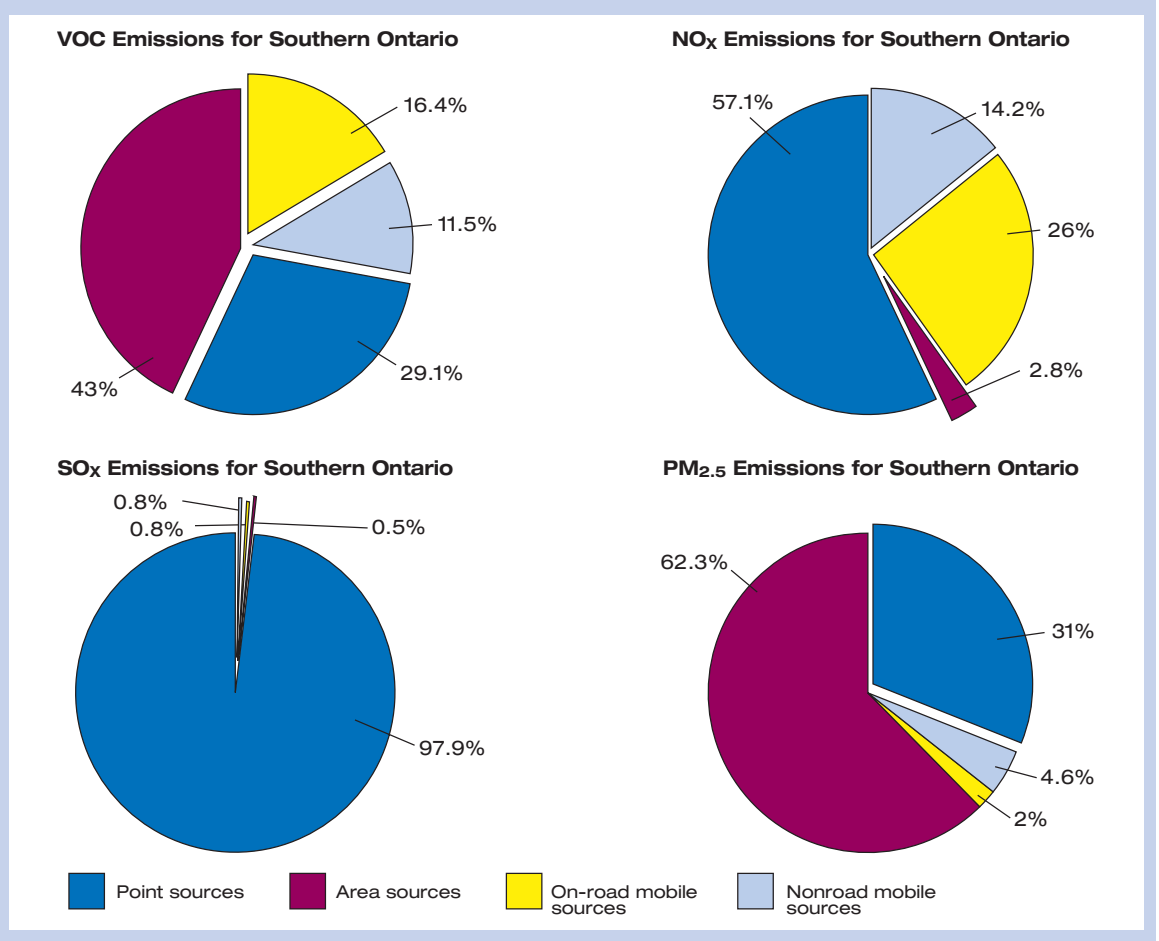
The Airshed Characterization Workgroup goal was to examine the key technical and scientific tools and information used in airshed management. The workgroup focused on five major areas: air quality monitoring, air emission inventories, air quality modeling, air quality indices and forecasting, and health issues. General results in each of these areas are detailed

Table 5 Annual emissions of criteria air contaminants in Southwest Ontario, 2000

	VOCs			NO_X			SO_X			$PM_{2.5}$		
	tonnes/ year	tons/ year	(%)	tonnes/ year	tons/ year	(%)	tonnes/ year	tons/ year	(%)	tonnes/ year	tons/ year	(%)
Point sources	27,641	30,404	29.1	86,738	95,410	57.1	197,009	216,707	97.9	10,590	11,649	31.0
Area sources	40,856	44,941	43.0	4,213	4,634	2.8	1,015	1,117	0.5	21,307	23,438	62.3
On-road mobile sources	15,554	17,109	16.4	39,495	43,444	26.0	1,670	1,837	0.8	698	768	2.0
Nonroad mobile sources	10,922	12,014	11.5	21,538	23,691	14.2	1,526	1,678	0.8	1,580	1,738	4.6
Total	94,972	104,468	100	151,983	167,180	100	201,219	221,339	100	34,176	37,593	100

Note: Percentages do not necessarily add to 100, and totals may be rounded up or down.

Figure 2 Southwest Ontario emissions of criteria air pollutants, 2000



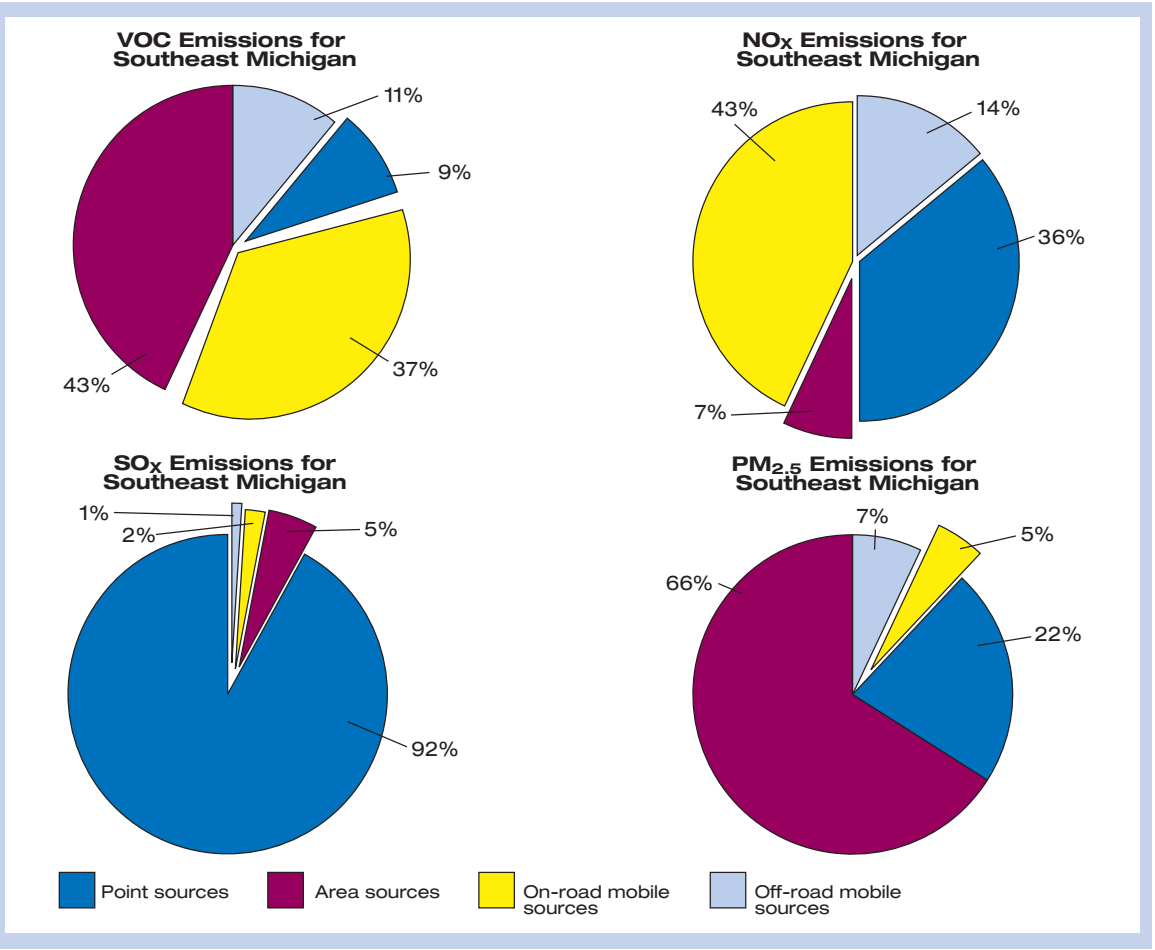
Note: Percentages do not necessarily add to 100, and totals may be rounded up or down.

Table 6 Annual emissions of criteria air contaminants in Southeast Michigan, 2002

	VOCs			NO_x			SO_x			$PM_{2.5}$		
	tons/ year	tonnes/ year	(%)	tons/ year	tonnes/ year	(%)	tons/ year	tonnes/ year	(%)	tons/ year	tonnes/ year	(%)
Point sources	21,000	19,000	9	109,000	99,000	36	253,000	229,000	92	9,000	8,000	22
Area sources	105,000	95,000	43	22,000	20,000	7	15,000	14,000	5	27,000	24,000	66
On-road mobile sources	89,000	81,000	37	127,000	115,000	43	6,000	5,000	2	2,000	2,000	5
Off-road mobile sources	27,000	24,000	11	41,000	37,000	14	4,000	4,000	1	3,000	3,000	7
Total	242,000	219,000	100	299,000	271,000	100	278,000	252,000	100	41,000	37,000	100

Notes:
1 Percentages do not necessarily add to 100, and totals may be rounded up or down.
2 Data are from the 2002 Preliminary National Emission Inventory (NEI) Database on NEI Emissions On the Net (NEON), rounded to the nearest 1,000. Final 2002 NEI data may show significant differences. Counties include Lenawee, Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne.

Figure 3 Southeast Michigan emissions of criteria air pollutants, 2002



Note: Percentages do not necessarily add to 100, and totals may be rounded up or down.

below, with the exception of health studies, which are discussed under the health report.

Air Quality Monitoring

Extensive networks of air quality monitoring stations operate within the Southwest Ontario/Southeast Michigan border airshed, under the auspices of state, provincial, and federal monitoring programs. An integrated map showing ozone and $PM_{2.5}$ monitoring locations is shown in Figure 1-1 of the Airshed Characterization Workgroup Report (Chapter 1). In general, air pollutants are measured using equivalent instrumentation within the airshed on both sides of the border.

A project was undertaken to evaluate the quality assurance procedures used in each country in an effort to ascertain the compatibility of air quality monitoring data collected. This project included site visits to a number of monitored locations on both sides of the border. The results indicate favorable comparisons; however, there is an **opportunity for further future collaboration on air quality monitoring and data analysis. Harmonizing instrumentation and data collection methods** within the airshed will allow for enhanced sharing and comparability of data.

Air Emission Inventories

Knowledge of the amount of pollutants emitted into the airshed is useful in developing strategies for reducing emissions in an effort to improve air quality and to improve human health.

As part of this study, there has been a sharing of emission inventory information among air quality officials on both sides of the border. As a result, there is an **improved understanding of emission inventory processes** which will lead to improved inventory data sets. These inventories are important inputs into the models used for air quality forecasting and for evaluating the effectiveness of various emission reduction strategies. It is important that this **sharing continue to take place** and that there is an **interaction between emission inventory developers to improve the quality and utility of emission inventories** through bilateral meetings and forums.

Air Quality Modeling

Air quality models are useful in understanding the link between sources of pollution and their impacts, as well as in estimating the relative contributions from multiple emission sources, to determine the most effective control strategies. As part of the efforts under this study, modeling practices on both sides of the border were shared. Results indicate that there are a **number of organizations that are conducting air quality modeling, using a variety of air quality tools** relevant to the Southwest Ontario/Southeast Michigan region. The activities range from Canada–U.S. transboundary transport evaluations to field study campaigns to focused modeling exercises examining the response of models to changes in emissions.

The continued sharing of modeling results and improvements among model users should be encouraged. The additional information provided by **multiple models can add valuable information about the ozone and particulate matter concentrations in the airshed**. A model comparison study of all the various tools used in the airshed should be conducted.

Air Quality Indices and Forecasting

There are **commonalities and differences in the AQI and air quality forecasting systems of Canada and the United States**. It is important that these **differences be understood for communicating to residents living within the airshed**. There is an opportunity for improving coordinated management of the airshed through the development of common approaches to reporting on air quality and health.

II. Policy Needs

The goal of the Policy Needs Workgroup was to improve air quality coordination and information exchange between the United States and Canada

in the Southwest Ontario/Southeast Michigan border area. The workgroup focused on five major areas: administrative and structural frameworks, control strategies and jurisdictional plans, permitting systems for existing, new, and modified sources, compliance and enforcement systems, and policy uses for scientific tools. General results in each of these areas are detailed below.

Administrative and Structural Frameworks

The Southwest Ontario/Southeast Michigan airshed is managed under two entirely independent and complex administrative structures, which have been in existence for many years and have been established to meet individual jurisdictional needs. As such, program implementation and policy development are in most part undertaken separately within the two countries. While a good understanding of programs and policies can lead to increased cooperation, it is doubtful that these could be dramatically changed in the short term to meet the needs of airshed management.

Work on this Great Lakes Basin Airshed Management Framework Pilot Project does, however, indicate that **there is opportunity for cooperation among jurisdictions within the border region to utilize the existing mechanism under the Canada–United States Air Quality Agreement to address sources within and outside the Southwest Ontario/Southeast Michigan airshed that may impact air quality in the airshed. Federal authorities may be necessary to address emissions of sources within and outside the airshed that Ontario and Michigan have no authority to control**.

Control Strategies and Jurisdictional Plans

There are differences in air quality standards, authorities for regulating sources of pollution, and statutory deadlines for meeting air quality regulation on both sides of the border. A review of existing control programs indicates that despite differences in numerical targets and timelines, they are working towards the same fundamental goal of reducing emissions of particulate matter and ozone precursors from industrial, transportation, and area sources to meet national air quality standards. Area sources that are relatively more challenging to control warrant further review of control programs. However, further examination is required as to whether these existing control programs are adequate to meet air quality standards in both countries. In the meantime, existing local mechanisms (e.g., SEMOS) that are addressing air quality should be encouraged to encompass a cross-border focus. **In addition, the existing mechanism under the Canada–United States Air Quality Agreement should be utilized for agencies to be kept informed of public processes to ensure that jurisdictions are notified on a timely basis of proposed regulations and other management options so that input to the process may be submitted. There should be dialogue on complementary approaches of national initiatives at the federal level. In addition, there should be dialogue at the local level on control measures that would apply within Southwest Ontario/Southeast Michigan**.

Permitting Systems for Existing, New, and Modified Sources

New and modified industrial sources of air emissions are assessed through permit systems at the state/provincial level. These sources are reviewed based on technical evaluation and compliance with domestic legislation and regulations.

As each government is sovereign, coordination of permitting systems is a challenge. However, there is **a potential for increased communication on permitting issues**. For example, the Michigan Department of Environmental Quality (MDEQ) and the Ontario Ministry of the Environment (OMOE) agreed that it would be beneficial to meet annually to share information on common issues of interest, such

as proposed facility permits near the border, joint training, and sector-based initiatives. There is also **room for improving notification protocols** to facilitate cross-border participation in the public comment process. In addition, there is a need to review transboundary notification procedures to **ensure that obligations within the Canada–United States Air Quality Agreement are being met**.

Compliance and Enforcement Systems

Although there are significant jurisdictional differences, the fundamental approach to air enforcement in the two countries is comparable. In fact, inspection procedures and complaint responses in the two countries are similar.

At times, complaints are made by U.S. citizens regarding sources in Canada, and vice versa. However, the workgroup found no mechanism referring these complaints to appropriate authorities in the country where the source is located. The workgroup also noted several differences in the way in which minor penalties are administered, especially with regards to the authority to issue administrative tickets for minor violations in Canada.

An agreement already exists between the state of Michigan and the province of Ontario to address transboundary spills and emergency air releases. This mechanism appears to be adequate for responding to emergency release conditions.

As a result of transboundary enforcement discussions under this pilot project, a mechanism for cross-border complaints has now been established, including follow-up inspections of facilities and development of a contact list of abatement and enforcement staff. There remains a **potential for improving the responses to complaints regarding sources across the border and sharing general compliance information among abatement and enforcement staff**.

Policy Uses for Scientific Tools

As decisions are made on control strategy options for an airshed, it is important that complex technical information (i.e., air monitoring, emissions inventories, modeling, and health tools and research activities) be presented to policymakers and the general public in a manner that allows for scientific information to play a meaningful role in the policy debate.

While Canada and the United States continue to collaborate on addressing the common science questions that are of interest to policymakers on both sides of the border, there is a need to **establish a more effective mechanism (e.g., web site, periodic meetings, etc.) to share scientific information on air quality and health among policy and science experts from all jurisdictions**. In addition, **communication with the local community on scientific information should be encouraged** to develop programs and to promote local actions to address emissions from commercial, residential, and transportation sources. In the meantime, there should be continued participation by federal, state, and provincial agencies in existing groups that have a science policy interest.

III. Voluntary and Early Actions

The Voluntary/Early Action Workgroup identified voluntary opportunities in the airshed and developed several pilot demonstrations that were largely focused on transportation opportunities, as well as point source emissions from small and medium-sized enterprise (SME) manufacturing facilities. The focus was on sectors that are not historically regulated and on projects with the potential to produce verifiable results in a short time frame. While the voluntary/early action efforts undertaken within this feasibility framework have resulted in positive air quality gains, they have been "top-down" actions initiated by the federal governments in both Canada and the United States.

A broad spectrum of voluntary/early actions currently under way in both the Canadian and U.S. portions of the airshed are being led at all levels. While these initiatives are not formally coordinated, there are numerous examples of similar opportunities within both countries resulting in emission reductions. The existing initiatives are primarily issue, sector, and/or geographically based, are largely transportation focused, and go beyond-compliance.

With respect to the industrial contribution, research was conducted to characterize reported air emissions by the industrial SME manufacturing base in the Southwest Ontario portion of the airshed. This provides a starting point for a comprehensive analysis of industrial SME manufacturers on both sides of the border. By identifying priority industrial sectors (large emitters and SMEs) common to both the United States and Canada for voluntary/early action initiatives, synergies developed can be of particular value in advancing air emission reductions with SMEs.

Experience with implementing voluntary programs indicates that the most successful projects are those that include participation from local units of government. Local organizations should be encouraged to promote voluntary/early action efforts and should be provided with technical support, information on financial assistance, and tools to link voluntary/early action to environmental and health benefits to help build their capacity to manage these programs. In addition, raising awareness of the benefits of voluntary/early actions and involving local governments could result in greater potential for air quality improvements.

There is an **opportunity for both countries to build on existing efforts and identify other areas of mutual interest** (e.g., reducing idling at border crossings and marine engines). **Continued research and analysis of the industrial manufacturing base** (large emitters and SMEs) **for identifying common priority sectors across the airshed will also help to advance air emission reductions with SMEs in Southwest Ontario/Southeast Michigan**.

IV. Communications and Outreach

Cooperating on communication efforts in this pilot area is not a new concept for Canada and the United States. A good example of this is a meeting in 2000 of the Southeast Michigan Council of Governments and the OMOE to discuss "Ozone Action! Days" (notifications to the public that elevated ozone concentrations are anticipated, allowing the public to make clean air choices).

Canada and the United States need to **build on the working-level relationships that have been developed through this study and develop joint communication and outreach initiatives** that provide continuous education and outreach to a wide range of interested parties on both sides of the border. In fact, air quality is especially important to stakeholders living within the border area, and it is important that Canada and the United States provide **consistent messaging regarding air quality and air quality management**. It is also important to provide residents, businesses, industry, and others with information on how they can be involved and what they can do to improve air quality, as well as to recognize those efforts to improve air quality.

Many opportunities have been identified for Canada and the United States to continually improve cross-border communications. **While a number of preliminary recommendations are also considered, these represent a starting point for identifying the public's need for air quality information**. At a future point, these will have to be matched up with an assessment of the needs of the public (i.e., public opinion poll). One of the recommendations is to perform an analysis of the communications audit that was undertaken in March 2005 as part of this Great Lakes Basin Airshed Management Framework Pilot Project to identify additional communication needs or gaps in the pilot area.

V. Health

The people of Southwest Ontario/Southeast Michigan are aware of the high level of air pollution in their area compared with other areas in the two countries. Regional health concerns include urban pollution from diesel truck emissions, residential fuel combustion, road dust, and industrial pollution from coal-fired power plants, manufacturing, steel mills, waste incinerators, oil refineries, and chemical manufacturers.

There has been considerable media coverage of the increasing frequency of smog advisories in the border area. In these reports, air pollution is often linked to health problems in children, seniors, and other vulnerable populations.

While there is recognition that the health policies in both countries play a key role in the studies that are being conducted under the Border Air Quality Strategy, it would have been useful at the beginning of the process to establish formal communication between Canada and the United States on health policy. Furthermore, it would have been useful at the beginning of the process to have a joint Canada–U.S. consortium of researchers and policy representatives develop a framework for the implementation of a common research design. **Canadian and U.S. researchers are encouraged to utilize the exisiting mechanism under the Canada–United States Air Quality Agreement to promote ongoing communication and data sharing**. The collaborative efforts among agencies, local health units, academics, and politicians in these research activities provide a good model for addressing significant local health issues and a basis for ongoing health work.

One particular study, known as the Windsor Children's Respiratory Health Study, conducted by Health Canada, has been a step towards narrowing a key data gap — i.e., the long-term health effects of air pollution, particularly for children. However, the usefulness of this study could be significantly enhanced by the inclusion of a longitudinal component (i.e., multiyear follow-up). **Similarly, Canada and the United States should discuss the health effects of PM, its sources, as well as any future research needs through the Canada–United States Air Quality Committee**.

Significant Results

Significant results of the pilot project include:

- Increased understanding of technical information and tools used in Canada and the United States, including air quality modeling, monitoring, and emission inventory development.
- Completion of an evaluation of the air monitoring quality assurance procedures used in each country, which found favorable comparisons.
- Improved mechanisms for responding to cross-border complaints on air quality. Citizens and air quality officials in both countries may now report their complaints regarding facilities in the neighboring country, and they will be responded to by the appropriate authorities.
- Improved industrial source permit notification procedures. As a result, groups in Canada were able to voice concern over a proposed permit for a coke oven in Ohio, which contributed to stricter mercury limits being imposed on the facility.
- Initiation of health research within the airshed that is furthering our understanding of particulate matter and its effects on human health.
- Retrofitting of a number of local and regional fleets across the airshed, with diesel oxidation catalysts reducing emissions of Carbon Monoxide (CO), Volatile Organic Compounds (VOCs) and Particulate Matter (PM) totaling 5.16 tonnes (5.69 tons) per year.

CONCLUSIONS

- **Coordinated management of the airshed is feasible and desirable**, and there may be applicability to other areas within the Great Lakes Basin.
- There are **barriers and obstacles with coordinated management of the airshed**, but many of these **can be overcome with long-term sustained effort** from the engagement of various levels of government and other partners.
- Coordinated management of the airshed is possible by taking advantage of existing mechanisms (existing permitting processes, technical committees, annual workshops and meetings); however, in some cases, **new opportunities need to be explored and implemented (communications, health). Partners should work together through the Canada–United States Air Quality Agreement to accomplish this**.

RECOMMENDATIONS AND NEXT STEPS

- Following the release of this pilot project report, partners should undertake efforts to **communicate report findings to stakeholders**, including industry, business, environmental groups, academia, First Nations, and other levels of government.
- Over the next year, **partners should work to formalize their interactions through an appropriate mechanism, such as the Canada–United States Air Quality Agreement**, for ongoing cooperation and dialogue.
- **The Steering Committee recommends that the Canada–United States Air Quality Committee consider convening an Ad Hoc Task Group under the Canada–United States Air Quality Agreement to serve as the primary mechanism by which future activities in the Southwest Ontario/Southeast Michigan airshed are continued**. This Ad Hoc Task Group should include members from the partner groups that contributed to the Great Lakes Basin Airshed Management Framework Pilot Project, including the U.S. EPA, Environment Canada, Health Canada, OMOE, and MDEQ.

  The activities of this Ad Hoc Task Group should include, but not be limited to:

- taking advantage of existing opportunities to discuss transboundary air quality issues (SEMOS, Windsor Essex County Air Quality Committee, Essex Air & Waste Management Association, etc.) in the local area;
- convening an annual meeting of partners and other interested groups to discuss integrated airshed planning;
- sharing technical information from both sides of the border;
- discussing ways in which individual recommendations outlined in this report from the workgroups can be implemented; and
- reporting progress annually to the full Canada–United States Air Quality Committee.

CHAPTER 1

AIRSHED CHARACTERIZATION WORKGROUP REPORT

DESCRIPTION

The goal of the Airshed Characterization Workgroup was to improve air quality coordination and information exchange between the United States and Canada in the Southwest Ontario/Southeast Michigan border area. This would facilitate binational collaboration among agencies to improve air quality management. The workgroup focused its efforts specifically on ozone (O_3), fine particulate matter ($PM_{2.5}$), and their precursors.

Five technical subgroups were established under the Airshed Characterization Workgroup. The subgroups focused on air quality monitoring, emission inventories, air quality modeling, air quality forecasting and indices, and health studies. **Health studies are discussed separately in Chapter 5**.

The workgroup's membership was composed of representatives of the following organizations: U.S. Environmental Protection Agency (U.S. EPA) Region 5, Environment Canada, Michigan Department of Environmental Quality (MDEQ), Ontario Ministry of the Environment (OMOE), International Joint Commission, Health Canada, Southeast Michigan Council of Governments (SEMCOG), Canadian Consulate, and Municipalities of Windsor, Chatham, and London.

CURRENT STATUS AND ISSUES

Air Quality Monitoring

Air quality monitoring is useful in describing how pollutants in the airshed are distributed and how they change over time. Monitored concentrations can help quantify the levels of exposure for residents in the airshed and can be used to compare air quality with applicable standards.

Extensive networks of air quality monitoring stations operate within the Southwest Ontario/Southeast Michigan border airshed, under the auspices of state, provincial, and federal monitoring programs. In general, air pollutants are measured using equivalent instrumentation within the airshed on both sides of the border.

Monitoring and reporting activities for this study focused primarily on ozone and $PM_{2.5}$. Air quality monitoring in Southwest Ontario is a cooperative effort between Environment Canada and OMOE. Air quality monitoring in Michigan is the responsibility of MDEQ. The U.S. EPA provides monitoring support to MDEQ by providing financial resources and program oversight.

A measurement-intensive study is being planned for 2007 by Environment Canada for the Windsor/Detroit area. This study will examine the interactions between local meteorology (lake breezes, lake breeze-induced convection, etc.) and local and long-range transport of chemically reacting trace gases and particulate matter.

I. Air Quality Status

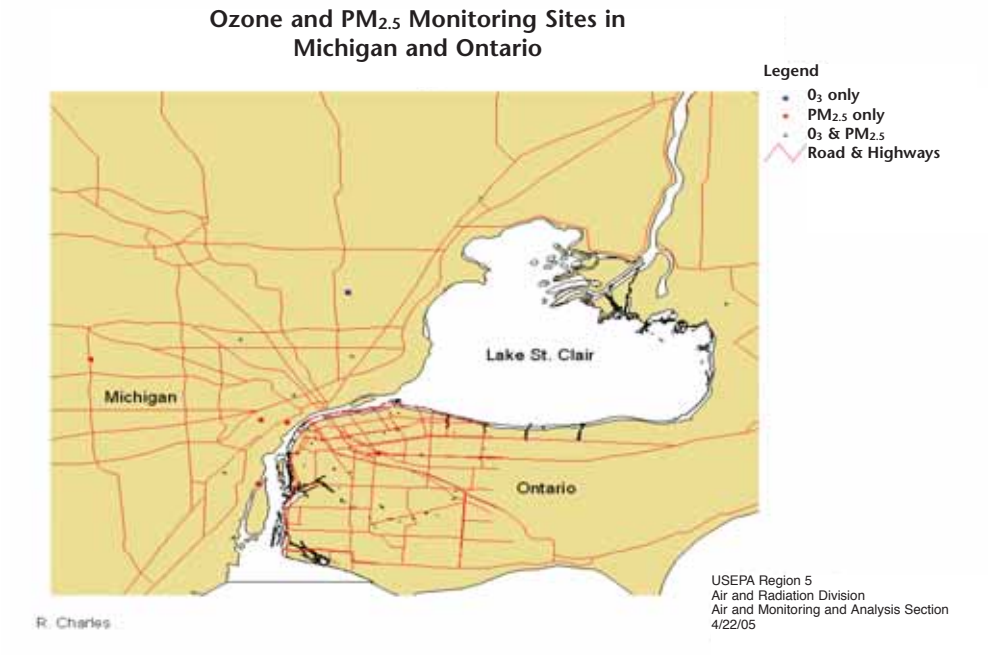
At the provincial level, Ontario has a one-hour Ambient Air Quality Criterion (AAQC) of 80 parts per billion (ppb) for ground-level ozone. Currently, Ontario does not have an AAQC for $PM_{2.5}$.

In 2000, the Canadian Council of Ministers of the Environment (CCME) developed a Canada–wide Standard (CWS) for ozone and $PM_{2.5}$. [1]

The CWS for ozone is 65 ppb, eight-hour running average time, based on the fourth-highest annual ambient measurement averaged over three consecutive years. For Windsor, the fourth-highest eight-hour daily maximum ozone

[1] Jurisdictions are required to meet the CWS for ozone and $PM_{2.5}$ by 2010 and commence reporting on the achievement of the CWS by 2011.

Figure 1-1 Binational monitoring map



concentration averaged over three years (2001-2003) is 88.1 ppb.

The CWS for $PM_{2.5}$ is 30 micrograms per cubic meter (µg/m³), 24-hour averaging time, based on the 98th-percentile annual ambient measurement averaged over three consecutive years. Unlike ozone, there is insufficient $PM_{2.5}$ data at this time to calculate the CWS for Windsor for the three-year period 2001-2003; however, the 98th-percentile daily average for 2003 is 29.4 µg/m³.

In the United States, the National Ambient Air Quality Standard (NAAQS) for eight-hour ozone is 0.08 parts per million (ppm). The standard is defined as the three-year average of the annual fourth-highest daily maximum ozone concentration. The design value (i.e., monitored value used to determine whether the area is meeting the standard) for eight-hour ozone measured in the Detroit area is 0.092 ppm (92 ppb) for the years 2002-2004.

For $PM_{2.5}$, the annual NAAQS in the United States is 15 µg/m³ and is defined as the average of three yearly values. The 24-hour standard is 65 µg/m³ and is met if the average of the 98th-percentile daily value, averaged over three consecutive years, is less than the threshold. The Detroit area is meeting the short-term standard, with a design value of 44 µg/m³ for the years 2001-2003. The current annual design value for the Detroit area is 18.6 µg/m³ based on 2002-2004 data. The monitoring subgroup shared information on monitoring locations and data collected to produce an integrated binational map. This map is shown in Figure 1-1.

As part of Environment Canada's monitoring effort, two separate passive sampling campaigns were conducted in the airshed during 2004 for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and volatile organic compounds (VOCs). These passive data sets will be used to support both scientific and health-related studies. As well, a comprehensive monitoring station at Wallaceburg has been built to continuously monitor and collect data related to most of the criteria pollutants. It is anticipated that a

monitoring station will also be set up near the town of Harrow to measure a targeted suite of pollutants (ozone, particulate matter, and carbon monoxide (CO)) to provide support to the mobile campaigns that will be carried out using the Canadian Regional and Urban Investigation System for Environmental Research (CRUISER). In addition, these monitoring programs will help to establish source regions associated with the air pollutant impacts through the use of both chemical and meteorological parameters, as well as studies related to lake breeze impacts on air quality.

A project was undertaken to evaluate the quality assurance procedures used in each country in an effort to ascertain the compatibility of air quality monitoring data collected. This project included site visits to a number of monitored locations on both sides of the border. The results indicate favorable comparisons, and this could facilitate future binational data analysis work.

Air Emission Inventories

Pollution from ozone and fine particulate matter is the result of emissions from a wide variety of sources, including large industrial facilities, trucks and automobiles, and small business facilities. Knowledge of the amount of pollutants emitted into the airshed is useful in developing strategies for reducing emissions in an effort to improve air quality and to improve human health.

The inventory subgroup has focused on sharing emission inventory information among air quality officials on both sides of the border. This has been done through increased communication among inventory experts and improved understanding of the tools and data, as well as through participation by emission inventory practitioners in binational meetings and conferences. A result of this effort has been an improved understanding of emission inventory processes on both sides of the border, which will lead to improved inventory data sets. These inventories are important input into the models used for air quality forecasting and for evaluating the effectiveness of various emission reduction strategies.

Air Quality Modeling

Air quality models considered by the modeling subgroup are mathematical tools capable of simulating the transport and chemistry associated with ozone and fine particulate matter and their precursors. These models are useful in understanding the link between sources of pollution and their impacts. In addition, the models assist in estimating the relative contributions from multiple emission sources to determine the most effective control strategies.

The workgroup recognized that it was important to share information on modeling practices. For example, Environment Canada and OMOE have participated in meetings hosted by SEMCOG, which focused on particulate matter and ozone attainment in Detroit.

There are a number of organizations that are conducting air quality modeling relevant to the Southwest Ontario/Southeast Michigan region, including Environment Canada, OMOE, MDEQ, Lake Michigan Air Directors Consortium (LADCO), and the U.S. EPA. Their activities range from Canada–U.S. transboundary transport evaluations to field study campaigns to focused modeling exercises examining the response of models to changes in emissions. The organizations listed here use a variety of air quality models. The additional information provided by multiple modeling tools can add value to an airshed assessment. The organizations' air quality modeling activities are described briefly below:

- Environment Canada's regional air quality modeling activities focus on two main areas: science support for Canadian government policy initiatives; and the creation of models to be used in air quality forecasting, either in support of field campaigns or in the operational context of public air quality

forecasts. The two main regional air quality models currently in use by Environment Canada for policy advice and air quality forecasts are the Canadian Hemispheric and Regional Ozone and NO_X System (CHRONOS) and A Unified Regional Air Quality Modelling System (AURAMS).

- OMOE conducts atmospheric modeling on a range of spatial scales. Modeling on local scales is done mainly in response to environmental emergencies or for regulatory purposes. Examples include modeling for Certificates of Approval, for Environmental Assessments, and in support of investigation of regulatory noncompliance, possibly leading to prosecution. Current regional-scale modeling applications concentrate mainly on fine particulate matter and ozone and encompass applications including assessing the links between sources and receptors and evaluating the effect of proposed emission reduction scenarios. The regional-scale modeling tool used by OMOE is the Models-3/Community Multiscale Air Quality (CMAQ) system.
- MDEQ is active in modeling for both regional pollutants (e.g., ozone and fine particulate matter) that can be transported over long distances and local-scale pollutants that produce significant concentrations near the source. Regional modeling simulations for ozone and fine particulate matter are being conducted to evaluate control program reductions in precursor emissions and to compare predicted ozone concentrations with attainment demonstration criteria in the Southeast Michigan area as well as in downwind areas. The primary regional-scale modeling tool being used by MDEQ is the Comprehensive Air Quality Model with Extensions (CAMx). CAMx is a publicly available tool that can be used to model photochemical pollutants as well as particulates. MDEQ is performing CAMx modeling to support policy decisions regarding regulatory requirements for ozone and fine particulate matter.
- LADCO provides technical assessments for and assistance to its member states (Illinois, Ohio, Indiana, Michigan, and Wisconsin) on problems of air quality and provides a forum for its member states to discuss air quality issues. LADCO is currently very active in providing modeling information and technical assistance for ozone, particulate matter, and regional haze. The information developed by LADCO is used by member states as they investigate potential control strategies and develop attainment demonstrations for applicable eight-hour ozone and fine particulate matter State Implementation Plan submittals. Although LADCO's regional-scale modeling work has included a number of modeling tools, the principal air quality model being used is CAMx.
- The U.S. EPA's Air Quality Modeling Group provides technical information on modeling tools and techniques for other U.S. EPA headquarters staff, regional offices, and state and local agencies. It conducts modeling analyses to support policy/regulatory decisions within the agency. Much of the regional modeling uses the CMAQ system and CAMx. The Regional Modeling System for Aerosols and Deposition (REMSAD) has also been used to evaluate particulate matter concentrations and deposition.

A detailed description of air quality-related modeling activities focused on the Southwest Ontario/Southeast Michigan airshed is included in the workgroup's reference material.

Air Quality Indices and Forecasting

This subgroup undertook an examination of air quality indices and forecasting practices on both sides of the border.

I. Indices

The Air Quality Index (AQI) is an indicator used to provide the public with information

Table 1-1 Air quality index pollutants and their impacts for Ontario

Index	Category	Ozone (O_3)	Fine Particulate Matter ($PM_{2.5}$)	Nitrogen dioxide (NO_2)	Carbon monoxide (CO)	Sulfur dioxide (SO_2)	Total reduced sulfur (TRS) compounds
0-15	Very good	No health effects are expected in healthy people	Sensitive populations may want to exercise caution	No health effects are expected in healthy people	No health effects are expected in healthy people	No health effects are expected in healthy people	No health effects are expected in healthy people
16-31	Good	No health effects are expected in healthy people	Sensitive populations may want to exercise caution	Slight odor	No health effects are expected in healthy people	Damages some vegetation in combination with ozone	Slight odor
32-49	Moderate	Respiratory irritation in sensitive people during vigorous exercise; people with heart/lung disorders at some risk; damages very sensitive plants	People with respiratory disease at some risk	Odor	Blood chemistry changes, but no noticeable impairment	Damages some vegetation	Odor
50-99	Poor	Sensitive people may experience irritation when breathing and possible lung damage when physically active; people with heart/lung disorders at greater risk; damages some plants	People with respiratory disease should limit prolonged exertion; general population at some risk	Air smells and looks brown; some increase in bronchial reactivity in people with asthma	Increased symptoms in smokers with heart disease	Odorous; increasing vegetation damage	Strong odor
100 and over	Very poor	Serious respiratory effects, even during light physical activity; people with heart/lung disorders at high risk; more vegetation damage	Serious respiratory effects even during light physical activity; people with heart disease, the elderly, and children at high risk; increased risk for general population	Increasing sensitivity for people with asthma and bronchitis	Increasing symptoms in nonsmokers with heart disease; blurred vision; some clumsiness	Increasing sensitivity for people with asthma and bronchitis	Severe odor; some people may experience nausea and headaches

Source: Environment Canada, "Air Quality in Ontario 2003 Report", 2004

Table 1-2 AQI values, classification, and effects information for Michigan

AQI value	Classification	Effects
0 to 50	Good	Air quality is considered satisfactory, and air pollution poses little or no risk.
51 to 100	Moderate	Air quality is acceptable; however, for some pollutants, there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101 to 150	Unhealthy for sensitive groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151 to 200	Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
201 to 300	Very unhealthy	Health alert: everyone may experience more serious health effects.
Greater than 300	Hazardous	Health warnings of emergency conditions. The entire population is more likely to be effected.

Source: http://www.airnow.gov

about the levels of air pollution for a given area. Knowledge of this information allows people to take action to protect themselves from the harmful effects of elevated levels of air pollution. It is important to note that the AQI systems are different in Ontario and Michigan. While the general methodologies and messages are similar, differences exist in how the indices are calculated and reported.

In Ontario, the AQI is the responsibility of OMOE. It is based on hourly measurements of the six most common air pollutants: SO_2, ground-level ozone, NO_2, total reduced sulfur (TRS) compounds, CO, and fine particulate matter.

OMOE uses real-time air quality data from its 38 ambient air monitoring stations to produce the AQI readings for each location. AQI readings are reported to the public and news media at set intervals each day. The AQI can be obtained from the Ministry by phone (1-800-387-7768 (English), 1-800-221-8852 (French)) or through the Ministry's web site at **http://www.airqualityontario.com/**.

The AQI is determined, at the end of each hour, by converting the concentration of each pollutant that the AQI station monitors into a numeric range using a common scale or index to calculate each pollutant's sub-index. The pollutant with the highest sub-index for a given hour becomes the AQI reading for that hour. The lower the AQI reading, the cleaner the air, as shown in Table 1-1.

In addition, a new health-based AQI has been proposed in Canada that addresses the combined effects of air pollutants on public health. Health messages that target specific populations at risk are also under development. This index is currently under development jointly by Environment Canada and Health Canada and is soon to be piloted.

In Michigan, the AQI that is reported is a national index, calculated using local monitoring data. The index is based on measurements of particulate matter, ground-level ozone, CO, SO_2, and NO_2. The AQI is automatically calculated from continuous air monitor information. The highest of each pollutant's AQI value is reported as that day's AQI value. Ground-level ozone is one of Michigan's toughest summertime air quality challenges. During the summer months, the AQI is often based on ozone levels. Table 1-2 shows AQI information for Michigan. Information on the national AQI can be found at **http://www.airnow.gov**.

II. Forecasting

The Smog Advisory Program in Ontario is designed to inform the public when poor air quality conditions are expected. It is jointly managed by agencies at both the federal and provincial levels. The air quality forecast is produced on a daily basis, 365 days a year, for ground-level ozone and fine particulate matter. The forecast covers the next three days for all of southwestern and parts of northern Ontario. Federally, 48-hour model-based national air quality forecasts are also produced daily and are available for use by the provinces in the production of their provincial or regional air quality forecasts.

There are two stages in the Ontario smog alert program:

1) 1st Stage "Smog Watch" — issued when there is at least a 50 percent chance that elevated smog levels are forecast within the next three days; and
2) 2nd Stage "Smog Advisory" — issued when there is a strong likelihood that widespread, elevated, and persistent smog levels are forecast to occur within the next 24 hours or if elevated smog conditions occur without warning and weather conditions conducive to elevated smog are forecast to continue for several hours.

The forecast is provided to the public through an automated telephone answering device and the OMOE web site. Smog advisories are issued jointly by Environment Canada and OMOE.

To evaluate public knowledge of the current Smog Advisory Program and the linkages between air quality and health impacts, the Ontario Lung Association developed a project proposal to create and deliver a series of public opinion surveys. The surveys were aimed at four target groups (public, media outlets, municipalities with active smog response programs, and health-related nongovernmental organizations). The current smog advisory delivery is based on a strong likelihood that widespread, elevated, and persistent smog levels are forecast to occur within the next 24 hours. A new system was proposed to have a more proactive delivery of the smog advisories, by issuing smog advisories based on levels of a single or group of monitors to represent the forecasting for the region. The surveys were to tackle whether a change to the current delivery approach would be beneficial. As well, this information may be used to assist in getting appropriate information to the public.

Funded by Environment Canada and OMOE, the series of surveys was carried out by an independent consultant hired by the Ontario Lung Association between August 2004 and February 2005. The target communities were within the Windsor to Cornwall corridor and included Windsor, Sarnia, London, Kitchener/Waterloo, Hamilton, St. Catharines, Peterborough, Belleville, Kingston, and the Greater Toronto area (including Oakville, Mississauga, Toronto, Richmond Hill, Vaughan, Markham, and Pickering). While this project supports many of the same goals, as the Border Air Quality Strategy, it was not originally designed or intended to be solely for the Southwest Ontario region.

A preliminary assessment of the results has been performed and revealed a broad range of opinions and level of knowledge. In general, people living in the City of Windsor have a greater awareness of the Smog Advisory Program than those living in other areas of Ontario. Further assessment and analysis of the survey results are required before the survey can be used to support policy changes or operational decisions.

The air quality forecast program in Michigan is the responsibility of MDEQ. The forecast is based on the two primary pollutants of concern: ground-level ozone and fine particulate matter. The air quality forecasters meet at a minimum on a weekly basis to discuss the air quality situation and how it will likely evolve over the next few days. A follow-up meeting will be held when the forecasters believe that a change in air quality will occur. In a typical week, there

are two meetings, but during periods when the situation is changing rapidly or elevated levels are expected to persist, the forecasters meet daily.

MDEQ and its Clean Air Coalition partners (SEMCOG and the Clean Air Coalition of Southeast Michigan) issue an "Ozone Action! Day" declaration when atmospheric conditions are anticipated to produce eight-hour ozone levels greater than 85 ppb and/or one-hour ozone levels greater than 125 ppb.

On "Ozone Action! Days," SEMCOG and the Clean Air Coalition of Southeast Michigan request public participation in a voluntary emission reduction initiative to keep air clean.

LESSONS LEARNED

- There is some **compatibility of monitoring data between the two countries** with respect to quality of data, instrumentation, and collection methods.
- **Significant air pollution analysis and planning work is already being conducted** by existing organizations on both sides of the border in support of airshed characterization.
- Different modeling tools are used in Environment Canada, OMOE, U.S. EPA, and MDEQ. **The additional information provided by multiple tools can add valuable information about the ozone and particulate matter concentrations in the airshed**.
- **A binational network of technical contacts has proven to be useful** in day-to-day dialogue on air quality issues.
- There are **commonalities and differences in the AQI and forecasting systems of both countries** that need to be understood and communicated to residents living within the airshed.

OPPORTUNITIES FOR COOPERATION

- **Continued collaboration on air quality monitoring and data availability** on both sides of the border.
- **Binational participation in Environment Canada's 2007 Southwest Ontario Measurement Field Study**.
- Continued information sharing through **participation in bilateral meetings, site visits, and air quality activities**.
- **Continued participation** by Canadian air quality staff from both federal and provincial agencies **in SEMCOG meetings**.
- **Increased interaction among inventory developers** by encouraging participation in existing forums in the basin to improve the quality and utility of emission inventories (e.g., Canadian National Emission Modeling meeting held in Toronto in April 2004).
- **Collaboration on the harmonization of model input data**, especially emission inventories, to allow for intercomparisons of model outputs.
- **Participation in emission inventory user conferences** to have input into the development of future versions of modeling systems.
- Joint management in the airshed through development of **common approaches to reporting on air quality and health**.

RECOMMENDATIONS AND NEXT STEPS

- **Harmonize instrumentation and data collection methods** within the airshed to allow for enhanced sharing and comparability of data.
- **Develop common data analysis methodologies for air quality data**.
- **Expand the current AURAMS/CMAQ model comparison study to include CAMx simulations**.

- Continue **increased interaction among inventory developers** to improve the quality and utility of emission inventories using existing forums.
- **Focus inventory efforts** on developing common data formats, identifying common functionality among models and processors, and improving emission factor economies of scale and the potential for common grids.
- **Establish collocation of criteria pollutant instrumentation** at one Michigan "master" station and one Ontario "master" station for a period of at least one year to quantify standard comparability statistics.
- **Convene a data management workgroup** to develop the scope of data analysis and assessment projects and carry out analyses.
- Ensure that web sites containing technical information contain **links to binational technical sites**.

CHAPTER 2
POLICY NEEDS WORKGROUP REPORT

DESCRIPTION

The goal of the Policy Needs Workgroup was to improve coordination and information exchange between air quality agencies in Canada and the United States in an effort to more completely and accurately describe, manage, and work collaboratively to improve air quality in the Southwest Ontario/Southeast Michigan border area.

The workgroup's membership was composed of representatives from the following: Environment Canada, U.S. Environmental Protection Agency (U.S. EPA), Health Canada, Ontario Ministry of the Environment (OMOE), Michigan Department of Environmental Quality (MDEQ), the International Joint Commission, and the City of Windsor.

The Southwest Ontario/Southeast Michigan airshed shares many common air issues. Both regions of the airshed experience exceedances of the national ambient air quality standards for fine particulate matter ($PM_{2.5}$) and ozone. Air quality is impacted by local industrial, transportation, and transboundary sources. Several common industries, such as coal-fired power plants, petroleum refineries, chemical manufacturing, and auto manufacturing, are major local sources of air pollutants.

Transboundary flows of air pollutants can affect air quality on both sides of the border. Lake effects and local meteorology may exacerbate poor air quality in this region. In certain urban centers, such as Windsor/Detroit and Sarnia/Port Huron, local transportation, including the busiest international border crossings between Canada and the United States, can also have a significant impact on local air quality.

Both countries are conducting air quality and health impact studies, and both countries are developing initiatives to reduce smog precursors. Air quality and health studies, program implementation, and policy development are for the most part undertaken separately within each country. To address airshed-based issues, it is important to develop a good understanding of how air quality is managed among the different jurisdictions and examine whether air policies and regulations are or can be complementary.

The workgroup set out to 1) assess key air quality-related systems in both countries; 2) evaluate the potential for improved coordination/collaboration in each of these areas; and 3) develop recommendations to improve coordination between the two countries. In order to achieve this, the workgroup focused on five key areas: administrative and structural frameworks for air quality; control strategies and jurisdictional plans; permitting systems for existing, new, and modified sources; compliance and enforcement systems; and policy uses for scientific tools and research.

CURRENT STATUS AND ISSUES

Administrative and Structural Frameworks for Air Quality

In order to identify areas where increased cooperation is possible in air management, it is important to understand each jurisdiction's administrative and structural framework for air quality activities, including constitutional authorities, role of federal, state/provincial, and local authorities in air quality management, fiscal systems, and important limitations on authority. There are significant differences in both the administrative and structural frameworks between Canada and the United States.

Environment Canada's mandate covers environmental protection, environmental conservation, and meteorology. Human health impact assessments from pollution, reduction of identified health risks, and risk communication are carried out by Health Canada. The U.S. EPA's mandate also covers environmental protection and environmental conservation, but human

health impacts and indoor air quality are also included within the responsibilities of the agency.

In Canada, environmental management is a shared responsibility between federal, provincial, and territorial governments. The key forum for the development and implementation of new national environmental initiatives is the Canadian Council of Ministers of the Environment (CCME), in which federal, provincial, and territorial governments participate as equal partners. In 1998, the Canada–wide Accord on Environmental Harmonization was developed under CCME to address environmental protection and health risk issues. However, under the division of powers, the environment is largely within provincial/territorial jurisdiction, which has the authority to issue Certificates of Approval and manage local pollution sources. Therefore, implementation of national standards is usually undertaken by provinces and territories. Provinces and territories also have independent authority to enact other environmental legislation.

The key federal environmental protection legislation for air pollution is the Canadian Environmental Protection Act, 1999 (CEPA 1999), which deals with toxic substance release, international air pollution, fuels, products, and waste disposal. Precursors of particulate matter less than 10 microns (PM_{10}) and ozone have been designated as toxic under CEPA 1999. Under CEPA 1999, the federal government is authorized to develop regulations to restrict vehicle engine emissions (on-road and off-road) and fuel quality. Transport Canada has the authority to manage border crossings and rail, aviation, and marine operations. However, emissions from these sources are addressed by Environment Canada. Under the Canadian Constitution, the federal government has the responsibility for all transboundary pollution issues, including those related to water and air.

In the United States, both the federal and state governments have responsibility for environmental protection, with deciding authority generally residing with the federal government. Administration of federal laws and programs and issuance of permits are often delegated to the states, subject to federal oversight. Generally, the states have the responsibility to develop state programs that are consistent with the requirements of the Clean Air Act (CAA) and U.S. EPA regulations and guidance. These programs are then approved by the U.S. EPA. The states also have independent authority to enact environmental legislation that goes beyond the requirements of the federal CAA.

A fundamental difference between the federal authority in both countries is the level of oversight authority. The U.S. system features significant oversight and review of major source permitting programs, air monitoring programs, and enforcement programs, as well as approval of some state air quality regulations and plans. Additionally, in the United States, the federal government provides annual grants on a continual basis to support the operation of state air quality programs. These grants can account for as much as 30 to 40 percent of states' annual operating budgets. Annual priorities and commitments for utilizing this money are negotiated with states, and the federal government maintains an ongoing oversight role.

Both CEPA 1999 and the U.S. CAA contain reciprocity provisions that allow the governments to address transboundary issues under some circumstances. The Canada–United States Air Quality Agreement is in place for the two countries to address transboundary air pollution in the border area. However, to help meet air quality standards and to improve local air quality within this airshed, it is important to consider sources outside of the airshed when developing air quality management plans. Given the jurisdictional issues, these issues would likely need to be addressed at the federal level.

Control Strategies and Jurisdictional Plans

Ultimately, a coordinated airshed management approach should result in the coordination of air

pollution control strategies to improve public health throughout the airshed. This is a difficult task, given the differences in air quality standards, authorities for regulating sources of pollution, and statutory deadlines for meeting air quality regulations in both countries. Although it will be challenging, all parties want to explore better communication and coordination opportunities in order to develop a more efficient and integrated air quality control strategy throughout the transboundary airshed.

The workgroup agreed that it was important to first share information regarding existing control strategies in the study area, including information on local, regional, and national programs. Table 2-1 and Table 2-2 provide information on existing control programs in Southwest Ontario and Southeast Michigan, respectively. A preliminary review of the existing control programs showed that although numerical targets and timelines differ between both countries, they are working towards the same goal of reducing emissions of particulate matter (PM) and ozone precursors from industrial, transportation, and area sources to meet air quality standards. For example, the U.S. EPA recently finalized the Clean Air Interstate Rule (CAIR). CAIR will reduce sulfur dioxide (SO_2) emissions in the eastern half of the United States by over 70 percent and nitrogen oxide (NO_X) emissions by over 60 percent from 2003 levels. This will result in significant improvements in ozone, PM, and haze levels in Southeast Michigan and Southwest Ontario. At the same time, OMOE is also seeking to reduce SO_2 and NO_X emissions by proposing regulations with an emissions trading system for SO_2 and NO_X for major Ontario industries. In the United States, pollutant emission reduction is being achieved primarily through a regulatory approach, while in Canada, a combination of mandatory and voluntary initiatives is applied.

Mandatory reporting of smog pollutants and their precursors — PM, NO_X, volatile organic compounds (VOCs), and SO_2 — is in place in Canada and the United States for point sources. Comprehensive inventories, including point, area, mobile, and biogenic sources, are maintained in both countries. Both inventories show significant contribution of air pollutants by all anthropogenic sources — point, mobile,

Table 2-1 Canadian control programs that affect Southwest Ontario

Industrial Point Sources
GENERAL • Certificate of Approval (Air) (Environmental Protection Act, Section 9) • General Air Pollution (O.Reg. 346/90) • Lambton Industry Meteorological Alert (O.Reg. 350/90)
ELECTRICITY • Ontario Power Generation (O.Reg. 153/99) • Lakeview Generating Station (O.Reg. 396/01) • Emission Trading (O.Reg. 397/01) • Electricity Projects (O.Reg. 116/01 under the Environmental Assessment Act)
INDUSTRY • Boilers (O.Reg. 338/90) • Sulphur Content of Fuel (O.Reg. 361/90) • Proposed Industry Emissions Reduction Plan (2004) – NO_X and SO_2 limits with emission trading for seven industrial sectors (carbon black, cement, glass, iron and steel, nonferrous, petroleum, pulp and paper) • Reporting (O.Reg. 127) • Vinyl Chloride Release Regulations, 1992 (SOR/92-631) • National Pollutant Release Inventory (NPRI)

Table 2-1 Canadian control programs that affect Southwest Ontario (contd.)

GUIDELINES
- A-1 Combustion, Air Pollution Control and Monitoring Requirements for Biomedical Waste Incinerators in Ontario
- A-5 Atmospheric Emissions from Stationary Combustion Turbines
- A-7 Combustion and Air Pollution Control Requirements for New Municipal Waste Incinerators
- A-9 NOx Emissions from Boilers and Heaters
- Interim Design and Review Guidelines for Wood-Fired Combustors
- National Volatile Organic Compound (VOC) Control Guidelines or Codes for: above-ground storage tanks, underground storage tanks, plastics processing industry, wood furniture manufacturing, consumer products, commercial/industrial surface coating operations – automotive refinishing, paint strippers in commercial furniture refinishing, fugitive emissions from equipment leaks, commercial and industrial degreasing facilities, dry cleaning facilities, commercial printing facilities, vapor recovery at refueling, fuel dispensing, and distribution networks
- National Emission Guidelines or Codes for: coal-, oil-, and gas-fired power plants, commercial/industrial boilers and heaters, stationary combustion turbines, cement kilns, hazardous waste incineration, thermal electricity generation, steam electric power generation, municipal solid waste incineration

VOLUNTARY PROGRAMS
- Anti-Smog Action Plan
- Business Air Quality Program – pollution prevention and energy audits at SMEs

AGREEMENTS
- Canada-wide Standards for Particulate Matter and Ozone
- Canada-wide Acid Rain Strategy for Post 2000
- Ozone Annex – Canada-United States Air Quality Agreement

MUNICIPAL
- Landfill gas recovery and destruction activities – Windsor, London

Transportation

ON-ROAD VEHICLES
- Motor Vehicles (O.Reg. 361/98)
- Drive Clean Program – Inspection & Maintenance
- Ontario's Smog Patrol
- On-Road Vehicle and Engine Emission Regulations (SOR/2003-2)
- Consultation under way on all-terrain vehicles, off-road motorcycles, and snowmobiles regulations

FUELS
- Gasoline Volatility (O.Reg. 291/01)
- Recovery of Gasoline Vapour in Bulk Transfer (O.Reg. 455/94)
- Reporting Requirements – Sulphur Levels in Gasoline (O.Reg. 212/02)
- Benzene in Gasoline Regulations (SOR/97-493)
- Sulphur in Gasoline Regulations (SOR/99-236)
- Sulphur in Diesel Fuel Regulations (SOR/2002-254)
- Fuels Information No. 1 – reporting regulation (SOR/C.R.C.,C.407)
- Gasoline and Gasoline Blend Dispensing Flow Rate Regulations (SOR/2000-43)
- Gasoline Regulations (SOR/90-247)
- Contaminated Fuels Regulations (SOR/91-486)
- Consultation under way on heavy and light fuel oils regulations

VOLUNTARY PROGRAMS
- Low Sulphur Fuels Procurement Guide
- The Motor Vehicle Fuel Efficiency Initiative

Table 2-1 Canadian control programs that affect Southwest Ontario (contd.)

• Environmental Code of Practice for on-road light-duty and heavy-duty vehicle emission inspection and maintenance programs • Diesel retrofits and biodiesel fuel pilot projects
OTHERS (MARINE, RAIL) • Renewing Memorandum of Understanding with Railway Association of Canada • Proposed EC and U.S. EPA joint plan to reduce emissions under the North American Security and Prosperity Agenda
MUNICIPAL • London Fleet Pilot Demonstration of Intelligent Vehicle Tracking and Monitoring System • Windsor Corporate Fleet Vehicle Conversion Program – utilize state-of-the-art emission control devices and alternative-fuel vehicles
Area Sources
OFF-ROAD ENGINES • Off-Road Small Spark-Ignition Engine Emission Regulations (SOR/2003-355) • Proposed Sulphur in Off-Road Diesel Fuel Regulations • Off-Road Compression-Ignition Engine Emission Regulations (SOR/2005-32)
WOOD COMBUSTION • Burn it Smart – education and wood stove changeout program
SOLVENTS • Tetrachloroethylene (Use in Dry Cleaning and Reporting Requirements) Regulations (SOR/2003-79) • Solvent Degreasing Regulations (SOR/2003-283)
MUNICIPAL • Smog Action Plan and Energy Management Programs – Windsor, London • Public outreach and events to raise awareness on clean air issues

and area sources — within this airshed. Air pollution from most of the major industries is being addressed through regulatory tools or other management options. Standards and timelines in federal regulations controlling fuel quality and vehicle emissions are generally aligned between the two countries, although gasoline sold in Michigan has a lower volatility than gasoline sold in Ontario. Area sources, such as residential/commercial fuel combustion, road dust, small engines, surface coatings, agriculture, and construction, as well as small and medium-sized enterprises (SMEs), are also key sources of smog-causing pollutants. These sources have not traditionally been the subject of regulation, and further review of methods for controlling these sources may be warranted. Managing the area sources would require an effective outreach component and would benefit from partnerships formed with local agencies and stakeholders. Some voluntary programs are in place to seek early emission reductions from diesel trucks and SMEs in this region. Further detailed examination of the existing and proposed control programs is required to identify areas for improved coordination.

Each jurisdiction has a range of control initiatives, but there is a need to better understand how the existing and proposed initiatives will meet the air quality standards. To examine opportunities for coordination of local, regional, or national control strategies that can be complementary and beneficial to the transboundary area, an analysis should be conducted to include adopted, but not yet implemented, programs; deadlines for strategy development and implementation; and new and

Table 2-2 Ozone control programs in Southeast Michigan

Motor Vehicles and Gasoline	Industrial Point Sources
• Federal Motor Vehicle Control Program – includes: Tier I standards starting in 1994 model year, Tier II/Low Sulfur Gasoline, Heavy Duty Diesel Vehicle Engine Standards/Ultra Low Sulfur Diesel • Low Reid Vapor Pressure (7.8 psi) Gasoline • Federal Gasoline Detergent Additive Program • Federal On-Board Vapor Recovery (starting 1996 model year) • Nonroad Engine Standards • Low Sulfur Diesel for Nonroad Equipment	• Reasonably Available Control Technology (RACT) for major sources (100 tons/year) of VOCs for the following source categories: 1. Gasoline Loading Terminals 2. Gasoline Bulk Plants 3. Service Stations – Stage I 4. Fixed Roof Petroleum Tanks 5. Miscellaneous Refinery Sources (Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds) 6. Cutback Asphalt 7. Solvent Metal Cleaning 8. Can Coating 9. Metal Coil Coating 10. Fabric Coating 11. Paper Coating 12. Automobile and Light-Duty Truck Coating 13. Metal Furniture Coating 14. Magnet Wire Coating 15. Coating of Large Appliances 16. Leaks from Petroleum Refineries 17. Miscellaneous Metal Parts 18. Flatwood Paneling 19. Synthesized Pharmaceutical Products 20. Rubber Tire Manufacturing 21. External Floating Roof Petroleum Tanks 22. Graphic Arts 23. Perchloroethylene Dry Cleaning 24. Gasoline Tank Trucks and Vapor Collection System Leaks 25. Polymer Manufacturing 26. Synthetic Organic Chemical Manufacturing Industry (SOCMI) and Polymer Manufacturing Equipment Leaks 27. Large Petroleum Dry Cleaners 28. Air Oxidation Processes - SOCMI 29. Equipment Leaks from Natural Gas/Gasoline Processing Plants • Non-Control Technique Guidelines (CTG VOC RACT for major stationary sources (100 tons/year) not included in above source categories) • Emission Statement Program • Prevention of Significant Deterioration Program for stationary sources • Michigan NO_X State Implementation Plan (SIP) call rule (for electric generating units (EGUs), major non-EGUs, cement kilns) • Clean Air Interstate Rule (CAIR)
Area Sources	
• Federal Nonroad Engine Control Program	

emerging technologies for criteria air pollutants. This should also include identifying opportunities for influencing overall control strategy development; filling information gaps; providing input on individual rules and regulations; and coordinating point, area, and mobile source reductions, including interaction on transportation and border crossing projects (e.g., Detroit River International Crossing).

Human health impact is most important in the establishment of ambient air quality standards in both countries. Results from existing health studies in this airshed need to be considered, which will further guide policy needs in the airshed.

Permitting Systems for Existing, New, and Modified Sources

New and modified industrial sources of air emissions are assessed through permitting systems. Under these systems, permits or Certificates of Approval for air emissions are issued at the state/provincial level. In both countries, sources are reviewed based on technical evaluation and compliance with legislation and regulations. A better understanding of each other's permitting system may help the public and jurisdictions to provide meaningful input on permitting decisions.

Canada and the United States have ongoing notification procedures, established in fall 1994, to identify possible new sources and modifications to existing sources of transboundary air pollution within 100 kilometers (62 miles) of the border. Each government also notifies the other of new sources or modifications of concern beyond the 100-kilometer (62-mile) limit. This notification process is administered by the U.S. EPA and Environment Canada and applies to notification for large industrial sources. However, smaller industrial sources are routinely permitted by the state and provincial permitting authorities, and the workgroup engaged in an effort to better understand how all sources are permitted in the airshed.

In April 2004, permit staff from Michigan and Ontario met to share information on their respective permit systems. Each jurisdiction undergoes a similar process in the review of applications, which includes technical review, impact assessment through dispersion modeling, and a public notification and comment process. Differences identified included the pollutants under review, best available control technology requirements, the scope of dispersion modeling, and the public notification process. The workgroup performed an analysis of the permit systems in Michigan and Ontario and produced a description of these systems, as well as a contact list which is included in the workgroup's reference material.

In Michigan, there are two permit programs in place. The New Source Review program issues "permits to install," which apply to new installations or modifications of processes or equipment that may increase air contaminants. The Renewable Operating Permit program requires facilities with higher quantities of air emissions to undergo review every five years to update the permit to current legislative or regulatory requirements. Applications for permits are also reviewed by the U.S. EPA regional office. Public notification may be required for some applications, usually for major new sources, renewable operating permit applications, controversial proposals, or sources near the border. In such cases, the rules require a minimum 30-day public comment period with an opportunity for public hearing. Several Canadian contacts from OMOE and local municipalities have been included in the distribution list on these notifications.

In Ontario, facilities are required to obtain a Certificate of Approval (Air) from OMOE before construction or modification of a process or equipment that may emit an air contaminant. When approval is obtained, facilities are not required to renew the approval unless additional modifications are proposed. Most Certificate of

Approval proposals are posted on the Environmental Bill of Rights Registry at the OMOE web site for 30 days to notify the public of the OMOE decision on the proposal. Environment Canada generally does not review the applications for Certificates of Approval.

Some undertakings that are subject to the Ontario Environmental Assessment Act and its regulations may require more extensive assessments and consultations, and sometimes review by Environment Canada. Organizations subject to the Act are municipalities, provincial ministries and agencies, and conservation authorities. In addition, private sector activities may become subject to the Act through designation by the Minister and Cabinet or through a regulation (e.g., electricity projects). In the United States, the National Environmental Policy Act (NEPA) requires federal agencies to integrate environmental values into some of their decision-making processes by considering the environmental impacts of some of their proposed actions and reasonable alternatives to those actions (mainly those expected to have environmental impacts). To meet this requirement, federal agencies prepare a detailed statement known as an Environmental Impact Statement (EIS). The U.S. EPA reviews and comments on EISs prepared by other federal agencies, maintains a national filing system for all EISs, and ensures that its own actions comply with NEPA where applicable.

Issues raised during the workgroup's discussions included the need for a mechanism for local communities to file comments on the permit applications across the border, the lack of technical support available for local communities in the review of the permit applications, and the effectiveness of current notification systems between Canada and the United States.

Compliance and Enforcement Systems

A fundamental element of an integrated airshed management system is a robust compliance and enforcement program. In a transboundary airshed, it is critical to understand the abatement and enforcement systems on both sides of the border in order to assess whether control requirements on pollution sources are being enforced in a rigorous manner. The Policy Needs Workgroup studied these issues by exploring the state/provincial compliance systems, including regulated sources, sector initiatives, complaint procedures and follow-up, emergency release response procedures, enforcement, and penalties.

In June 2004, the workgroup convened a meeting of enforcement and abatement staff from MDEQ and OMOE, along with other staff from Environment Canada, the U.S. EPA, the City of Windsor, and the International Joint Commission. The group met in Ontario to discuss abatement and enforcement systems in Michigan and Ontario. The group included air quality inspectors from the Detroit field office of MDEQ and the OMOE district office in Sarnia and Southwest Regional Office in London. An enforcement officer from MDEQ was present to discuss enforcement activities. The workgroup produced an overview of the compliance and enforcement systems in Michigan and Ontario and a list of contacts, which are included in the workgroup's reference material.

As part of this discussion, it became evident that the fundamental approach to enforcement in the two countries is similar. Inspection procedures and complaint responses in the two countries are also similar. One of the issues that was identified with regards to compliance is the manner in which one country responds to complaints from another jurisdiction. During the discussions, it became apparent that both jurisdictions have existing processes in place to address complaints from across the border; however, this had never been communicated prior to this initiative. In addition, several differences were noted in the way in which minor penalties are administered, especially with regards to the authority to issue administrative tickets for minor violations in Canada. There is general agreement that the Ontario-Michigan

Notification Plan was adequate for notifying and responding to emergency releases from across the border.

Policy Uses for Scientific Tools and Research

As part of the decision-making process on control strategy options for an airshed, it is important that complex technical information be presented to policymakers and the general public in a manner that allows for scientific information to play a meaningful role in policy development. Scientific information has already been used extensively in both jurisdictions in establishing appropriate standards and in the development of emission reduction programs to achieve the respective targets. Health impact information, ambient air quality data, atmospheric transport/ modeling, emission inventories, control techniques, and economic considerations form the basis for developing emission reduction programs. Our understanding of smog and its precursors is evolving. The workgroup saw the need to continue to explore ways to further enhance the use of scientific information and tools.

In order to accomplish this, the Policy Needs Workgroup met with the Airshed Characterization Workgroup co-chairs to discuss the status of various technical and scientific activities that are under way in the transboundary area. A list of scientific questions were created to help facilitate an understanding of policy needs. Much of the technical work is under way and scheduled to be completed within the next two to three years. The discussion focused on opportunities for communicating this information as it becomes available. The most important issue that exists in this area is how the vast amount of information that is becoming available can be distilled into a format that is useful for a broad variety of audiences, including the public. This is a communications challenge as much as it is a policy or technical challenge. Another fundamental issue is how policymakers communicate with their science experts to ensure that their activities complement policy needs.

LESSONS LEARNED

Administrative and Structural Framework

- There are **significant differences in administrative and structural frameworks in the two countries** that need to be understood and considered in making air quality decisions.
- **The U.S. federal government has a strong oversight role in the approval of both permits and state programs to address air pollution. Although the Canadian federal government is responsible for addressing transboundary air pollution, it must seek the cooperation of provinces and territories** to implement the commitments under international agreements and to manage local air pollution sources.

Control Strategies

- Despite the differences in management approaches, national standards, and timelines set by Canada and the United States, both countries are working to achieve the same goal of reducing source emissions of and human exposure to ozone and fine particulate matter and their precursors. However, **further examination of the control programs is required for making air quality improvements**.
- Although both countries have various control programs in place to manage emissions of PM and ozone precursors, it is unclear how these initiatives would impact this airshed and whether they are adequate to meet air quality standards from both countries for this region. In the United States, a workgroup (Southeast Michigan Ozone Study, or SEMOS) has been established to address this issue for Michigan. An **analysis to assess the whole Southwest Ontario/Southeast Michigan airshed is needed to guide the development of control strategies**.

- **Transportation infrastructure development proposals are being developed** (e.g., Detroit River International Crossing), **and it is important to monitor their potential impacts on air quality**. Major transportation undertakings would be subject to a more comprehensive environmental assessment in both countries, and opportunities for public input are available through this process.

Permit Systems/Compliance and Enforcement

- Discussions resulted in the **recognition of some differences in permitting and compliance systems**. Since each government authority is sovereign, coordination of these activities can sometimes be a challenge. In addition, each government has different legislation and rules in place that would complicate formal coordination of these activities. However, there was a great deal of interest in continuing dialogue to exchange information on practices and to help in addressing permitting and compliance issues that may arise in the future.
- **Dialogue and fostering working relationships are important for influencing permitting decisions and enforcement activities**. There are important differences in permitting and enforcement systems in both countries that need to be understood for an effective dialogue to occur.
- There is a **need to communicate information in a timely manner during the permitting process to interested parties on both sides of the border** so that everyone who is affected can have input into the process.
- The process for handling cross-border complaints was clarified as a result of discussions among the enforcement and abatement staff. **Michigan and Ontario both have systems that can respond to complaints from the public in the other jurisdiction. A contact list for complaints was shared among the partners**, to help an agency that receives a complaint on a transboundary source to refer it to appropriate staff in the other jurisdiction for follow-up.
- While this project was under way, **communication between the permitting systems was improved**, which resulted in meaningful changes to one particular permit's emission limits.
- **An agreement between Michigan and Ontario already exists to address transboundary spills and emergency air releases**.

Policy Uses for Scientific Tools

- There are **existing workgroups**, such as SEMOS and the National Emissions Processing Group (NEPG), which **have mechanisms for sharing information on air policy, emission inventories, air modeling, and air monitoring**. Both Canadian and U.S. agencies are invited to participate.
- There were **no formal links between Canada and the United States with respect to health research written into the Border Air Quality Strategy objectives**. This complicated communications between the two countries on health-related issues and research.

OPPORTUNITIES FOR COOPERATION

Administrative and Structural Framework

- There is **opportunity for cooperation among jurisdictions within the border region to utilize the existing mechanism under the Canada–United States Air Quality Agreement to address sources within and outside the Southwest Ontario/Southeast Michigan airshed** that may have an impact on air quality in the airshed. **Federal authorities may be necessary to address emissions of sources within and**

outside the airshed that Ontario and Michigan have no authority to control.

Control Strategies

- There is **opportunity for improving communications and sharing information on control strategies at all levels of government**. In addition, there is strong interest in continuing to share information to assist each other in control strategy development processes.

Permit Systems/Compliance and Enforcement

- There is an **opportunity for increased communication on permitting issues**, especially with respect to public notification and comment processes, information exchange on proposed facility permits, and transboundary notification.
- There is **potential for improving the responses to complaints on sources across the border and sharing general compliance information** (e.g., annual statistics and summaries) among abatement and enforcement staff.

Policy Uses for Scientific Tools

- There is an **opportunity for policymakers to engage the science experts in acquiring scientific information and identifying additional information** useful to support policy development.

RECOMMENDATIONS AND NEXT STEPS

Administrative and Structural Framework

- The Southwest Ontario/Southeast Michigan border region should **utilize the mechanism under the Canada–United States Air Quality Agreement to inform policy decisions affecting sources within and outside the airshed**.

Control Strategies and Jurisdictional Plans

- Any significant coordination of control strategy development in the airshed will require **participation in the public processes** at the federal, state/provincial, and local levels. These processes are already under way to varying degrees in both countries. The **existing mechanism under the Canada–United States Air Quality Agreement should be utilized for agencies to be kept informed of these processes**, to ensure that jurisdictions are notified on a timely basis of proposed regulations and other management options so that input to the process may be submitted. There should be **dialogue on complementary approaches of national initiatives at the federal level**. In addition, there should be **dialogue at the local level on control measures** that would apply within Southwest Ontario/Southeast Michigan.
- **Existing local mechanisms should be modified to encompass more of a cross-border focus** (e.g., SEMOS, Windsor Essex County Environment Committee) in order to track progress on local air quality issues, to help address area sources, and to ensure that impacts on other jurisdictions are taken into consideration in developing control actions.
- Control strategies are currently developed independently by each country to manage domestic air issues. **An analysis should be conducted to assess the existing and future control initiatives, with consideration of transboundary flows within and coming into the Southwest Ontario/Southeast Michigan airshed**, in order to determine if they will help meet the air quality standards in both countries and to identify potential gaps that would require further policy development or management tools.

Permit Systems/Compliance and Enforcement

- Discussion during the last year among permitting and enforcement/abatement staff proved to be very successful in bringing a

common understanding on the respective systems. This dialogue should be continued, possibly through **annual meetings among working-level staff** at the federal and state/provincial levels **to discuss shared areas of interest on permitting and abatement** (e.g., joint training, sector-based initiatives, improved public participation, joint audits, sharing of public compliance data, local issues of interest).

- There is a **need to review the permit notification processes in both countries** to determine if there are opportunities to allow for **more timely notification** of the public on proposed permits. The **review should include the transboundary notification procedures** by Environment Canada and the U.S. EPA **to ensure that obligations are being met** within the Canada–United States Air Quality Agreement.

Policy Uses for Scientific Tools

- There should be **continued participation** of federal, state, and provincial agencies **in existing workgroups (e.g., SEMOS and NEPG) that have science-policy interaction to share information** on air policy, emission inventories, air modeling, and air monitoring.
- While Canada and the United States **continue to collaborate on addressing the common science questions** that are of interest to policymakers on both sides of the border, there is a **need to establish a more effective mechanism (e.g., web site, periodic meetings, etc.) to share scientific information** on air quality and health among policy and science experts from all jurisdictions.
- **Communication with the local community on scientific information** should be encouraged to develop programs and to promote local actions to address emissions from commercial, residential, and transportation sources.

CHAPTER 3

VOLUNTARY/EARLY ACTION WORKGROUP REPORT

DESCRIPTION

The Voluntary/Early Action (V/EA) Workgroup was composed of representatives from Environment Canada, the U.S. Environmental Protection Agency (U.S. EPA), and the City of London. The focus of this workgroup was on examining V/EA opportunities that could produce results within two to five years.

The V/EA Workgroup examined beyond-compliance initiatives, such as demonstrations of innovative technologies or best management practices that could contribute to improving air quality by reducing key air contaminants. Specific targeted sectors for early actions included stationary industrial sources (e.g., small and medium-sized enterprises (SMEs), typically with fewer than 500 employees), mobile sources (e.g., diesel trucks, transit buses, school buses, construction equipment, and other nonroad/off-road diesel vehicles), and non-point sources (e.g., agriculture and marine). Based on the timeline and resources of the Border Air Quality Strategy, the workgroup focused on sectors that have not been historically regulated and on projects with the potential to produce verifiable results in the short term.

CURRENT STATUS AND ISSUES

A broad spectrum of V/EA actions are currently under way in both the Canadian and U.S. portions of the Southwest Ontario/Southeast Michigan airshed. The V/EA Workgroup focused efforts on federally led initiatives; however, there is a recognition that states/provinces and local governments also undertake a suite of V/EA activities.

The workgroup found that there is no overarching coordination in terms of voluntary actions. In addition, the existing initiatives are primarily issue, sector, and/or geographically based, are largely transportation focused, and go beyond-compliance.

Other factors identified by the workgroup in terms of existing V/EA activities included the following:

- There is a lack of financial and human resources to adequately engage underserviced sectors.
- There is a lack of local capacity to deliver meaningful programs.
- Existing funding structures and mechanisms are not conducive to the long-term sustainability of V/EA programs.
- Education and outreach are essential to encourage local actions.
- There is a need for cross-promotion of existing programs on energy conservation that have air quality co-benefits that are currently not being captured.
- The balance between providing technology solutions and encouraging individual actions has not been adequately scoped.

With respect to the industrial contribution, research was conducted to characterize reported air emissions by the industrial SME manufacturing base in the Southwest Ontario portion of the airshed. This provides a starting point for a comprehensive analysis of industrial SME manufacturers across the airshed.

As part of this project, the workgroup identified opportunities for voluntary action in the airshed and developed several pilot demonstrations. These demonstrations largely focused on opportunities to address emissions in the transportation sector, as well as point source emissions from SME manufacturing facilities. A snapshot of these is given below.

Fleet Pilot Demonstration of the Intelligent Vehicle Tracking and Monitoring System in London, Ontario

This demonstration involves the retrofitting of 50 light-duty fleet vehicles with monitoring equipment that transmits engine performance

data in real time. The goal is to reduce vehicle emissions and fuel consumption by carrying out vehicle repairs/adjustments on an as-needed basis, rather than waiting for regularly scheduled maintenance.

Funded jointly by Environment Canada, Natural Resources Canada (NRCan), the City of London, Paxgrid Telemetric Systems, Inc., and Rogers Wireless Inc., this demonstration will be promoted as a major project supporting fleet greening, consistent with existing anti-idling activities (e.g., NRCan's FleetSmart initiative). This pilot will contribute to the promotion of driver training that addresses idling and other driver behaviors that can result in increased fuel usage and vehicle emissions.

Estimates of the anticipated emission reductions are not available at present, but these will be quantified as the pilot demonstration progresses.

Business Air Quality Program Pilot for SMEs

This program focuses on reducing air emissions from SME industrial manufacturing facilities in Southwest Ontario. Initiated in November 2004, this 18-month pilot provides for facility assessments and reviews at 15 to 20 participating SMEs to identify best practice improvements to reduce air emissions. Environment Canada is contributing a front-end subsidy of 50 percent of pollution prevention audit costs, to a maximum of $5,000 per facility. The participating SMEs are responsible for the remainder of the audit costs.

In order to develop the work plan for this pilot, an analysis was conducted to characterize reported air emissions by the industrial SME manufacturing base in the Southwest Ontario airshed. This provided information on a county-wide and major urban center basis and permitted the identification of "high-risk" industrial sectors to target, including an estimate of the number of SME manufacturing locations in each sector.

This pilot is being coordinated with NRCan's existing Industrial Energy Audit Incentive to capture air quality co-benefits that are currently not being quantified. Emission reductions for this pilot cannot be quantified at this time, but will be available as SMEs complete the program.

Biodiesel Byway Project

This project is led by NRCan with testing performed by Environment Canada and is intended to demonstrate the efficacy of biodiesel use in the Canadian climate. It involves three large diesel trucks (plus one backup) operating in the Windsor to Toronto corridor, running on various blends of biodiesel (B2, B5, B20, and B100). Fuel heating system modifications will be made on one truck to allow for year-round operation on pure biodiesel (B100). Trucks will be tested for a suite of parameters, including carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_X), total hydrocarbons (THC), and total particulate matter (TPM). Over the two-year demonstration period, the biodiesel-powered fleet will log over 1.6 million kilometers or 1 million miles.

Preliminary test results from the project are currently being analyzed, for each truck, fuel, and temperature combination, to determine the emission reductions.

Diesel Retrofit Projects

A number of local and regional fleets in Canada and the United States were equipped with diesel oxidation catalysts (DOCs) to achieve emission reductions of CO, volatile organic compounds (VOCs), and particulate matter (PM). In aggregate, these retrofit projects represent total emission reductions of 5.16 tonnes (5.69 tons) per year. The emission savings indicated for each project represent annual reductions.

I. Transit Windsor Diesel Retrofit Project

Six Windsor transit buses were retrofitted with DOCs, resulting in anticipated annual emission reductions of 0.51 tonne (0.56 ton).

	Annual anticipated emission reduction			
	tons	lbs	tonnes	kg
Transit Windsor – Phase 1 (6 vehicles)				
VOCs	0.127	254	0.115	115
CO	0.368	736	0.334	334
PM	0.063	126	0.057	57
Project total	0.558	1,116	0.506	506

This project was funded by Environment Canada in partnership with the Canadian Urban Transit Association.

II. Transit Windsor Diesel Retrofit Project – Phase 2

This project involves retrofitting DOCs on 20 Windsor transit buses, resulting in annual anticipated emission reductions of 0.65 tonne (0.72 ton).

	Annual anticipated emission reduction			
	tons	lbs	tonnes	kg
Transit Windsor – Phase 2 (20 vehicles)				
VOCs	0.065	130	0.059	59
CO	0.631	1,262	0.572	572
PM	0.021	42	0.019	19
Project total	0.717	1,434	0.650	650

This project was funded by Environment Canada.

III. Great Cities Project: City of Detroit

This project was funded through a U.S. EPA grant to the City of Detroit and involved the retrofit of 40 city garbage trucks with DOCs, resulting in annual anticipated emission reductions of 0.66 tonne (0.72 ton).

	Annual anticipated emission reduction			
	tons	lbs	tonnes	kg
Detroit garbage trucks (25 vehicles)				
VOCs	0.203	406	0.184	184
CO	0.496	992	0.450	450
PM	0.023	46	0.021	21
Project total	0.722	1,444	0.655	655

The City of Detroit will examine an anti-idling component and conduct outreach to other city departments on diesel retrofits.

IV. Ann Arbor Public School Bus Retrofit Project

This project was funded by the U.S. EPA's Clean School Bus USA program. This demonstration project will retrofit 110 school buses with DOCs and use biodiesel fuel (B20). The annual anticipated emission reduction will be 1.63 tonnes (1.79 tons).

	Annual anticipated emission reduction			
	tons	lbs	tonnes	kg
Ann Arbor – School buses (110 vehicles)				
VOCs	0.492	984	0.446	446
CO	1.06	2,120	0.962	962
PM	0.162	324	0.147	147
Subtotal	1.714	3,428	1.555	1,555
Ann Arbor – Biodiesel component				
VOCs	0.016	32	0.015	15
CO	0.043	86	0.039	39
PM	0.02	40	0.018	18
Subtotal	0.079	158	0.072	72
Project total	1.793	3,586	1.627	1,627

V. Okemos Public School Bus Retrofit Project

This project was funded by the U.S. EPA's Clean School Bus USA program and involves the retrofitting of 78 school buses with DOCs in 11 school districts within the Greater Lansing area. The annual anticipated emission reduction will be 1.10 tonnes (1.21 tons).

	Annual anticipated emission reduction			
	tons	lbs	tonnes	kg
Okemos school buses (78 vehicles)				
VOCs	0.349	698	0.317	317
CO	0.752	1,504	0.682	682
PM	0.115	230	0.104	104
Project total	1.216	2,432	1.103	1,103

VI. Sarnia Transit Diesel Retrofit Project

This project involves retrofitting DOCs on 12 Sarnia transit buses, resulting in annual anticipated emission reductions of 0.62 tonne (0.68 ton).

	Annual anticipated emission reduction			
	tons	lbs	tonnes	kg
Sarnia Transit (12 vehicles)				
VOCs	0.039	78	0.036	36
CO	0.631	1,262	0.572	572
PM	0.013	26	0.012	12
Project total	0.683	1,366	0.620	620

This project was funded by Environment Canada.

LESSONS LEARNED

- **Focus efforts on community-based actions utilizing leveraged partnerships**. The V/EA efforts undertaken within this feasibility framework have resulted in positive air quality gains. However, most have been "top-down" actions initiated by the federal governments in both Canada and the United States. To ensure sustainability, local governments need to take ownership by identifying and initiating community actions. At the same time, senior levels of government need to make municipal governments aware of those options that are realistic, effective, and of low risk to the municipality and provide guidance and/or assistance in implementing these actions. This can be achieved by **utilizing local delivery organizations (or champions) working in partnership with senior levels of government to bolster V/EA efforts in the longer term**.
- **Link the air quality agenda to other related voluntary initiatives (transportation, energy conservation, pollution prevention)**. Experience with industrial SMEs has shown that sector-based programs would benefit from linking the air quality agenda with other initiatives (transportation, energy conservation, pollution prevention). This can be achieved by improving federal/provincial and federal/state cooperation to enhance deliverables for both parties, through cross-promotion of existing energy-focused programs with air quality co-benefits that are currently not being captured or quantified.

OPPORTUNITIES FOR COOPERATION

- There is a **potential for additional demonstrations/pilots, such as diesel retrofits with school buses, transit, and garbage trucks; anti-idling; biodiesel; etc**. This provides an opportunity for sharing of successes, case studies, and lessons learned between Canada and the United States.
- While V/EA initiatives are not formally coordinated, there are numerous examples of similar opportunities within both countries resulting in emission reductions. There is an **opportunity for both countries to build on existing efforts and identify other areas of mutual interest** — for example, the coordination of federal fleet-related and energy-efficient consumer product initiatives with air quality improvements in both Canada and the United States.
- Similarly, further SME research across the airshed could be utilized as a baseline for the coordination of existing delivery programs aimed at the industrial manufacturing base. **By identifying priority industrial sectors common to both the United States and Canada for V/EA initiatives, synergies developed can be of particular value in advancing air emission reductions with SMEs**.

- Cooperation between federal and state/provincial initiatives could result in greater potential for air quality improvements. This might be best achieved by **engaging local governments in the design and delivery of air quality programs**, thereby building local capacity for the management of these issues.
- Local governments have the potential to **engage a diverse range of partners**. Industrial associations and other local community organizations can also be key delivery partners for air quality efforts.

RECOMMENDATIONS AND NEXT STEPS

- **Investigate opportunities for joint binational actions in high-visibility border locations**. While the federal governments on both sides of the border can sustain and maintain efforts in their individual jurisdictions, joint V/EA actions concerning, for example, idling at border crossings and marine engines need to be explored to make additional air quality gains in the border area.
- **Focus on community-level initiatives to develop local delivery capacity**. Experience with implementing voluntary programs indicates that the most successful projects are those that include participation from local levels of government. Local organizations should be encouraged to promote V/EA efforts and should be provided with technical support, information on financial assistance, and tools to link V/EA to environmental and health benefits to help build their capacity to manage these programs.
- **Pursue leveraged partnerships in other underrepresented sectors to raise awareness of air emission reduction efforts**. V/EA efforts are well represented in the transportation sector across the airshed; however, there is **growing public interest in pursuing V/EA efforts in other sectors** (e.g., agricultural, residential, commercial/institutional, etc.).
- **Continue research and analysis of the industrial manufacturing base (large emitters and SMEs) to identify common priority sectors across the airshed**. Synergies between existing programs can be developed to advance air emission reductions with SMEs in Southwest Ontario/Southeast Michigan.
- **Build on existing efforts to engage local partners**. Additional leveraged funding may be available from other sources in the future for V/EA efforts, but these cannot be sustained indefinitely without local ownership of those aspects that they control.
- Increased communication efforts are needed to **raise awareness and understanding of the benefits of air emission reduction programs at the local level** to encourage additional V/EA efforts.

CHAPTER 4
COMMUNICATIONS AND OUTREACH WORKGROUP REPORT

DESCRIPTION

The Communications and Outreach Workgroup established two functions at the start of the Great Lakes Basin Airshed Management Framework Pilot Project:

1) to provide communications and outreach support for the Steering Committee and the other workgroups to facilitate public awareness of the project; and
2) to develop recommendations on future communications and outreach needs in the Great Lakes Basin airshed.

In terms of outreach, the workgroup focused on generating awareness of the pilot project among key stakeholders and soliciting information that could assist in identifying opportunities for cooperation.

In terms of communications support, the workgroup focused its attention on developing and providing appropriate tools to implement the outreach function, as well as on communicating the intent and progress of the pilot project to the public.

By undertaking key research activities, the workgroup developed recommendations on what communications and outreach strategies are needed to maintain ongoing dialogue on and support for coordinated air quality management in the future within the border area.

CURRENT STATUS AND ISSUES

Public Awareness

Air quality is important to stakeholders in the project area, and most stakeholders look for tangible improvements to air quality. It was important for the workgroup to emphasize that the objective of this study was to enhance information exchange and identify opportunities for cross-border cooperation that could improve air quality in the future.

The workgroup used various existing and ongoing stakeholder meetings and forums as a principal mechanism to raise awareness of the pilot project in order to reach key audiences and to make the most efficient use of resources. A key issue was distinguishing the project from other border projects being conducted in the Windsor/Detroit region, such as the International Consortium for Atmospheric Research on Transport and Transformation and the Canada–United States-Ontario-Michigan Border Transportation Partnership Study.

At the start of the project, the workgroup conducted a needs assessment to identify the communications and outreach needs of the pilot project. A survey was sent out to the Steering Committee and the three other workgroups. A summary of the preliminary issues identified by each of the workgroups is included below:

1) Air Characterization Communication Needs

- There needs to be **greater communication on the type of air quality data that are available to the public**, where the data can be obtained, how to interpret the data, and how to apply the data to actions that can be taken on a day-to-day basis.
- **Improved public knowledge about the differences in air quality indices in Canada and the United States** can help to improve perceptions of both the reliability and usefulness of these tools and consequently greater engagement of individuals to protect their health and/or reduce air pollution.

2) Policy Communication Needs

- The public may need to be informed about the **differences in attainment guidelines and ambient air quality standards** in the United States and Canada for both fine particulate matter ($PM_{2.5}$) and ozone to have a better understanding of health implications and potential remedial measures.

- **The public may need a greater understanding of the permitting processes on both sides of the border**, especially with respect to the public comment process, to improve their participation in these processes.
- Residents on both sides of the border may need to understand **how to report potential violations or obtain information on the compliance or enforcement status of facilities across the border**.
- The public should be made more aware of **information on accidental release procedures**, **especially with respect to public notification and response measures** that exist in the emergency protocol under the current Michigan/Ontario agreement.

3) Voluntary/Early Action Communication Needs

- There is a **need to improve awareness of voluntary actions** that can be taken to reduce air emissions and their associated benefits.
- There are many **voluntary programs on both sides of the border that are available to help industry and small and medium-sized enterprises (SMEs)** identify opportunities for reducing air emissions. Establishing relationships with these sectors and demonstrating mutual benefits are key to encouraging participation in these programs. In addition, sharing success stories on the environmental benefits could provide an incentive for others to replicate these programs.
- There is a **need to communicate the funding sources available from public and private sectors**, as well as additional incentives and recognition programs, to increase participation and motivate voluntary emission reduction practices.

The needs assessment was followed up with individual discussions with the three workgroup co-chairs. The needs assessment suggested that the following products would be most valuable: a PowerPoint presentation, fact sheet, and web site on the pilot project; an inventory of current air quality activities and initiatives in the region; information on upcoming outreach opportunities; and a recognition program for voluntary/early actions on clean air. These are briefly described below:

- **PowerPoint presentation:** The workgroup created a template PowerPoint presentation with information on the pilot project that can be adapted as needed. Long and short versions of the presentation have been made available for workgroup members to use at information sessions and other presentations, so that messaging to stakeholders from all partners in the project is consistent.
- **Fact sheet:** A fact sheet with general information on the pilot project was created for distribution at information sessions and other presentations. It contains information on workgroup activities and additional contact information for questions and/or concerns.
- **Web site:** The workgroup explored the development of a web site that can be used to provide information on the project and its activities, local air quality, and what local governments, industry, and communities can do to improve air quality. Web site content is being developed by Environment Canada in conjunction with the other workgroups, as well as the partners involved in the project.
- **Community programs/initiatives inventory:** An inventory of ongoing community programs and initiatives to improve air quality in the project area is being compiled by project partners. The inventory findings will be posted on the web site.
- **Outreach opportunities:** The workgroup took advantage of several opportunities both in Canada and in the United States for Steering Committee and workgroup members to make presentations on the pilot project. These outreach efforts provided an opportunity to inform stakeholders about the pilot project,

receive input from external partners and interested public on the pilot project, and develop recommendations for future action.

Research and Field Work

In order to develop communications and outreach strategies, more information is needed about public awareness, perceptions, and attitudes with respect to cooperation and action on air quality and transboundary air pollution in the region. The workgroup conducted an internal communications audit to bridge the gaps in knowledge needed to improve communications on air quality within the border area.

I. Internal Communications Audit

A communications audit was conducted to analyze the communications initiatives undertaken by partner agencies in order to identify opportunities for cooperation among partners on messaging frequency, media, and/or content.

Communications information from February 19, 2001, to date was collected and analyzed. Information was gathered from partners' web sites, publications (e.g., brochures, fact sheets, bulletins, newsletters, past newspaper clippings, etc.), and speeches by key spokespeople.

The results may be useful in identifying opportunities for the partners to cooperate on communications and outreach initiatives in order to enhance public access to air quality and cross-border air pollution information.

II. Public Opinion Research

A public opinion research plan was developed by Environment Canada that included the Southwest Ontario/Southeast Michigan region to determine public knowledge, attitude, action, and needs with respect to air quality and transboundary air pollution.

The plan calls for a random telephone survey of 1,200 Canadian and American adults in Ontario and Michigan, weighted according to education, age, gender, and income, to identify key opportunities for cooperation based on current needs.

The research will solicit the following information specifically from Canadians and Americans in the Windsor/Detroit region:

- current knowledge of air quality and cross-border air pollution issues;
- current perceptions of air quality and cross-border air pollution issues;
- current individual action on air quality and cross-border air pollution issues;
- current needs to improve knowledge of air quality and cross-border air pollution issues;
- current needs to improve perceptions of air quality and cross-border air pollution issues; and
- current needs to improve individual action on air quality and cross-border air pollution issues.

For the purposes of the research, air quality issues will include: [1]

- sources of air pollution;
- personal impact on air pollution (contributions);
- personal impact of air pollution (effects);
- government action (federal, provincial, and municipal);
- relative air quality compared with other regions and/or country (as applicable);
- relative air quality today compared with "the past";
- health impacts;
- measures to protect health;
- environmental impacts;
- measures to protect the environment;
- air quality standards;
- personal motivation to improve air quality;

[1] Not all air quality issues are relevant for each research objective.

- obstacles to improving air quality;
- sources of information; and
- learning and/or engagement opportunities.

For the purposes of the research, cross-border air pollution issues will include: [2]

- sources of air pollution (country of origin and/or source); and
- different air quality standards. [3]

A similar survey will be conducted by Environment Canada with senior representatives of 300 Canadian and American SMEs to assess their current understanding and knowledge of air quality and cross-border air pollution issues to promote beyond-compliance initiatives.

LESSONS LEARNED

Timely and meaningful information on air quality is especially important to stakeholders within the Southwest Ontario/Southeast Michigan border region.

- It is important to **clearly communicate and clarify the objectives of initiatives** such as the Border Air Quality Strategy **at the start of the project**.

OPPORTUNITIES FOR COOPERATION

- There is an opportunity for communicators on both sides of the border to **collaborate on raising awareness of what individuals can do to improve air quality in the international airshed**.
- An opportunity exists for Canada and the United States to **explore mechanisms to jointly promote and market voluntary programs** that exist for business and industry in the border area. Communication of successful voluntary efforts, especially in terms of economic benefits, could also be improved to motivate replication of pilot projects on both sides of the border. Development of incentive programs would also serve to increase participation in voluntary programs.
- An opportunity exists for Canada and the United States to **undertake an analysis of the communications audit to identify additional communication needs in the pilot area**.

RECOMMENDATIONS AND NEXT STEPS

Cooperating on communication efforts in the Southwest Ontario/Southeast Michigan region is not a new concept to Canada and the United States. In fact, there are many examples that can be cited where agencies from both sides of the border have been undertaking successful joint communication efforts. One such example is the joint "Ozone Action! Day" notifications that are issued to both Detroit and Windsor residents, as a result of the cooperative efforts of the Michigan Department of Environmental Quality and the Ontario Ministry of the Environment.

As a result of the needs assessment and by applying what was learned from the internal communications audit, the Communications and Outreach Workgroup identified a number of preliminary recommendations to improve communication on air quality issues in the border area. These recommendations are still deemed preliminary, as the public opinion poll being conducted by Environment Canada has not yet been completed. These recommendations are a starting point for identifying the public's need for air quality information.

Consistent Messaging about Clean Air Goals

- Canada and the United States should provide a **consistent message regarding air quality and air quality management in**

[2] Not all cross-border air quality issues are relevant for each research objective.

[3] In Canada, the Air Quality Index (AQI) describes air quality. However, the AQI and descriptors used in Canada and United States are not the same. Therefore, what is termed a "bad" air quality day on one side of the border is not necessarily the same on the other side.

the border area. One option is to develop a joint web site and use it as a communications vehicle for delivering consistent messages to border residents about clean air goals. The key messages could include the following: both countries have ambient air standards in place; both countries are continually developing control programs to meet these standards and timelines; and both countries are trying to achieve the same goal of protecting human health and improving air quality.

Increased Communication on Air Quality Information

- **Appropriate communication tools should be used to inform stakeholders in the border area** on the types of air quality data that are available to them, what the data means, how to access the data, and an explanation of what different data sets mean and their limitations.
- Canada and the United States should **build on the working-level relationships that have been established within this framework**, develop joint communication and outreach initiatives, and promote awareness of individual actions that could lead to improved air quality and protection of human health.
- Canada and the United States should agree to **perform an analysis of the communications audit** that was undertaken in March 2005 as part of this pilot project to identify additional communication needs to better inform the public, raise awareness of air quality issues, and educate people on how they can modify their behaviors to become part of the solution to air pollution.
- An **international recognition/reward program that would provide further incentive for sectors to improve air quality within the border area** should be considered.
- Canadian and U.S. agencies working in the border area **need to establish clear and well-defined lines of communication that should be maintained on a permanent basis to continue improving cross-border air quality and to address future issues that may arise**.
- Canadian and U.S. agencies working in the border area **need to identify key points of contact for the public on air quality issues**.

Include Residents and Businesses on Both Sides of the Border as Part of the Target Audience

- Canadian and U.S. agencies should **develop information targeted to stakeholders on both sides of the border** on permitting, enforcement, and accidental release procedures.
- While there are good outreach programs currently under way on both sides of the border, Canadian and U.S. agencies **need to continue to invest in education and outreach initiatives that will maintain public and private sector interest in voluntary programs** that improve air quality within the border area.
- Canadian and U.S. agencies should **develop information targeted to businesses and industry in the border area** on potential funding sources, voluntary programs, incentive and reward programs, and success stories.

Chapter 5
Health Report

Description

For decades, air pollutants have been associated with both short-term and long-term adverse health effects. Known organ systems impacted include the cardiovascular, respiratory, and reproductive systems. Long-term health effects can include increased risk of mortality, lung cancer, chronic respiratory disease, and heart disease as well as damage to the liver, kidneys, and potentially the brain. Sensitive subgroups (e.g., those with heart disease, diabetics, and children) may be at higher risk.

The purpose of this summary is to briefly highlight existing and planned health research in the Windsor/Detroit area on the association between adverse health impacts and air pollutants. The studies described in this chapter examine the health impacts of criteria pollutants, especially ozone, particulate matter (less than and equal to both 10 microns and 2.5 microns in diameter, abbreviated as PM_{10} and $PM_{2.5}$, respectively), and their precursors.

Situated across the river from Detroit, Michigan, Windsor is the busiest crossing point along the Canada–U.S. border. Both Detroit and Windsor have point source emissions, such as industry, and non-point source emissions from diesel trucks and other vehicles. Windsor is known to have relatively high levels of fine particulate matter ($PM_{2.5}$) contributing to local air pollution compared with other cities across Canada and is affected by transboundary long-range transport of air pollution. By conducting health research in this region, it will be possible to address local concerns about the health effects of air pollution.

Under the auspices of the Canada–United States Border Air Quality Strategy (BAQS), Health Canada's Air Health Effects Division (AHED) is carrying out scientific studies in an effort to characterize air quality and human health issues in the Great Lakes Basin. The objectives of the research studies are threefold:

1) to collect human health data in support of the pilot project;
2) to analyze evidence of human health impacts from air pollution in the regional airshed; and
3) to assess the risk to human health posed by air pollution on regional, national, and international scales.

There are six Great Lakes Basin health research initiatives under way in Canada. These, along with their health endpoints of interest, are:

1) Windsor Children's Respiratory Health Study (respiratory);
2) In Vitro Toxicology Study (acute cellular toxicity of particulate matter);
3) Windsor, Ontario, Exposure Assessment Study (exposure assessment);
4) Investigation of Mortality and Morbidity Rates (chronic exposure to air pollutants and impact on population mortality and cancer incidence);
5) Cardiovascular Effects of Air Pollution on Diabetic Patients (cardiovascular); and
6) Pregnant Women and Birth Outcomes Study (reproductive/developmental).

Two U.S. Environmental Protection Agency (U.S. EPA) studies are in progress: the Detroit Exposure and Aerosol Research Study (DEARS) and the Detroit Children's Respiratory Health Study. The Windsor, Ontario, Exposure Assessment Study has been designed to closely match the DEARS so that findings may eventually be compared on both sides of the border.

No new scientific research has been conducted or planned using Michigan government funds designated specifically for this Windsor/Detroit BAQS. However, a number of studies have been, are being, or will be conducted in the Windsor/Detroit airshed by a variety of organizations.

CURRENT STATUS AND ISSUES

Solid relationships were key to the success of the health studies described below in this section. Throughout the research process, steps were taken to build new relationships and capitalize on preexisting ones.

Securing Community Support

The people of Windsor are very aware of the high level of air pollution in their city compared with other areas of the country. There has been considerable media coverage of the increasing frequency of smog advisories in Windsor and other cities in Ontario. In these reports, air pollution is often linked to health problems in children, seniors, and other vulnerable populations. Naturally, air quality is an issue of concern for the people of Windsor.

The people of Southeast Michigan are also concerned about air quality. The Southeast Michigan Council of Governments, in partnership with the MDEQ, have established programs to communicate air quality information. An example is the "Ozone Action! Program," established in the 1990s, which has resulted in greater health awareness and pollution reducing activities from citizens.

At the time the BAQS projects were announced, the Windsor community was also very frustrated with the seeming lack of government action on air quality. They wanted answers and a concrete plan for taking action on air pollution.

With this in mind, Health Canada worked hard to gain the support of the people of Windsor by facilitating information exchange and citizen engagement. Health Canada built relationships in the community and, in collaboration with Environment Canada and the University of Windsor, co-sponsored a symposium on air quality in Windsor in February 2004. Health Canada representatives described the current state of research on the health impacts of air quality and explained the research projects that would be conducted under the BAQS.

The department representatives also explained how the research would have a lasting impact for the community, serving as a baseline against which future air quality and the effectiveness of interventions could be measured.

Health Canada made a concerted effort to be transparent and inclusive in carrying out its work in the community and also took care to avoid being an intrusive presence. In fact, considerable effort was made to encourage the participation of the community. To provide a face-to-face opportunity for community comment, Health Canada held a stakeholder forum in August 2004. Health Canada also established a professional collaboration with the Centre for Environmental Health of Ontario, based in Windsor. The purpose of this collaboration was to provide a local point of contact for area residents on the health studies.

Collaborating with Partners

Several studies have been and are being conducted in the Windsor/Detroit airshed on ambient air pollutants in association with a variety of health outcomes. However, communication among researchers has not always occurred in a timely manner. As a result of the BAQS, a network of contacts has been established between U.S. and Canadian government scientists that will further enhance communications.

In Michigan, the Departments of Community Health (MDCH) and Environmental Quality (MDEQ) have been collaborating with university researchers at the University of Michigan and Michigan State University (MSU) on two of the projects noted below (i.e., the Michigan Asthma Strategic Planning Initiative and the Michigan Adverse Birth Outcomes Study). These projects have been made possible with funds from the Centers for Disease Control's Agency for Toxic Substances and Disease Registry in the U.S. federal government. The Community Action Against Asthma (CAAA) project is an excellent example of community-based participatory research involving multiple stakeholders, which

is being conducted by the University of Michigan and funded by the U.S. EPA.

In Canada, the partnerships that Health Canada has with Environment Canada, the Ontario Ministry of the Environment, and the University of Windsor have been a key factor in successfully carrying out health studies in the Great Lakes Basin.

Prior to the BAQS, Health Canada already had sound relationships with these partners. These established links served as a solid foundation for collaboration at the working level.

In addition, the IJC was instrumental in coordinating two key meetings between Canada and U.S. researchers. The objective of these meetings was to facilitate the exchange of information and the development of common research methodologies.

As for long-term implications of the collaboration, the partnership with the University of Windsor will facilitate knowledge transfer and build domestic capacity for conducting future health research similar in nature to that being conducted under the BAQS.

Research

The following study descriptions are organized by the specific health impact studied, then further subdivided by the state/province and organization conducting the research.

1. Respiratory

Ontario

The Windsor Children's Respiratory Health Study

The effects of air pollution on respiratory health are a major concern and an important area for research. Compared with other Canadian cities, Windsor is known to have relatively high levels of fine particulate matter and ragweed. Air pollution and its effects on respiratory health have been major concerns in the area, especially in children, who are more vulnerable than adults to the negative effects of air pollution, since they breathe more rapidly, are more physically active, interact more closely with their physical environment, and are in critical stages of growth and development.

In order to characterize the respiratory health of Windsor's elementary school children in relation to their levels of exposure to both indoor and outdoor air pollution, Health Canada initiated the Windsor Children's Respiratory Health Study in the fall of 2004. The objective of the study is to determine the adverse health effects of ambient air pollution on children's lung function. The study involves cooperation of the four Windsor school boards, the Windsor Medical Officer of Health, and parents of school children. The study is carried out in three phases, described briefly below.

Phase I: Questionnaire

The first phase of this study was completed in December 2004 and involved a large, cross-sectional, baseline questionnaire survey of all Windsor elementary school students in grades one to eight (approximately 26,000 children) to determine their respiratory health and their levels of exposure based upon assessments of specific factors related to their home (e.g., home address, housing characteristics) and medical history. The home address was used to determine air pollution exposure. The questionnaire was designed to dovetail with the questionnaire used in a similar U.S. study (the Detroit Children's Health Study).

Phase II: Lung Function Testing

The second phase of this study, was completed over the course of winter to spring 2005, involved a cross-sectional test on lung function and lung inflammation which was conducted on Windsor children in grades four to six. A short questionnaire and consent form for parents was sent home with approximately 8,300 children. It determined risk factors just prior to the lung function measures and included questions such as age, parental education, family history of lung disease, and indoor exposure to allergens, irritants, and microbial agents.

Three tests were carried out: spirometry (lung function), exhaled nitric oxide, and inflammation markers in exhaled breath condensate. The tests involved blowing into machines and assessing lung inflammation and airway functioning, which were then correlated with levels of air pollution measured by outside monitors. Lung function tests were carried out by respiratory therapists. The order in which the school visits took place was randomly selected to avoid any bias in sampling design.

Phase III: Panel Study

The last phase of the study will be initiated and completed in fall of 2005. Four groups of 100 children will be selected to represent those with and without asthma and those who live in areas with high and low levels of air pollution. Both groups will undergo daily lung function tests (peak flow) and daily symptom diaries for one month to investigate the influence of daily changes in air pollution on day-to-day changes in lung function.

Michigan

Michigan Asthma Strategic Planning Initiative

As part of the Michigan Asthma Strategic Planning Initiative, a small study was performed jointly by MDCH and MDEQ, in collaboration with MSU. The purpose of the study was to examine potential associations between asthma hospitalizations and criteria pollutant exposures. Ambient monitoring data on criteria pollutants were obtained from the U.S. EPA Atmospheric Information Retrieval System from separate MDEQ monitors located on Linwood Road and East 7 Mile Roads in Detroit. The data were analyzed along with daily hospitalizations from the Michigan Inpatient Database as provided by MDCH. Hospitalizations were obtained from 23 Detroit-area zip codes for 1999-2000. Increasing nitrogen dioxide (NO_2) levels were related to higher daily asthma hospital admissions. Effects of $PM_{2.5}$ and sulfur dioxide (SO_2) on hospitalizations were not seen. A conflicting protective effect of ozone on asthma hospitalizations was seen, possibly due to the inverse relationship with NO_2. Funding has been pursued to expand this work to individual-level data (e.g., emergency department and doctor visits), but has not yet been received.

Community Action Against Asthma (CAAA) / Michigan Center for the Environment and Children's Health (MCECH)

A large community-based collaborative initiative is being conducted in the Detroit area with a focus on asthmatic children. The Michigan Center for the Environment and Children's Health is a community-based participatory research initiative investigating the influence of environmental factors on childhood asthma. MCECH involves collaboration among the University of Michigan Schools of Public Health and Medicine and numerous state and local partners. [1]

CAAA is a part of MCECH. Projects listed below are part of the CAAA initiative. Many publications have resulted from this collaborative, community-based participatory effort. A few recent studies are described briefly below:

- A group of 298 Detroit-area children with persistent asthma were studied prospectively from 1999 to 2002 by Dr. T. Lewis. Ambient particulate matter (PM) and ozone were the pollutants of study. Daily symptom diaries noting either the presence or absence of symptoms were completed. Simultaneous monitoring was done at two elementary schools. Daily concentrations of PM_{10} and $PM_{2.5}$ and eight-hour maximum values of ozone were all associated with increased odds of respiratory symptoms, particularly among sicker children. The effect was seen

[1] MCECH involves collaboration among the University of Michigan Schools of Public Health and Medicine, the Detroit Health Department, the Michigan Department of Agriculture, nine community-based organizations in Detroit and Henry Ford Health System. MCECH is funded by the National Institute of Environmental Health Sciences and the U.S. Environmental Protection Agency.

most often with a lag of two or more days between exposure and effect.

- In a related study by Dr. G. Keeler, exposures to PM_{10} and $PM_{2.5}$ for the children were examined at the elementary schools. For two years, daily indoor measurements were taken at the same two schools as in Dr. Lewis's study and at the homes of 20 asthmatic children. Ambient levels were measured as well. Researchers found increased particulate exposure in ambient air, in homes, and at the elementary school in southwest Detroit, as compared with the east side (likely due to proximity to industry and motor vehicles on a nearby expressway). In addition, they found that indoor PM levels were 1.5 to 2 times the outdoor levels within nonsmoking homes. Researchers concurrently administered twice-daily pulmonary function tests, including peak expiratory flow (PEF) and forced expiratory volume in one second (FEV1). Also collected were daily asthma symptom medication diaries.
- Dr. J. Harkema has been conducting a concurrent animal study to examine the effects of this community-based $PM_{2.5}$ on the airway epithelium in normal rats and compromised rats with preexisting hypersecretory airway disease. One objective was to identify the chemical or physical components of $PM_{2.5}$ that are responsible for $PM_{2.5}$-induced airway inflammation and epithelial alterations in these animal models of human airway disease. A special research trailer was placed at the location of one of the subject elementary schools, and ambient air from the site was concentrated to use as the exposure medium.

Detroit Children's Health Study

With funds from the U.S. EPA, the Detroit Children's Health Study will look at urban air pollutant levels and clinical/biological markers of exposure. The researchers plan to examine whether neighborhood differences in pollutant levels are related to the development of allergies and asthma. The study will be modeled after a previous cross-sectional asthma epidemiological study conducted in El Paso, Texas. Multiple federal, state, local, and university partners will collaborate on this study. The study will involve fourth- and fifth-grade students in about 60 schools in two school systems. Passive monitoring will be conducted. Mobile and point sources of air pollutants will be examined. Exposure monitoring is scheduled to begin in late summer 2005 and will include PM, volatile organic compounds (VOCs), and NO_2. An attempt will be made to try to collocate with VOC samplers in Windsor. Study components will include questionnaires, lung function tests, and exhaled breath measurements. The study is being conducted by the National Health and Environmental Effects Research Laboratory, Human Studies Division, Epidemiology and Biomarkers Branch of the U.S. EPA.

II. In Vitro Toxicology Study (Acute Cellular Toxicity of Particulate Matter)

This study, which was initiated by Health Canada's AHED in March 2004, with a focus on Windsor, Ontario, will provide evidence on how and why PM may cause adverse health effects. Specifically, the study will investigate the cytotoxic potency of PM in human pulmonary epithelial cells and determine which components of the pollutants from which part of the city have toxic effects on human cells.

Using results from the spatial monitoring conducted in Windsor, specific locations that result from sources such as diesel traffic or local industry will be selected to collect PM.

III. Exposure Assessment

Ontario

Personal exposure information is valuable in obtaining a comprehensive understanding of the risks posed to human health in specific situations. Personal air exposure studies have been limited

in the past due to nonrepresentative populations and the inability to measure multiple pollutants. The overall goal of the exposure study is to assess community and personal exposure from all air pollution. The study will be conducted through the simultaneous quantification of personal, indoor residential, and outdoor residential air pollutants in Windsor.

The Windsor, Ontario, Exposure Assessment Study involves the monitoring of air pollutants such as particulate matter ($PM_{2.5}$ and PM_{10}), NO_2, SO_2, ozone, nitrate, elemental carbon/organic carbon (EC/OC), VOCs, polycyclic aromatic hydrocarbons (PAHs), and acid vapour.

The study will be carried out in two phases, described below.

Phase I: Personal Air Pollution Exposure Monitoring

The first phase began in the winter of 2005 and will end by the summer of 2007. The study will involve recruitment of 144 participants over three years using information obtained from the Windsor Children's Respiratory Health Study. Eligible participants in year one will be healthy nonsmoking adults who are not occupationally exposed to PM, NO_2, SO_2, ozone, or VOCs, as the mandate of the BAQS is to investigate ambient air quality, and in years two and three will be children aged 9 to 11 years who live in detached homes.

Stationary air sampling equipment will be set up by Health Canada researchers at one location inside the participant's home (living room) and at one outdoor location (backyard). Participants will be carrying portable personal air quality monitoring equipment in a padded backpack. Sampling equipment will be in place for five consecutive days during each of the two seasons of interest. For each of the five days, participants will be asked to keep a daily diary of their activities so that sources of air pollution can be identified.

Phase II: Spatial Air Pollution Assessment Study

Another method being employed by Health Canada to determine exposure to air pollution is spatial air pollution sampling. This will determine community levels of exposure to air pollution and will be used in support of the health research being carried out in the area. Throughout the past year, in all four seasons, spatial monitoring has occurred throughout Windsor. There have also been intensive sampling campaigns between Windsor and Chatham and between Chatham and Sarnia, which were conducted by Environment Canada during the winter and summer only. This was a passive sampling methodology to monitor NO_2, SO_2, and VOCs. Future sampling will expand the number of pollutants and will be conducted in the backyards of the 48 participants involved in the personal exposure study. Again, this monitoring will be undertaken for a two-week period each season. Air pollutants that will be targeted include $PM_{2.5}$, total PAHs, total acid vapour, and EC/OC, as well as the previously monitored NO_2, SO_2, and VOCs. The results of this study will be combined with those of the Windsor Children's Respiratory Health Study to provide a more accurate assessment of each child's exposure to air pollution. Methods for analysis will include kriging, which maps the area of influence for different pollutants. The data will later be investigated using land use regression techniques to determine the impact of land use, population density, traffic, and meteorology.

Michigan

Detroit Exposure Aerosol Research Study (DEARS)

The Windsor, Ontario, Exposure Assessment Study is intended to complement this U.S. EPA three-year field monitoring study, which was initiated in summer 2004. DEARS will characterize the personal, indoor, and outdoor exposure patterns of randomly selected healthy adults living close to, and far from, specific air

pollution sources in Detroit, Michigan. It will specifically examine exposure relationships for air toxics, PM components, PM from specific sources, and criteria pollutants. Results from the study will determine whether ambient monitoring data should be used in human health risk assessments and for setting future air quality standards.

IV. Investigation of Mortality and Morbidity Rates including Cancer

The Windsor community is very concerned about long-term exposure to high levels of air pollution and its adverse effects on the population. Research is being conducted at Health Canada to investigate mortality and morbidity rates, including cancer rates, over the past 20 years in relation to chronic exposure to air pollution.

The study is being carried out in two stages. Stage one involves characterization of mortality rates for all causes of death and morbidity rates, including cancer rates, since the late 1970s. These have been examined across three census divisions (Windsor, Sarnia, and London) and compared with Ontario provincial rates. In stage two, the association between mortality and morbidity rates and air pollution will be investigated using postal code information and geographic information system techniques.

V. Cardiovascular

Ontario

Cardiovascular Effects of Air Pollution on Diabetic Patients

Epidemiological studies on population mortality and morbidity have shown that diabetic patients appear to be more susceptible than the general population to air pollution-related mortality and hospital admissions due to cardiovascular disease. The biological mechanisms are not clear. It is critical to gain knowledge on the biological evidence of the susceptibility of diabetic patients for the purpose of developing evidence-based air quality policies. It is hypothesized that this may be related to changes in blood vessel constriction and some molecules in the blood that modulate blood vessel function and inflammation.

In October 2004, Health Canada's AHED initiated the Diabetic Patients Panel Study in Windsor, Ontario, to determine if exposure to air pollution during diabetic patients' daily activities may be associated with clinical changes in cardiovascular function and inflammation markers. The study involves monitoring daily ambient concentrations of PM, NO_2, SO_2, ozone, and carbon monoxide (CO) while following 30 diabetic patients (type 1 or 2) for a period of two to three months to collect their blood samples and data on blood vessel constriction. Blood samples are used to determine the changes in systematic inflammatory markers.

Michigan

A study is being conducted by University of Michigan and Columbia University researchers to investigate air pollution effects on subclinical atherosclerosis in an existing cohort. To investigate associations of PM exposures with inflammatory markers and subclinical atherosclerotic disease, concurrent and historical monitoring data will be used. No findings are yet available from this research.

VI. Reproductive

Ontario

Pregnant Women and Birth Outcomes Study

This pilot study, which will take place in Ottawa, Ontario, with 10 pregnant women, will determine if air pollution has adverse effects on pregnant women and on birth outcomes. It is hoped that the study will provide critical data for further research to be carried out in Windsor.

The study will investigate the feasibility of following up pregnant women during their pregnancy for their health data and their air pollutant exposure data, measuring their blood inflammatory markers, and collecting birth outcome data.

Michigan

Adverse Birth Outcomes Study

To examine possible effects of criteria pollutants on adverse birth outcomes, a study is being conducted by MDEQ and MDCH in collaboration with MSU and the University of Michigan. Exposure to the criteria air pollutants CO, NO_2, ozone, $PM_{2.5}$, and SO_2 has been associated with low birth weight, premature birth, and small-for-gestational-age neonates. To assess the potential effects of these pollutants on low birth weight, the authors conducted a semi-individual study at four sites in Michigan. For each live birth, cumulative exposures to mean daily air pollutants were assessed in the first and last months of pregnancy. Daily average concentrations were matched temporally to the date of birth and length of gestation. In this study, low birth weight was associated with higher levels of CO, NO_2, and SO_2 during the first month of gestation. These associations became marginal in the multiple-pollutant models. During the last month of gestation, only CO is associated with low birth weight in both single-pollutant and multiple-pollutant models. Analysis for very low birth weight (<1500 grams) as an outcome did not provide any significant results. The preliminary results are consistent with the results of previous studies by other authors. Further studies involving more pollutants are in progress at the time of writing. Ambient air monitoring data from Windsor will be used to impute unavailable Michigan data in some cases. These studies should be completed within the next year.

LESSONS LEARNED

- **Sharing information on the proposed health research on air pollution with the citizens of Windsor and engaging them early in the process secured the community support and trust** necessary to successfully carry out the health research projects.
- **Solid relationships with key partners** served as a foundation for collaboration at the working level.
- It would have been useful **at the beginning of the process** to have a joint Canada–U.S. consortium of researchers and policy representatives **develop a framework for the implementation of a common research design**.

OPPORTUNITIES FOR COOPERATION

- There is an **opportunity to leverage Canadian and U.S. academic research and expertise to maximize knowledge development** based on the very successful meeting held on November 17, 2004, in Windsor, at which Canadian and U.S. researchers shared information on research.
- The research activities conducted in Windsor provide **opportunities for Health Canada to consult with the community about its concerns** relating to local air pollution and health.
- The BAQS has created an **opportunity for Health Canada to increase public awareness of the adverse health impacts of air pollution and to encourage behavior changes** that will enable Windsor residents to reduce their exposure to indoor and outdoor air pollutants.
- The **collaboration between federal departments and local health units, academics, and politicians** on the Windsor health research serves as a good model for addressing significant local health issues.

RECOMMENDATIONS AND NEXT STEPS

- Canadian and U.S. researchers are encouraged to **utilize the existing mechanism under the Canada–United States Air Quality Agreement to promote ongoing communication and data sharing**.
- **Data on toxic air contaminants/hazardous air pollutants should be reviewed** in a fashion similar to that done for the criteria pollutants and coordinated as appropriate.
- Because the health policies in both countries played a key role in the studies conducted under the BAQS and will continue to be an element of future discussion, **it would be beneficial to enhance and increase the joint activities between Canada and the United States on health policy issues**.
- The BAQS projects were not intended to include all regions where transboundary air issues are a major health concern. There is considerable variation in population characteristics and pollutant components between locations within the Southwest Ontario/Southeast Michigan airshed and different regions. **Therefore, findings from one region may not be generalizable to another**. The BAQS has served as a valuable exercise that could be used as a model for carrying out health research in other locations within the airshed as well as in other regions along the Canada–U.S.border regions.
- The collaborative efforts between Health Canada and Environment Canada will produce an extensive data set that will be useful for estimating population exposures critical for human health studies. For ongoing health work, it would be **essential to maintain the existing monitoring framework and potentially expand to other regions of the airshed**.
- The Windsor Children's Respiratory Health Study and Detroit Children's Health Study are steps towards narrowing a key data gap, i.e., the long-term health effects of air pollution, particularly for children. **The inclusion of a longitudinal component to studies of the long-term health effects of air pollution in children could significantly enhance our ability to address such data gaps**.
- **Canada and the United States should discuss the health effects of PM, its sources, as well as any further research needs through the Canada–United States Air Quality Committee**. A sustained effort to address knowledge gaps on the health effects of PM should be a high priority.

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