NARSTO Particulate Matter Assessment Plan

Introduction

This plan for a Particulate Matter Science Assessment to be prepared under the auspices of NARSTO[1] has been prepared for consideration by the NARSTO Executive Steering Committee (ESC) and other NARSTO members. It was endorsed by the ESC in April 2000.

In March 1998 NARSTO revised their charter to include fine particle research related to relevant regulatory standards and to goals and exposure issues (NARSTO News 2:2, 1998). This reflects the present knowledge of the relevance of fine particle impacts on public and ecosystem health and visibility, and an appreciation that the same atmospheric processes and transport scales studied for ozone are important aspects of the PM issue.

Based on discussions at the January 1999 NARSTO meeting, and subsequent thinking, the assessment product is envisaged to focus on exploring the state of science relevant to air quality management issues for reduction in ambient fine particle concentrations; i.e., develop a conceptual model(s) of PM formation and distribution for air quality managersTo be most useful, the assessment product needs to be concise, scientifically credible, reasonably brief but comprehensive in its discussion, focussing attention on the strengths and weaknesses in current science and technology based management tools as they relate to decision making. These include elements of measurements, emissions data, atmospheric processes, and air quality models that guide strategy for addressing health and visibility impacts of PM exposure. The anticipated audiences are decision makers, science — policy analysts, the science community and the public. Given the anticipated increase of information on PM, the focus of the scientific community on current research projects, and the request for timely scientific input to PM air quality management discussions, this assessment is seen as an interim NARSTO review of the state of scientific understanding in the context of implementation. It is anticipated that a sequence of assessment activities will follow. Timing for publication of this assessment report is end of 2002.

Working Assumptions

The charge to the Analysis and Assessment Team is predicated on a number of assumptions about the assessment process and surrounding events likely to take place over the course of the assessment.

1. The definition of the problem is reducing levels of PM. Regulatory agencies are expected to recommend both PM<2.5µm (fine PM) and PM2.5µm-10µm (coarse PM) standards over the next two years. This assessment will encompass a review of PM characteristics relevant to both size fractions.
2. The PM Assessment will contain contextual information on exposure, health and environmental impacts. This information will come from the extensive and in-depth science reviews, without update, prepared by Canada and the US during their air quality goals and standards setting process.
3. A summary of related environmental issues, including deposition, climate change, and air toxins, is required to provide context for a discussion of the science of atmospheric aerosol occurrence and exposure.
4. Addressing PM, ozone linkages and other co-pollutant linkages is important to understanding the PM issue.

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[1] NARSTO is a cooperative entity devoted to research on tropospheric ozone and fine particles, whose members include representatives of government, industry and academia from Canada, Mexico and the United States.

5. It is appropriate for the PM Assessment to address contextual aspects of emission control technologies mainly by reference to existing publications and information.
6. It is necessary to achieve a balanced assessment picture for the PM issues facing the NARSTO member countries.
7. The PM assessment process should be fully open to public participation.
8. The PM assessment should explore accountability approaches which directly relate observations to determining the effectiveness of air quality management plans.
9. Given the continuing advancement of information on PM, this assessment will be the first in a series of periodic NARSTO assessments.

This assessment approach incorporates two complimentary elements in preparing the presentation of current science to policy makers: the assessment products or reports, and the assessment process necessary to preparing the product.

The assessment process is that interaction among scientists and with the policy community that allows discussion of current understanding of particle sources, formation and transport, and the science needed to support implementation and policy expectations. This discussion, or socio-political process, feeds the iterative research cycle of instrument development, data collection and analysis, atmospheric process research, model development and evaluation, and control strategy development, evaluation and implementation. Ideally, the assessment process is reflected in the planning of research activities. The NARSTO PM Assessment and Analysis Team (A+AT) includes members of other science teams and ensures ongoing interactions with those preparing the 2000 NARSTO Fine Particle Research Implementation Strategy.

To facilitate the development of a timely and incisive assessment, we propose to combine a traditional assessment approach with opportunities for broad input from the scientific community and public comment opportunities. The report will be targeted to the policy maker s need for PM science information. A phased approach is planned whereby the assessment client(s) and their information needs are identified and the roles of the information users and information producers are clearly separate but inter-related.

The Assessment Goals and Specific Objectives

Recognizing the potential for NARSTO to be an organization at the interface between the science and policy communities ***the assessment goals*** reach in both directions, and represent broad guidance in developing the assessment report. The overall goal for the PM Assessment is to fully describe how current knowledge and future research can aid air quality policy and management decision making. To satisfy this goal several specific objectives are to be met:

1. Gain an understanding from **decision-makers** of information needs and constraints, including economic, policy, and implementation boundaries.
2. Provide a comprehensive conceptual model of aerosol formation and particulate matter distribution for **science-policy analysts and air quality decision makers.** The model is to accommodate changing knowledge about atmospheric processes, emission sources, emission control technology, exposure, and human health and environmental impacts. It is to address existing limits in information and forecast the implications of expected results from ongoing and future research.
3. Provide a plain language conceptual description of particulate matter air quality for the **public** which describes the relevance of the atmospheric science research with its recent progress and findings.
4. Recommend atmospheric science and related emissions research, with priorities tied to the decision making process, to **research managers** developing a coordinated research

strategy for PM.

5. Provide a framework for **atmospheric scientists** which relates their work to standards, implementation and air quality management, and to health, exposure and environmental impact research for standard setting.
6. Provide a context for **researchers in related fields** to link their work to that of the atmospheric science community, supplying important information on the current state of knowledge of particle formation and distribution and offering opportunities for future research coordination.

It is not intended to retread extensive and in-depth reviews prepared by Canada and the US describing the science underlying the development of air quality standards. Nor is the intent to make policy recommendations, nor a detailed research plan. This assessment can be viewed as a companion to the NARSTO Particle Research Plan.

The assessment process is laid out in three phases. Phase I achieves clear definition of the assessment objectives and identifies the information needs of the audience, the policy community, for the next five years. Phase II undertakes to synthesize the scientific information and critique the state of knowledge in the context of the policy communities information needs. Phase III focuses on the integration of that knowledge and summary of key issues relevant to a conceptual model for PM and the development of air quality management strategies to address health and visibility impacts.

Phase I

The purpose of Phase I is to organize the assessment effort, identify the key lead participants and co-chairs, define the assessment focus, objectives and provide resources for the assessment activity. From discussions held in a variety of forums over the past three years a basic set of overarching science policy questions have been developed:

1. Do we have a significant pollutant PMx[2] problem, and how confident are we?
   - ¥ How far above the levels of the standard are we, and is any exceedance a rare event, or an intermittent to ongoing occurrence?
   - ¥ How certain are we of our data, and in our trends?

2. Where we have a pollutant PMx problem, what is the source of the concentrations we observe now and in the future?
   - ¥ What is transported vs. generated in our area?
     For that generated in our area what is natural vs anthropogenic?
     For that transported in what is natural vs anthropogenic?
   - ¥ What are the particular sources which make-up the natural and anthropogenic fraction?
     That are generated locally and that are transported in?
   - ¥ Again, how certain are we?

3. What broad approaches might we take to fix the problem? What pollutants need to be reduced and by how much to bring our PMx concentrations down to acceptable levels?
   - If we control locally?
   - If we and others upwind both control?

[2] PMx refers to various size fractions e.g.: <1 µm, <2.5 µm etc., that have been adopted as air quality standards.

4. What specific options do we have for fixing the problem? Given the broad control approaches above, what source control alternatives do we have and where can we get the biggest improvements in air quality?
   - How is what we are doing now and have on the books working and expected to work?
   - How much more control will be needed now and in the future?
   - What source sectors could be further controlled and by how much to meet our need ?

5. What are the relationships between the pollutant PMx problem and other problems we are working on, particularly considering its sources and control options (see Q s 2-4 above)?
   - What is the relationship to the ozone problem? The regional haze issue? The acid deposition problem? The global climate and Uvb issues? The air toxics problem?

DECISION POINT ON CONTROLS BY POLICY MAKERS
(Incorporating 1-5 above, co- & dis-benefits on other pollution problems, sector economic health -willingness to pay, legal constraints - precedents and delays, societal and political pressures - potential impacts on elections and administrations)

6. How can we measure our progress? How can we determine the effectiveness of our actions in bringing about: emissions reductions, air quality improvements, and corresponding health improvements?
   - What source and ambient measurements do we need ?
   - What criteria of success should be used?
   - What daily air quality forecasting and indexes are possible?

7. When and how should we reassess and update our control program to adjust for any weaknesses in our plan, and to take advantage of advances in science and technology? How should we evaluate the effectiveness of implementation actions?

8. What further atmospheric sciences information will be needed in the periodic reviews of our national standards?
   - A. In relating what it is about PMx (ambient characterization as a surrogate*) that is responsible for its toxicity ?
   - B. In relating human exposures (ambient concentrations as a surrogate*) to health risks?

It is envisioned that these (or similar) questions will form the underlying theme(s) of the assessment followed through the individual science chapters.

It is recognized that the decision-makers in federal and provincial/state governments, industry and NGOs need an opportunity to identify their information needs to the science community. This process could more clearly define the assessment audiences, goals, structure and content. An added benefit is that it would also achieve from the clients scientific and technical insights that are useful to the researchers (e.g.: outlook for future PM related technologies, implementation or policy boundary conditions, economic constraints etc.) which would help the scientific community construct useful future scenarios.

The mechanism planned to achieve this input combines individual solicitations to policy groups within the NARSTO membership and other stakeholders, and a follow-up workshop including both NARSTO and non-NARSTO participants as appropriate. Based upon this input a brief report will be drafted identifying the assessment clients and their needs which will be available for broad comment on the NARSTO website. This exercise will confirm the assessment is focused in a manner that will meet the needs of decision-makers implementing

current standards, and to identify potential controversies regarding the scientific basis of implementation.

Phase I also includes preparation of initial draft Preface and Chapter 1 of the assessment report (see proposed topical outline).

Phase II

Establish a common network to promote an open and flexible process assimilating knowledge and information relevant to each element of the report. To maintain an open and flexible process, the NARSTO A+AT will solicit input from the principal investigators of major field studies and a full range of relevant research projects to gauge the impact of new information, and provide opportunity for early public review and comment of report drafts.

To accommodate the anticipated influx of new knowledge from recent and current research programs, investigators of major field studies and research projects will be asked to identify the key information which their studies are designed to obtain. The purpose of this solicitation is to provide a basis for discussing the need for flexibility within the assessment and the potential to incorporate new scientific information in implementation plans. The solicitations[3] to principal investigators could be via the NARSTO web page and Newsletter, as well as advertisement in major journals. All submissions will be posted on the NARSTO website, organized for evaluation and synthesized by the assessment team.

The A+AT is considering the development of several white papers to provide a scholarly and substantive review of several issues to act as a resource for the writing of the assessment. These issues are sources, health effects in context of atmospheric science, physical and chemical processes, spatial and temporal characteristics and, possibly, uncertainty analysis.

Current knowledge generally cannot fully answer all questions posed by the user community. Indeed, many information needs may be only partially answered with current knowledge. This is particularly the case for an issue such as PM that is being re-shaped in the context of past experience with existing objectives or standards. However, the fact that questions cannot yet be answered fully is useful information, in itself, to the decision-maker, particularly if the assessors can give some measure of the possible time-scale of the development of the needed information.

Further, the conventional assessment process has been criticized for being overly restrictive for NARSTO participants to provide inputs. Review of the NARSTO ozone assessment process as compared with other science assessment or synthesis activities, such as the OTAG process[4], suggest that electronic communications with the science community at large provides several benefits. The review and comment aspects of the process provide major opportunities for open communication allowing a wide variety of input from varied sources, enhanced transparency of process involving a greater number of participants in the discussion of research activities and science based recommendations.

The authority of the assessment relies upon the credibility of the information that is assessed. A standard approach of using currently available peer reviewed literature as the foundation of

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[3] Contributions would be limited to ~300 words and be received electronically by the NARSTO Secretariat. Submissions would require a brief discussion of their relevance to the objectives and framework of the assessment report and be supported by peer reviewed references. The contributions would be distributed to the lead authors for each report element early in the process to allow for as much flexibility as possible in the writing and synthesis activities.

[4] OTAG information can be found at http://www.capita.wustl.edu/otag or http://www.epa.gov/ttn/rto/otag .

the assessment will be followed. In instances where the material is publicly available and has undergone to some degree expert review, in-press publications and gray literature from internal publications will also be considered. In addition, the Guidelines for the formulation of scientific findings to be used for policy purposes NAPAP Oversight Review Board Report Appendix III, will be used to guide the writing of the assessment. See Attachment #1.

The integration of the document will be completed through a series of communications and meetings of the assessment team that result in the draft report for review by NARSTO members and contributors. It is this series of meetings between lead authors that is anticipated to generate the inter-disciplinary discussion necessary to developing an integrated assessment report.

The focus of Phase II is preparation of drafts of Chapters 4 — 10 as proposed in the topical outline.

Review by NARSTO members and the public of interim report drafts and formal peer review and public comment of the final draft is a critical component of Phase II.

Phase III

The focus of Phase III is on integration of scientific knowledge to address cross-cutting issues and summarize the key elements of a conceptual model(s) for PM. This model is intended to incorporate the perceived linkage with the effects community and the development of air quality management strategies. This is encompassed in the writing of Chapters 2, 12 — 13 (see proposed topical outline) and the assessment report summary. Also in this phase the pertinent scientific information embodied in a conceptual model(s) of PM describing the formation, transport and ambient distribution characteristics is presented to decision-makers in the form of an Executive Summary to the Assessment Report. A plain language summary possibly including Frequently Asked Questions is planned for the general public. The intent is to provide a comprehensive description of the emissions and atmospheric processes involved in particle formation and accumulation and the expected impacts of possible management actions.

The Products

There are four products planned for this assessment: a brief report identifying the assessment audience and their information needs, the Assessment Report, an Executive Summary, and public information material.

The proposed topical outline for the PM Assessment Report follows. It is anticipated that this format may be revised based upon the input from Phase I, however is serves as a starting point identifying the key disciplines and issues to be addressed. The assessment may team may adapt an alternate format that integrates these topics to address key policy oriented questions in analogy to the 1999 NARSTO ozone assessment. It is anticipated that lead authors will access the expertise of additional co-authors where appropriate. It is envisaged that each of the major sections would be about 10 - 15 pages in length, making the report approximately 130 - 150 pages in length.

TOPICAL OUTLINE

Executive Summary

Assessment Summary

Preface: Introduction to NARSTO and the purpose of the PM Assessment
- A. What is NARSTO?
- B. Objectives and Approach to this Assessment
- C. Contents/Scope of Assessment

1. Overview of the Air Quality Planning Framework and Process (including tri-country, and fed/state-prov perspectives)
- A. Current Ambient Air Quality Standards in North America
- B. Summary of Current Understanding of PM Impacts and Scientific Rationale for Current Standards and Implementation Plans
- C. Implementation Issues and Schedules

2. Conceptual Framework for PM Formation and Distribution

3. Sources of PM
- A. Primary Emissions and Emissions Modelling
- B. Gaseous Precursors (SO_2, NOx, VOC, NH_3) and Production in the Air (Secondary Particles)
- C. Observational Based Techniques for Source Attribution: Descriptive assessment spatial and temporal trends, Chemical Mass Balance, Other Methodologies, Evaluation of Component Accuracy: Emission Inventories, Ambient Monitoring Methodologies and Databases

4. Measurement and Monitoring
- A. Instrument Considerations
- B. Data Storage Formats and Accessibility
- C. Data Comparability

5. PM Air Quality in North America
- A. Spatial and Temporal Patterns (Urban and Non-urban)
- B. Apparent Trends in PM Concentrations
- C. Episode and Transport Characterization
- D. Monitoring, Network Design and Quality Assurance Issues

6. Physical and Chemical Processes Affecting PM Concentrations
- A. Microphysics and Chemistry
- B. Macro-processes Meteorological Factors and Particle Deposition
- C. Potential Tradeoffs of Precursor Management Options

7. Chemical Transport Models
- A. Modelling Capability and Performance
- B. Application Considerations
- C. Potential for Exposure Estimation

8. Impacts Overview for Context
- A. Visibility
- B. Human Health
- C. Methodologies for Exposure Assessment: Temporal and Spatial Considerations

9. PM Trends and Implications for Management
- A. Analysis of Emission and Ambient Trends in PM

The Schedule

The NARSTO 1999 ozone assessment initiated in 1996 has taken to mid 2000 to complete. The duration of the ozone assessment exercise is deemed unacceptable given the immediate needs for information to policy makers, and the timing for decision making. In Canada the PM Canada Wide Standard will be reviewed by 2005 requiring the scientific and technical information to be available by end of 2003. In the U.S. the review of the PM National Ambient Air Quality Standard will be completed by July 2002. The Criteria Document summarizing the science will be completed by December 2000 with a Staff Paper discussing policy options to b completed by early winter 2001. A decision will be proposed in the fall of 2001 and finalized by July 2002. Th proposed timeframe for the NARSTO PM Assessment is March 2000 to December 2002.

Phase	Task		Date
Prepare Assessment Plan	**Assessment Plan Approval by Executive Steering Ctte.**		March 2000
	First formal meeting A+AT and lead authors		May 2000
Phase I	**Identification of Assessment Clients and their Needs** **Preface and Chapter 1**		March 2000 - 2001
	Solicit contributions	Spring 2000	
	Workshop	September 2000	
	Draft Report	October 2000 — January 2001	
	Draft Preface and Chapter 1	Summer 2000	
	NARSTO + Public Review of available drafts	February — March 2001	
	Finalize Report	April — May 2001	
Phase II	**PM Science Assessment + Writing (Ch. 3 — 9)**		January 2001 — Autumn 2002
	Introductory Mtg of Lead Authors (Charleston, SC)	January 2000	
	Solicit contributions from PIs of major field studies and research projects	October — November 2000	
	Meeting (Qu retaro, Mexico)	October 2000	
	Writing	January — December 2001	
	Meetings (US city, Toronto, US city respectively)	February, June + November 2001	
	NARSTO + Public Review	Autumn 2001	
	Peer Review and Public Comment of Ch 1, 3 — 9	January — June 2002	
	Meeting	Summer 2002	
	Finalize report	November 2002	
Phase III	**Chs. 2, 10 — 12 Summary and Communication Products** • Chapters 2, 10 — 12 + Summary + Appendices • Executive Summary • Public Information Piece		January — December 2002
	Ch 2, 10 — 12 Writing	January - June 2002	
	Summary and Exec Summary Writing	July — August 2002	
	Public Education Piece Writing	Autumn 2002	
	Peer Review + Public Comment	September - November 2002	
	Finalize	December 2002	
Publication	**Publish all reports**		January 2003

The Review Process

The PM assessment schedule includes opportunities for NARSTO member and public review of interim draft reports prior to a more formal peer review and public comment opportunity. The review of interim drafts will utilize the NARSTO website and serve to refine the assessment approach and context as it progresses. The pee review and comment opportunity on the final drafts will include a formal response by the assessment authors. Discussions are underway to develop an efficient yet credible formal external review mechanism for the PM assessment. Options include a combined Royal Society of Canada / National Academy of Sciences panel or a solicitation of external reviewers who would be commissioned formally to read and comment on the external draft assessment. This issue will be discussed more fully within the A+AT and the Executive Steering Committee.

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Attachment #1

APPENDIX III

GUIDELINES FOR THE FORMULATION OF SCIENTIFIC FINDINGS TO BE USED FOR POLICY PURPOSES

Oversight Review Board of the National Acid Precipitation Assessment Program

The following guidelines in the form of checklist questions were developed by the ORB to assist scientists in formulating presentations of research results to be used in policy decision processes. These guidelines may have broader utility in other programs at the interface of science and public policy and are presented here with that potential use in mind.

1) Is the statement sound? Have the central issues been clearly identified? Does each statement contain the distilled essence of present scientific and technical understanding of the phenomenon or process to which it applies? Is the statement consistent with all relevant evidence - evidence developed either through NAPAP research or through analysis of research conducted outside of NAPAP? Is the statement contradicted by any important evidence developed through research inside or outside of NAPAP? Have apparent contradictions or interpretations of available evidence been considered in formulating the statement of principal findings?

2) Is the statement directional and where appropriate, quantitative? Does the statement correctly quantify both the direction and magnitude of trends and relationships in the phenomenon or process to which the statement is relevant? When possible, is a range of uncertainty given for each quantitative result? Have various sources of uncertainty been identified and quantified, for example, does the statement include or acknowledge errors in actual measurements, standard errors of estimate, possible biases in the availability of data, extrapolation of results beyond the mathematical, geographical, or temporal relevancy of available information, etc. In short, are there numbers in the statement? Are the numbers correct? Are the numbers relevar to the general meaning of the statement?

3) Is the degree of certainty or uncertainty of the statement indicated clearly? Have appropriate statistical tests been applied to the data used in drawing the conclusion set forth in the statement? If the statement is based on a mathematical or novel conceptual model, has the model or concept been validated? Does th statement describe the model or concept on which it is based and the degree of validity of that model or concept?

4) Is the statement correct without qualification? Are there limitations of time, space, or other special circumstances in which the statement is true? If the statement is true only in some circumstances, are these limitations described adequately and briefly?

5) Is the statement clear and unambiguous? Are tl words and phrases used in the statement understandable by the decision makers of our society? Is the statement free of specialized jargon? Will too many people misunderstand its meaning?

6) Is the statement as concise as it can be made without risk of misunderstanding? Are there any excess words, phrases, or ideas in the statement which are not necessary to communicate the meaning of the statement? Are there so many caveats in the statement that the statement itself is trivial, confusing, o ambiguous?

7) Is the statement free of scientific or other biases or implications of societal value judgments? Is the statement free of influence by specific schools of scientific thought? Is th statement also free of words, phrases, or concepts which have political, economic, ideological, religious, moral, or other personal-

agency-, or organization-specific values, overtones, or implications? Does the choice of how the statement is expressed rather than its specific words suggest underlying biases or value judgments? Is the tone impartial and free of special pleading? If societal value judgments have been discussed, have these judgments been identified as such and described both clearly and objectively?

8) Have societal implications been described objectively? Consideration of alternative courses of action and their consequences inherently involves judgments of their feasibility and the importance of effects. For this reason, it is important to ask if a reasonable range of alternative policies or courses of action have been evaluated? Have societal implications of alternative courses of action been stated in the following general form?:

If this [particular option] were adopted then that [particular outcome] would be expected

8) Have the professional biases of authors and reviewers been described openly? Acknowledgment of potential sources of bias is important so that readers can judge for themselves the credibility of reports and assessments.

FROM: NAPAP Oversight Review Board. 1991. The Experience and Legacy of NAPAP: Report to the Joint Chairs Council of the Interagency Task Force on Acidic Deposition. National Acid Precipitation Assessment Program, Washington, DC. 40 pp.