# Science Advice in Environment Canada

*Working Paper No. 11*
Science Policy Branch
Environment Canada

*Document de travail n° 11*
Direction de la politique scientifique
Environnement Canada

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# SCIENCE ADVICE IN ENVIRONMENT CANADA

Wintergreen Consulting
April 2000

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**Part III Business Line Tables: an Approach to Science/Policy Linkages at Environment Canada**

# Note to Reader

In July 1999, the Council of Science and Technology Advisors publicly released the *Science Advice for Government Effectiveness* or *SAGE* report. This report presented a set of principles and guidelines designed to improve the science-based decision-making process within the federal government.

In May 2000, in response to the *SAGE* report, the Government of Canada released the Framework for Science and Technology Advice. The Framework reflects the extensive consultations within the federal government and with external stakeholders, and builds upon existing science advice measures and processes currently utilized by federal departments.

The principles and guidelines listed in the Framework are consistent with those in the *SAGE* report. The Framework also includes broad implementation measures to promote the adoption and to evaluate the effectiveness of the Framework as well as to identify accountability within each department for its implementation.

Before the appearance of the Framework, Environment Canada undertook a number of studies to assess the Department's science advice practices against the principles and guidelines outlined in the *SAGE* report.

One of the studies was this report, *Science Advice in Environment Canada*. The work was conducted by Dr. Alex Chisholm of Wintergreen Consulting, a former senior manager of the Department. The report consists of three parts:

**Part I** - Develops an inventory of the Department's major science advice measures that address the *SAGE* Principles. Twenty-nine Environment Canada staff members (and two former employees) were interviewed by telephone and asked to identify science advice measures used in decision making. Also, a number of relevant reports and documents were identified and reviewed.

**Part II** - Scores the Department's performance (science advice measures) against the *SAGE* principles and guidelines. This analysis helped to identify the strengths, weaknesses and trends within the three themes of policy and regulatory decision-making (i.e., national policy, regulatory formation and regional/operational decision-making).

**Part III** - Examines and evaluates the role of the Business Line Tables in the process of linking science to policy. The consultant found that these Tables present the Department with a broad and comprehensive mechanism to review and address a variety of issues from early identification to policy / regulation formulation in a highly integrated fashion.

In the report, Wintergreen Consulting assessed 60+ science advice measures practiced by Environment Canada over the years and found that the Department has been remarkably successful in providing Canada with environmental policy and regulations based on sound science. The Department received high marks from the consultant for its performance against the principles but deficiencies were noted in addressing specific guidelines. Three options for change were recommended: status quo, evolutionary change or revolutionary change.

Wintergreen Consulting also made a number of recommendations to Environment Canada regarding the continued fostering and development of the Business Line Tables as fora where science issues can be brought forward and discussed particularly in the context of pursuing policy and regulatory actions.

The report helps establish a baseline of science advice measures employed by Environment Canada and confirms that existing measures and mechanisms have been effective to date in formulating policy and regulations. However, the report only identifies and assesses existing science advice measures. It does not identify crucial areas where no or limited science advice measures may exist. This topic must remain a high management priority in a science-based department such as Environment Canada.

# Part I

# Environment Canada's Science Advice Measures: Inventory

# Environment Canada's Science Advice Measures: Part 1- Inventory

## 1. Introduction

In March 1996, the federal government released its strategy paper on Science and Technology for the new century (Ref.1). This strategy, aimed at improving the effectiveness of the government's S&T resources, has had considerable impact on science-based departments and agencies (SBDA's) and the way in which they manage S&T. One product of the federal strategy has been the development of the Council of Science and Technology Advisors (CSTA), which issued in May 1999, its report entitled *"Science Advice for Government Effectiveness"*, also known as SAGE (see Ref. 2 and Refs. 3, 15) for supporting documentation). The SAGE report lists six *principles* that CSTA recommends SBDA's adopt as well as a series of *guidelines* to assist in their implementation.

Prior to implementing the SAGE principles for the management of its science advice, Environment Canada requires an inventory of existing science advice measures used by the department. Such measures are used in the formulation of environmental policy and regulations, and in decision-making for environmental operational programs both regionally and nationally. To assist in the process, Environment Canada's S&T Advisory Committee has recently completed its own report thereby providing the department with recommendations for implementing the SAGE principles (Ref. 3).

The specific purpose of this report is to provide an inventory of the significant mechanisms, activities and procedures (i.e. measures) which Environment Canada presently uses in the provision of science advice. It should be pointed out that the sole purpose of this report is to provide an *inventory;* neither in-depth analyses nor recommendations are provided herein. These are contained in Part 2 of this report.

## 2. The SAGE Principles

The full text of the SAGE principles is found in Appendix V. A brief summary of the six SAGE principles follows:

*i)* *Early Identification of Issues:* Departments need to anticipate those issues, both challenges and opportunities, for which science advice will be required.

*ii)* *Inclusiveness:* Scientific advice should be drawn from a variety of scientific sources and disciplines to capture the diversity of scientific schools of thought and opinion.

*iii)* *Sound Science/Advice:* Public expectations of quality, objective, science advice requires that due diligence procedures are practiced, including peer review.

*iv)* *Uncertainty and Risk:* As science is often uncertain, it is essential to undertake risk assessments and adopt a risk management approach.

*v)* *Openness:* Democratic governments are expected to employ transparent decision-making processes open to stakeholders.

vi) *Review:* Science-based decisions should be revisited to: a) absorb new scientific knowledge and, b) to evaluate the decision-making process.

## 3. Historical Perspective

As a science-based department, the concept of science advice measures is not new to Environment Canada. In fact, since its inception in 1971, Environment Canada has utilized a variety of science advice measures in many different circumstances.

*Eutrophication of the Great Lakes:* One of the first major environmental issues faced by Environment Canada was that of the *Eutrophication of the Great Lakes.* Extensive research was conducted by Environment Canada scientists on this issue prior to the formulation of policy, regulation and the implementation of remedial measures.

*Acid Rain:* Prof. Eville Gorham of Dalhousie University first identified the acid rain phenomenon in the Atlantic Provinces in 1955. It was not until the mid-1970's that Environment Canada, in co-operation with provincial governments and universities, became significantly involved in research on acid rain. By the early 1980's, acid rain had become a *public policy issue* in Canada. At that time, however, the United States was very much opposed to the control of acidic emissions. As a consequence, the research spearheaded by Environment Canada became a crucial element in convincing the United States government that airborne emissions from US industrial sources were responsible for significant downwind environmental damage in both the US and Canada. This was an object lesson to the department, indicating that it is essential to maintain a *national environmental research capability* sufficient to address major environmental problems of national concern. Consequently, some of the first *environmental science assessments* were produced *in parallel* in both the United States and Canada prior to the signing of the Canada/US Air Quality Agreement In 1991.

Acid rain is still an environmental issue in need of research, science assessment and risk management for policy formulation and action. The "*Canada Wide Acid Rain Strategy for Post – 2000*" (see Ref. 22), signed by the Federal/Provincial/Territorial Ministers of Energy and Environment in Halifax on October 19, 1998, is witness to:

i) the ongoing commitment of governments to this problem;

ii) the review of new scientific findings; and

iii) the importance of research and monitoring for its solution.

It is noteworthy that this commitment to action stems from the *"1997 Canadian Acid Rain Assessment"* (see Refs. 17-21).

*Ozone Layer Depletion:* Predictions of *depletion of the stratospheric ozone layer* by stratospheric transport aircraft and later by chlorofluorocarbons (CFC's) became an environmental issue in the early 1970's. This concern and the rapid rise in the use/release of CFC's led to the regulation of the use of CFC's as a propellant in aerosol spray cans in the early 1980's. Unfortunately, by the late 1980's the manufacture/release of CFC's had risen again to 1980 levels. Extensive diplomatic work by the United Nations Environment Programme (UNEP) led to the development and signature of the *"Montreal Protocol on Substances that Deplete the Ozone Layer"* (Ref.62), much of it based on international scientific work in international science assessments spearheaded by NASA. *The concept of scientific assessments, as well as assessments of technology and socio-economic factors, was entrenched in Article 6 of*

*the Montreal Protocol, to be repeated on a four year cycle for the use of the contracting parties.* The latest (i.e. 1998) Ozone Science Assessment is found in Ref. (23).

*Biodiversity:* Science assessments do not always precede policy formulation. This was the case with the topic of biodiversity. In 1992, Canada and other governments signed the Convention on Biodiversity at the United Nations Conference on the Environment in Rio de Janeiro. This convention called on countries to develop national strategies to achieve the three objectives of the convention, namely:

i) conservation of biological diversity;

ii) sustainable use of its components; and

iii) fair and equitable sharing of the benefits arising from the use of its genetic resources.

Environment Canada became responsible for undertaking the development of a *national biodiversity strategy* (see Ref. 14). A major requirement was a scientific assessment of biodiversity issues in Canada with implications for policy and research, particularly for Environment Canada's own policies and research. Consequently, a biodiversity science assessment was commissioned, undertaken and published in 1994 (see Ref. 13).

*Climate Change:* Environment Canada identified *climate change* as a potential environmental issue early in the 1970's and commenced the development of a *global climate change model,* at that time. Climate change began to develop as a public policy issue in the late 1980's. Much of the media information on this issue has come from global climate change models. These model predictions of future climate were also the basis for *scientific, technical and social assessments* undertaken by the Intergovernmental Panel on Climate Change (IPPC) in the early 1990's. The result of this process was the development and signature of the *"Kyoto Climate Change Protocol"* (Ref. 63) in late 1996. The work of the IPCC has taken the assessment process much further than before to look at the *vulnerability* of different areas of the world to the impacts of climate change (see Ref. 33). Environment Canada has contributed to this process by involving university researchers in *impact assessments* since the mid-1980's. The department has since advanced to studying the *adaptations* that Canadian society will have to undertake assuming reductions in greenhouse gases will neither be made in the quantity nor with the timeliness necessary to deal with major climate change.

*Pulp Mill Effluent:* Research on the impact of pulp mill effluent on fish stock, downstream from pulp mills, commenced in the department approximately 20 years ago. Similar research on this topic was carried out, as well, in the Nordic countries. The Nordic research implicated *organochlorines* in pulp mill effluent as being responsible for environmental effects on fish. Quite rapidly after this development, the Nordic countries began adopting regulatory measures to reduce the organochlorines in pulp mill effluent, which was disposed of in various water bodies.

The Canadian experience, however, indicated that mills whose organochlorine levels met the Nordic targets still gave rise to reproductive problems in fish living downstream. A naturally occurring substance was suspected, instead, as being responsible for the deleterious effects. At this juncture governments in Canada were under considerable pressure from environmental groups to proclaim regulations on the combined organochlorine mix (known as AOX) in pulp mill effluent. At the same time, the EEC was preparing to blacklist Canadian pulp and paper products because of the AOX problem. *In this instance, the need for policy drove the science.* In two short years, the Canadian team (Environment Canada, Fisheries and Oceans Canada and researchers from three

Canadian universities) did the requisite research which proved that the organochlorines present in pulp mill effluent; *were not toxic, broke down rapidly under sunlight and were neither individually, nor collectively, responsible for the effects on fish.* Instead, naturally occurring substances that are contained in the "cooking liquor", in the pulp mill process, were found to be the cause of the problems. Much of this research is only now being published in peer-reviewed journals and corroborated by research by the international scientific community. This is an example of policy driving the need for science.

*$NO_x$ /VOC's and Particulate Matter:* A science assessment on the topic of urban smog (i.e. pollution resulting from $NO_x$/VOC's) was completed in 1996 (see Refs 35 - 41) and a science assessment on the impact of particulate matter on humans is currently under way.

*Science Assessments:* The development of science assessments has come about quite naturally in the science community. It follows the scientific method and is an extension of the publication of papers in *peer-reviewed* journals where the research and analyses are under the scrutiny of peers. Science assessments have also developed to include an assessment of the future risk to humans and the environment (i.e. *a risk assessment*) and often contain a plain-language *"Summary for Decision-Makers".* An in-depth analysis of science assessments performed by the Meteorological Service of Canada is found in *"Science Assessment: A Report on Science Policy Linkages in the Atmospheric Environment Service"* (see Refs. 4,5,6).

*Environmental Impact Assessments:* Science assessments are appropriate for the formulation of policy. There are, however, circumstances where the impact of man's actions on the environment must be predicted and assessed. Some classic examples are major development projects, such as hydro dams, offshore oil drilling and production, the development of mining, milling and ore transport capabilities, and the siting of nuclear power plants and subsequent disposal of their waste products. The process that has developed internationally to deal with these matters is the *"environmental impact assessment".* The Federal Environmental Assessment Review Office (FEARO) has used this methodology in Canada, under Cabinet guidelines. With the passage of the Canadian Environmental Assessment Act, the process is now law under the jurisdiction of the Canadian Environmental Assessment Agency (CEAA).

Environment Canada fostered this process federally, and has contributed significantly to research on the environmental impact process. Additionally, Environment Canada's scientific staff are frequently called before *environmental assessment panels* as expert witnesses. These panels, which guide the assessment process and formulate recommendations, are composed of highly credible Canadians, both scientific and non-scientific. Their job is often highly controversial, balancing the benefits of economic development with environmental conservation. The environmental impact assessment provides them with an assessment of the risk to the environment and some means to mitigate these risks. The task is then to formulate a risk management strategy that will minimize the environmental risks while permitting economic development to proceed in a reasonable manner.

*Other Science Advice Measures*: The SAGE report concentrates on science advice measures that are used to formulate national policy. As pointed out above, environmental impact assessments can have a significant influence on major economic developments in Canada as well as the potential degradation of the environment. There are a number of other processes, which impact in a similar manner both on a regional and national basis.

The first of these is the *Remedial Action Plan* (see Ref. 59) as applied to the Great Lakes region, and a similar process used on the St. Lawrence River to identify environmental "hot spots" and take action to remedy the problem. These require extensive scientific input, not unlike a science assessment, as well as stakeholder/public involvement, and industry, provincial and federal co-operation to address the problems and solve them.

Another case of regional, and national scientific advice measures is the scientific input, which is provided by the Canadian Wildlife Service (CWS), by field biologists, who conduct research on waterfowl, and provide scientific advice on the formulation of provincial hunting regulations. The CWS also provides scientific advice on endangered species, through a variety of acts, regulations and processes, and assists in the preservation and remediation of wildlife habitat with organizations such as Ducks Unlimited.

*Openness:* Environment Canada has, since its inception, operated in a very open fashion. This practice accelerated during the development of Canada's Green Plan, when *stakeholder groups* from across the country were asked for their input on the Green Plan programs. This has continued with the involvement of citizens, industry, and environmental groups in the design of ecosystem research programs, the formulation of regulatory options and guidelines for environmentally hazardous substances, as well as the current formulation of policy on climate change issues by stakeholder tables.

Environment Canada publishes a wide variety of information on environmental topics for the general public. The Green Lane is Environment Canada's public web site, which provides access to a great deal of Environment Canada's materials by way of the Internet.

This history has been one of considerable success in identifying, researching and addressing Canada's major environmental threats through the use of sound science in the formulation of policies and decisions. These practices will undoubtedly be refined and developed further in years to come.

# 4. Policy/Decision-Making Themes

A review of Environment Canada's major decision-making themes, as they relate to science advice, indicates that there are three major policy/ decision-making themes each with different requirements. These major themes are as follows:

i) the formulation of national policy;

ii) the formulation of regulations under the Canadian Environmental Protection Act; and

iii) decision-making for regional/operational programs.

Examples of these three themes follow:

*National Policy Formulation:* This is the type of task for which the SAGE principles appear to have been formulated. In Environment Canada, issues such as Lake Eutrophication, Acid Rain, Stratospheric Ozone Depletion, Toxic Chemicals, Global Climate Change, Pulp Mill Effluent, Persistent Organic Pollutants, and $NO_x$/VOC's, are matters of national (and often global) environmental concern, which require new in-depth research in the Canadian context to provide science advice for Canadian decision-makers. This advice is required for the development of a Canadian policy stance, to negotiate accords bilaterally and multilaterally, and ultimately to develop measures, regulatory and

otherwise, to deal with the issue on a national and federal/provincial basis, as the case may be. Ministers undertake national policy formulation of this nature, *and Cabinet, makes decisions in secret,* as is the case under the Westminster form of government.

*Regulatory Formulation:* This theme of science advice/decision-making is quite different from the preceding theme, primarily because the basic policy has already been formulated by Cabinet and an Act (CEPA) passed to govern the regulatory process. In general, it meets the requirements of the SAGE process, but the measures that must be used are outlined as requirements under the *Canadian Environmental Protection Act*. The *primary decision-makers are frequently, but not solely, senior departmental officials in Environment Canada and Health Canada* who provide recommendations jointly to the Ministers of Health and the Environment on the regulation of environmentally harmful substances.

*Regional/Operational Decision-making:* There are many cases where the practice of sound science is particularly important to regional decision-making. For example, the remediation of the Sydney Tar Ponds has required health effects research, chemical analysis, risk assessment, risk management and decision-making, as well as stakeholder input, peer review and expert panels. This has ensured that the task was carried out in a manner that will minimize human health effects yet still accomplish the process in an effective manner acceptable to the community involved. In these instances, *the decision-maker is typically, but not exclusively, the senior regional official of the department.* Frequently, these decisions are made in collaboration with federal and provincial counterparts.

These three different classes of decision-making will be used to classify the different aspects of science advice in Environment Canada for presentation in inventory form.

*Time Scale:* In most instances, the SAGE principles apply from early identification through to policy formulation by Cabinet. It should be pointed out however, that the complete process is of the order of years to decades. For example the early identification of acid rain by the Canadian scientific community took place in 1955. Acid Rain did not become a public issue until the late 1970's and regulations to decrease sulphur dioxide emissions were agreed upon by federal and provincial governments in 1985.

The story on stratospheric ozone depletion is quite similar – Rowland and Molina first predicted the problem in the early 1970's. The first regulatory action in Canada was taken in 1980, and the Montreal Protocol, which launched international controls, was signed in 1987. Most of the other issues follow a similar pattern. While the pulp mill effluent process appeared to have been much shorter, the original research on this topic was started some fifteen years earlier. Much of the research was collapsed into a two year time period – driven by an urgent need for the appropriate science to underpin a national policy on this topic.

There are two messages here:

*i)* *scientific early identification* is typically provided by the science community (either domestically or internationally);

*ii)* *scientific early identification* should not be confused with the early identification of the issue as a *public policy issue* – an equally important item, which typically follows the communication of the issue by the media and the mounting concern of the public who make it a policy issue for consideration by Ministers.

## 5. Methodology

The approach to the development of this inventory of science advice measures has been as follows:

i) Interviews were conducted with twenty-nine Environment Canada staff members and two former Environment Canada staff members. These interviews were conducted, by telephone, and typically lasted 45 minutes. The questions asked are included as Appendix IV. The purpose of these questions was to identify science advice measures used by Environment Canada in the formulation of policy and for decision-making. The questions were primarily to focus answers on the main topic. Every attempt was made, however, to follow unexpected paths, which were relevant to the department's efforts to meet the main SAGE principles.

ii) The staff of Science Policy Branch supplied a number of reports and documents relevant to this report. During interviews, the respondents further identified documents such as science assessments, regulatory procedures, review documents, etc., which have been used as *References* (see Appendix I) and cross-referenced in this inventory.

iii) Following the interview process, the interview notes and references were analyzed and the *Inventory of Science Advice Measures* (see Appendix II) was developed.

## 6. SAGE Inventory of Science Advice Measures

Appendix I, which follows, is an inventory of measures used by Environment Canada, that meet the SAGE principles. These measures are listed according to the individual principles. Furthermore, the measures are classified with respect to the three major decision-making themes:

i) National Policy Formulation;

ii) Regulatory Formulation; and

iii) Regional/Operational Decision-making.

It should be understood that this inventory is inclusive but not exhaustive. As well, the inventory lists measures by class and quotes examples of application. A complete listing of *all departmental items* in each class was outside the scope and the resources allocated for this report. Documentation that explains the measure, the policy framework and/or examples of its application is listed in "References" in Appendix I. For ease of use, each reference is numbered and this number is used to label the reference in the inventory. Simply put, where references appear, there is documentation that explains the policy, the use of this measure or gives an example of its results. Where examples are used, these do not indicate the total volume of material in this category but are examples only of the application of the particular measure.

## 7. Summary and Conclusions

It is evident that Environment Canada, as a comprehensive science-based department has undertaken a series of science advice measures that generally meet the requirements of the SAGE principles to a high level of acceptance.

*Early Identification:* Environment Canada's scientific and technical staff, with their substantial national and international networks of colleagues have alerted the department to numerous emerging environmental issues over the past three decades. Environmental scans and predictive modelling complement this front line measure.

*Inclusiveness:* Environment Canada has, as a matter of policy, performed its duties in a remarkably open and inclusive manner. The fact that 48% of the journal-refereed papers, published by Environment Canada's staff in 1995 (Ref. 10), were co-authored with external scientific staff is indicative of the inclusiveness of the science. Equally indicative are the contributions that Canadian scientists, across government departments and universities, have made to international science assessments on topics such as stratospheric ozone depletion, pulp mill effluent, and climate change.

*Sound Science/Science Advice:* The department has practiced due diligence with respect to the quality of its science and science advice. Over the past five years, new programs have increasingly been subjected to external peer review prior to finalizing directions, staffing and budget. This external review process is now policy in Environment Canada (see Ref. 9) for both major new and ongoing programs. Environment Canada's scientific reports and publications are subject to both internal and external peer review. Furthermore, individual scientists are encouraged to publish their findings in peer-reviewed journals. Science assessments, prepared by Environment Canada, are subject to external peer-review, as are international science assessments that Environment Canada contributes to, and draws from, for the basis of both policy and regulatory formulation.

Environment Canada staff contribute significantly to the work of the Canadian Environmental Assessment Agency in the preparation of environmental impact assessments and as expert witnesses at environmental impact assessment hearings. In many circumstances Environment Canada's scientific staff have unique knowledge relevant to the environmental parameters of consequence.

*Uncertainty and Risk:* The primary objective of science assessments and environmental impact assessments is to *assess the scientific risk* of a particular practice, substance or process to human health and the environment and to determine how this risk might be reduced, mitigated or eliminated. On the other hand, the policy integration process (economic, social, political) and the development of policy deal with *the management of the risk* through voluntary action, reduction and/or regulation of the manufacture, sale, use and disposal of hazardous materials or processes. In this sense Environment Canada is the classic example of the *risk management department.*

*Openness:* Environment Canada, throughout its history, has practiced an "open door" policy and has pioneered the involvement of consultation and stakeholder groups in the federal government context. The inclusion of industry, environmental groups, communities, aboriginal bands, and interested citizens in all walks of life has been a trademark of how Environment Canada conducts its business. These initiatives include: the formulation of ecological research initiatives, the revision of the Canadian Environmental Protection Act, the formulation of national policy (e.g., Climate Change Issue Tables), the development of regulations and industrial guidelines, the decisions made by environmental impact assessment panels, the provision of extensive public information through State of the Environment reports and publications, and unfettered access to public documents through its web site, *the Green Lane.*

*Review:* A number of international environmental conventions, to which Canada is signatory, mandate a science assessment, or update, on a 4 yr. cycle. CEPA must be reviewed every 5 years, though this does not mean that every regulation is automatically reviewed. These and other review mechanisms, both formal and informal, have led to the updating of Environment Canada's policy and regulations where necessary.

In conclusion, in general Environment Canada practices with considerable vigour, most of the principles that the SAGE Report recommends. Not all of these measures are formalized nor are they all practiced universally. Nonetheless, the considerable effort put forth on this front has served the department and its Ministers well. An in-depth analysis of the department's performance, strengths, weaknesses and options for action will be the subject of the companion report to this inventory, namely *Part II - Analysis*.

# Appendix I: References for Sage Inventory


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# Appendix II: Inventory of Science Advice Measures in Environment Canada

## I - Early Identification of Issues

| Measure | Application | Comments/References |
|---|---|---|
| **1. National Policy Formulation** | | |
| scientific/technical networks | scientific/technical staff use network of colleagues, conferences, papers, personal contacts to identify emerging environmental issues of consequence to the department | highly effective, informal<br><br>Ref: no written documents |
| science assessment | analyses undertaken during science assessments identify environmental matters of concern | an important but secondary<br>Ref: no documents |
| numerical modeling | identification of future environmental problems by the use of physical/numerical models to predict future states | a major new way of predicting environmental issues.<br><br>Examples: ozone depletion and climate change science assessments<br><br>Refs: (24, 28-34) |
| 5NRD MOU | inter-departmental early identification of crosscutting issues. Fast response, internal science assessments done by inter-departmental science teams | effective interdepartmental mechanism<br><br>Example: UVB Science Assessment, Heavy Metals, Endocrine Modifying Substances W/G<br><br>Ref: (50) |

# I - Early Identification of Issues - Cont'd

| Measure | Application | Comments/References |
|---|---|---|
| monitoring networks | data from physical, biological and ecological monitoring networks provide early warning of increases in pollution loading, biological impacts, etc | public information<br><br>Example: NAPS, CAPMon, $GO_3OS$, EMAN, and EEM monitoring networks<br><br>Ref: (51) |
| **2. Regulatory Formulation** | | |
| scientific/technical staff networks | scientific/technical information is obtained from the Canadian Network of Toxicology Centres, the Toxic Substances Research Initiative as well as by accessing knowledge and expertise internationally through the International Program on Chemical Safety (under the World Health organization) | CEPA is a consumer of scientific/technical information and supports these networks, both nationally and internationally<br><br>Ref: (52) |

NAPS - National Air Pollution Surveillance (NAPS) Network
CAPMon - Canadian Air Pollution Monitoring Network
$GO_3OS$ - Global Ozone Observing System
EMAN - Ecosystem Monitoring and Assessment Network
EEM - Environment Effects Monitoring
5NRD MOU - Five Natural Resource Department Memo of Understanding

# I - Early Identification of Issues - Cont'd

| Measure | Application | Comments/References |
|---|---|---|
| chemical modeling | Environment Canada recently gathered together 27 international experts in the field of chemical modeling for discussions on the use of chemical modeling to screen chemicals for toxicity prior to undertaking laboratory testing. It is expected that this technique will be used in a forthcoming screening of some 23,000 substances. | for use in the future. expected to be highly effective and cost efficient<br><br>Ref: no documents |
| Environmental Effects Monitoring Program (EEM) | stakeholder program (with industry) which provides information on trends on biota subjected to pulp mill effluent and mining wastes | experimental program with considerable promise<br><br>Ref: (47- 49) |
| **3. Regional Decision-Making** | | |
| ecosystem monitoring | identification of trends in regional ecosystems by cooperative networks, involving provincial/municipal governments, universities, local citizens and aboriginal communities | involves stakeholders from beginning to end of program<br><br>Examples:<br>Fraser River Action Plan, Northern Regions Ecosystem Initiative, St. Lawrence Action Plan Vision 2000, etc.<br><br>Ref: (43) |
| environmental scans | emerging environmental issues are identified annually by Regional Science Committees | formal mechanism<br><br>Ref: no documents |

## II - Inclusiveness

| Measure | Application | Comments/References |
|---|---|---|
| **1. National Policy Issues** | | |
| research in partnership with international programs | EC scientists are involved in research programs such as the World Climate Research Program with the World Meteorological Organization, and the Human Dimensions of Global Change Program | such research programs permit EC scientists to work with world class scientists on Cdn issues<br><br>Refs: (53, 54) |
| participation in international science assessments | EC staff have participated in science assessments with WMO and UNEP on climate change and ozone depletion, and with the Society of Environmental Toxicologists and Chemists (SETAC) on a variety of toxic chemicals. | these assessments are state of the science reviews which draw on a broad range of scientific talent.<br><br>Refs: (29, 24, 65, 68) |
| national science assessments | Environment Canada has conducted a number of science assessments on Canadian issues. These have involved government and university researchers primarily, with occasional researchers from abroad. | high quality, peer-reviewed assessments<br><br>Examples: Biodiversity, Acid Rain, Ozone update, Hydrogen Fluoride, UVB Radiation, Arctic Contaminants, Nonylphenol Ethyl- Oxylates.<br><br>Refs: (16,44,18,26,27,47,46,50, 66,67) |
| S&T Advisory Board | Environment Canada established a formal S&T Advisory Board some three years ago to provide advice to the Deputy Minister | External review mechanism for all S&T issues<br><br>Ref: (1) |

## II - Inclusiveness - Cont'd

| Measure | Application | Comments/References |
|---|---|---|
| fed/prov research programs | research and monitoring programs undertaken in partnership with provinces and territorial governments | intergovernmental partnership<br><br>Example: Acid Rain<br><br>Refs: (18 – 22) |
| journal refereed scientific papers | Joint publications with external researchers account for 48% of Environment Canada's journal publications | Highly inclusive<br><br>Ref: (10) |
| **2. Regulatory Formulation** | | |
| use of science assessment information from international protocols | international science assessments are used as the scientific basis for domestic regulation | highly inclusive, peer- reviewed, international class science.<br><br>Example: methyl bromide<br><br>Reference: (55) |
| stakeholder groups | used to advise on the decision-making process under the Canadian Environmental Protection Act ( CEPA) | a mandatory requirement under CEPA<br><br>Ref: (56) |
| public review | review of science and risk assessments under CEPA | currently under way<br><br>Ref: no document |

## II - Inclusiveness - Cont'd

| Measure | Application | Comments/References |
|---|---|---|
| Environmental Effects Monitoring Program (EEM) | stakeholder program, with industry, which provides information on trends on biota subjected to pulp mill effluent and mining wastes | experimental program, extremely promising<br><br>Example: mining effluent<br><br>Refs: (47-49) |
| **3. Regional Decision-Making** | | |
| Ecosystems Initiative Program | this program involves fed/ prov/municipal partnerships, individual community groups, industry, and aboriginal peoples in the design, operation and implementation of initiatives. The program undertakes monitoring of targeted local/ regional ecosystems across Canada with cooperative action to restore habitat, reduce waste/pollution, and reduce risks to human health | classic example of application of sound science, partnerships and stake holder input from beginning to end of project<br><br>Examples:<br><br>Northern Regions Eco-System Initiative, St. Lawrence Action Plan<br><br>Ref. (47) |
| fed/prov committees<br><br>committees, | much of the business in regions involves working on a variety<br><br>of S&T committees in partnership with the provinces. Many of these involve stakeholder groups. | stakeholder<br><br>federal S&T expertise valued highly<br><br>Examples:<br><br>CASA program in Alta, Sydney Tar Ponds, Great Lakes Water Quality Agreement and Remedial Action Plans<br><br>Ref: ( 59) |

## II - Inclusiveness - Cont'd

| Measure | Application | Comments/References |
|---|---|---|
| wildlife research networks generates | research conducted by collaborative networks involving CWS researchers/university staff and students | highly effective network, peer reviewed, quality new staff<br><br>Examples: ACWERN<br><br>Ref: (9) |
| environmental assessment review process | reviews conducted on lands under federal jurisdiction, or on projects having federal financing or under federal legislation. involves proponent, local communities, environmental groups, and university and government scientists | draws heavily on Environment Canada scientific staff<br><br>Example: Voisey Bay Mine<br><br>Ref: (57) |
| traditional knowledge | aboriginal elders assist in identifying environmental phenomena or environmental change in their respective areas | this has been quite successful in Labrador and in the Arctic<br><br>Ref: Labrador Biodiversity Mapping Project – in design phase |

# III - Sound Science/Advice

| Measure | Application | Comments/References |
|---|---|---|
| **General** | | |
| recruitment/retention and development of scientific personnel | quality scientific talent provides; the basis for quality research, sound science advice, leadership both nationally and internationally. These scientists are in regular contact with their counterparts globally. | this was a frequently recurring theme from RDG's and Science Directors. Basis of dept's science system<br><br>Ref: no documents |
| conflict of interest guidelines | federal government staff are required to conduct their personal affairs in a manner to avoid conflict of interest and the perception of conflict of interest | Ref: Gov't of Cda Conflict of Interest Guidelines |
| **1. National Policy Issues** | | |
| external peer review of R&D in Environment Canada | a management framework for the external peer review of both new and ongoing large research programs in Environment Canada | this represents the formalization of a practice which has been developing in the department over the past five years<br><br>Example: Initial review of<br>Climate Change Modelling Consortium at the University of Victoria<br>Ref: (11) |
| peer review of internal and external science publications | Environment Canada's internal/external publications are subjected to internal and external review before publication | ensures quality information for Canadian public<br><br>Ref: none |

## III - Sound Science/Advice - Cont'd

| Measure | Application | Comments/References |
|---|---|---|
| science assessments (national) | assessments on the status of science have been undertaken over the past twenty years on a variety on environmental topics of national concern. These assessments have included federal/provincial and university researchers, a rigorous external peer review, and typically a section labeled "Advice to Decision-Makers." They have been used as the basis for federal/provincial policy and regulations | most of these assessments have been undertaken on topics of interest to Canadians primarily.<br><br>Examples: Acid Rain, Ozone Science Update, NOx/VOC's, Particulate Matter, UVB Radiation<br><br>Refs: (18, 26, 36-42, 50) |
| science assessments (international) | used as the basis for the formulation of national policy on international environmental issues. As such they serve as the underpinnings of international conventions and protocols | the ultimate form of science assessment. Involve hundreds of international class scientists. Peer- reviewed.<br><br>Examples: Climate Change, Ozone Depletion<br><br>Refs: (29-34, 24) |
| **2. Regulatory Formulation** | | |
| science assessments (national) | as above in Section 1 | provides science base for national regulations<br><br>Example: Acid Rain Strategy<br><br>Ref: (23) |

## III - Sound Science/Advice - Cont'd

| Measure | Application | Comments/References |
|---|---|---|
| science assessments (international) | as above in Section 1 | science base for national regulations<br><br>Examples: Ozone Depletion Climate Change<br><br>Refs: (24, 29) |
| science advice from national/international external sources | CEPA requires toxicological data, much of which cannot be generated internal to the department. This mechanism permits access to quality peer-reviewed scientific advice in universities and research institutes through the support of toxicological networks in Canada and abroad | access to a wide range of scientific expertise in universities and institutes. Cost-effective.<br><br>Example: Canadian Network of Technology Centres (CNTC)<br><br>Ref: (52) |
| **3. Regional/Operational Decision-making** | | |
| S&T committees in regional Ecosystem Initiatives | Fed/prov/university scientists collaborate on ecosystem research. Science advice provided to joint management committees. | consultative, inclusive, strong peer review.<br><br>Examples: St. Lawrence Action Plan Vision 2000, Atlantic Coastal Action Plan<br><br>Ref: (43) |

## III - Sound Science/Advice - Cont'd

| Measure | Application | Comments/References |
|---|---|---|
| Science briefings at Environment Management Board/Annual Regional Management Retreats | updates management on priority science issues in the department. Brings senior scientists, science managers to the management table. | Interactive, high quality advice on a broad range of science issues.<br><br>Examples: EMB briefings on Persistent Organic Pollutants (POPs), Climate Change<br><br>Ref: (EMB Minutes |
| national/international science assessments | provides scientific background for regional field applications | assessments applicable to provinces/regions<br><br>Example: Ozone depletion<br><br>Reference: (25) |
| environmental impact assessments | reviews conducted on lands under federal jurisdiction, or on projects having federal financing or under federal legislation. Panel hears scientific evidence and makes decisions on development projects. | scientific review process. Draws heavily on Environment Canada's scientific staff.<br><br>Example: Diamond mines in NWT<br><br>Ref: (57) |

# IV - Uncertainty and Risk

| Measure | Application | Comments/References |
|---|---|---|
| **1. National Policy Formulation** | | |
| Science Assessments (national/international) | These assessments address risk through analysis of impacts and prediction. Risk is assessed by categorization, or, where possible, by quantitative means using models to construct scenarios | Scientific risk assessment<br><br>Examples: Climate Change scenarios based on different greenhouse gas assumptions<br><br>Ref: (33) |
| **2. Regulatory Formulation** | | |
| Science assessments/Regulatory impact assessments (RIA's) | Used in the assessment of risks to individual toxic substances by laboratory testing. Socio-economic aspects addressed in RIA's | Formal risk assessment/risk management approach mandated by CEPA.<br><br>Example: benzene<br><br>Ref: (58) |
| **3. Regional/Operational Decision-making** | | |
| remedial action plans | Remediation work requires the scientific assessment of inherent risks. Operations which follow, or not, as the case may be, manage the risk to human health and the environment | field application of risk assessment/risk management.<br><br>Examples: removal of contaminated sediment from Hamilton Harbour. Setting of hunting quotas for waterfowl under the Migratory Birds Act.<br><br>Refs: (59, 60) |

## IV - Uncertainty and Risk – Cont'd

| Measure | Application | Comments/References |
|---|---|---|
| environmental impact assessments<br>Environment Canada's scientific projects. | reviews conducted on lands under federal jurisdiction, or on projects with federal financing or under federal legislation.<br>Scientific risk assessments undertaken on development | scientific review process. Draws heavily on staff.<br><br>Example: Disposal of Nuclear Waste<br><br>Ref. (57) |

# V - Openness

| Measure | Application | Comments/References |
|---|---|---|
| **General** | | |
| Environment Canada policy guidelines on S&T Partnering | this document outlines Environment Canada's philosophy and principles on S&T partnering, as part of EC's S&T Management Framework, while building on the direction provided in the federal government's "Science and Technology for the New Century: A Federal Strategy" | six principles outlined. 35 examples of EC partnerships.<br><br>Ref: (8) |
| state of environment reports | science information for the public on current topics | Example: Understanding Atmospheric Change<br><br>Ref: (35) |
| Green Lane | Environment Canada's website – open to the public | award-winning website<br><br>Example: Environmental assessments of priority substances under CEPA<br><br>Ref: (64) |
| **1. National Policy Formulation** | | |
| stakeholder involvement | Environment Canada utilizes stakeholder groups (industry environmental NGO's, universities, individuals) to assist in the formulation of policy alternatives on environmental issues of national interest. | mechanism under continual development.<br><br>Example: Climate Change issue tables currently formulating policy options<br>Ref: (60) |

## V - Openness - Cont'd

| Measure | Application | Comments/References |
|---|---|---|
| international S&T partnerships | Environment Canada S&T staff regularly partner bilaterally/ multilaterally in research projects and in science assessments | These tackle large, complex scientific field grams which EC could not do alone. Reduces costs, gains expertise from other institutes/countries.<br><br>Examples: World Climate Research Program(WCRP), Great Lakes Water Quality Agreement, North American Research Strategy on Tropospheric Ozone, Sustainability of Arctic Communities<br><br>Ref: (9) |
| national S&T partnerships | to conduct research relevant to policy decisions concerning environmental matters | highly cost-effective partnerships which include OGD's, provinces, industries, and universities.<br><br>Examples: Metals in the Environment, Pesticide Research in the Prairies, Canadian Acid Rain Research<br><br>Ref. (9) |
| scientific freedom | scientists are encouraged to publish their findings in the open, peer-reviewed literature | scientific findings open to the public and the scientific community<br><br>Ref: none |
| national environmental management initiatives | to co-operate on environmental action plans with provinces, industry and communities | uses scarce scientific resources efficiently, effectively. Significant environmental impact.<br><br>Example: Migratory Birds Hunting Regulations<br><br>Ref: (60) |

## V - Openness - Cont'd

| Measure | Application | Comments/References |
|---|---|---|
| **2. Regulatory Formulation** | | |
| stakeholder involvement (Environmental Effects Monitoring) | Stakeholders (industry, local groups, ENGO's) are involved in the regulatory process from project design to guideline development with respect to the environmental effects of mining and pulp and paper effluent | a developing process which shows considerable promise<br><br>Ref: (48) |
| CEPA regulations | Stakeholders are involved in the formulation of regulatory options and can challenge the final regulatory decision by formal process. | Ref: (55) |
| **3. Regional/Operational Decision-making** | | |
| Environment Initiatives Program | Addresses emerging environmental issues or pollution problems which require S&T input and involve federal/provincial governments, communities and universities | brings significant resources to bear on problems. Often involves3 levels of government as well as stakeholders and the academic community<br><br>Example: Northern River Basins Study. Atlantic Coastal Action Plan, Canadian Co-operative Wildlife Health Centre.<br><br>Ref: (9) |
| environmental impact assessments | review of development projects in various regions of Canada. Based on scientific risk assessment, with stakeholder input. Panels typically meet, openly, in local communities near development | an excellent process using expert witnesses, external review, with involvement of local inhabitants and proponent<br><br>Example: Voisey Bay Mine and Mill<br><br>Ref: (57) |

# VI - Review

| Measure | Application | Comments/Reference |
|---|---|---|
| **1. National Policy Formulation** | | |
| International protocol review | a number of international environmental conventions and protocols have mandated science, technology and socio-economic reviews aimed at revisions and upgrading of the policies agreed upon in the international accord | highly effective. Reviewed by the Contracting Parties.<br><br>Examples: Montreal Ozone Protocol, Kyoto Climate Protocol<br><br>Ref: (62, 63) |
| review of bilateral accords | accords between the US and Canada are reviewed on regular basis and appropriate action taken, singly or jointly | regular review of S&T. action plans revised<br><br>Examples: Canada/USA Air Quality Agreement, Great Lakes Water Quality Agreement<br><br>Ref: (45) |
| internal review federal | assessing the economic impact of Environment Canada's R&D by case studies | unique studies in government<br><br>Examples: Impact studies of Pulp and Paper, Ozone Depletion R&D<br><br>Refs: (12, 13) |
| **2. Regulatory Formulation** | | |
| CEPA Review | the Canadian Environment Protection Act is mandated to be reviewed every 5 years | Ref: (55) |
| CEAA Review | the Canadian Environmental Assessment Act is currently undergoing a five year review | Ref: (57) |

## VI - Review - Cont'd

| Measure | Application | Comments/Reference |
|---|---|---|
| regulation formulation under CEPA | the regulations under CEPA can be challenged at any time, resulting in the review of regulations on any substance regulated under the act | Ref: (55) |
| **3. Regional/Operational Decision-making** | | |
| regional management committee review | decisions made regionally are reviewed informally at S&T committees and by Regional Management Committees as new scientific knowledge/technologies become available | informal but effective mechanism<br><br>Ref: none |

# Appendix III: Interviews Conducted

| | Name | Date |
|---|---|---|
| 1 | McBean, Gordon | 30 Nov 99 |
| 2. | Brydges, Tom | 01 Dec 99 |
| 3. | Enros, Philip | 01 Dec 99 |
| 4. | Thornton, Dave | 02 Dec 99 |
| 5. | Masterton, Joan | 02 Dec 99 |
| 6. | Lerer, Harvey | 03 Dec 99 |
| 7. | Whelpdale, Doug | 06 Dec 99 |
| 8. | McMillan, Ann | 07 Dec 99 |
| 9. | Jarvis, Bill | 07 Dec 99 |
| 10. | Buccini, John | 08 Dec 99 |
| 11. | Bangay, Garth | 10 Dec 99 |
| 12. | Hengeveld, H. | 10 Dec 99 |
| 13. | Brackett, David | 10 Dec 99 |
| 14. | Bondy, Dan | 10 Dec 99 |
| 15. | Maltby, Lynda | 10 Dec 99 |
| 16. | Hardie, Duncan | 13 Dec 99 |
| 17. | Russell, Doug | 14 Dec 99 |
| 18. | Vollmershausen, Jim | 16 Dec 99 |
| 19. | Beland, Michel | 16 Dec 99 |
| 20. | Mills, John | 17 Dec 99 |
| 21. | Sato, Ken | 17 Dec 99 |
| 22. | Gauthier, J.P. | 20 Dec 99 |
| 23. | Carey, John | 20 Dec 99 |
| 24. | Cutler, Nancy | 20 Dec 99 |
| 25. | Wrona, Fred | 20 Dec 99 |
| 26. | McKay, Don | 21 Dec 99 |
| 27. | Stone, John | 22 Dec 99 |
| 28. | Wong, Mike | 22 Dec 99 |
| 29. | Slater, Bob | 23 Dec 99 |
| 30. | Martell, Art | 30 Dec 99 |
| 31. | Blake, Ivan | 05 Jan 00 |

# Appendix IV: Questionnaire for Interviews – SAGE Inventory

## 1. Introduction

In the interests of increasing the effectiveness of science advice in federal government decision making, the Council of Science and Technology Advisors (CSTA) published a report, in May 1999, entitled *"Science Advice for Government Effectiveness"* (SAGE). This report lists six principles that the CSTA recommends science-based departments and agencies (SBDA's) adopt, as well as a series of guidelines to assist in implementation.

As a prerequisite to implementing the SAGE principles, Environment Canada requires an inventory of existing science advice measures, which are in use in the department, to bring science to bear on policy formulation and decision-making.

Environment Canada has contracted the task of compiling this inventory to **Wintergreen Consulting**. We trust that you will be able to assist us in this task, by participating in a personal interview or a telephone interview, of approximately 30-45 minutes in length with, Dr. Alex Chisholm. During this interview, we would ask that you focus primarily, though not exclusively, on measures (i.e. mechanisms, activities, procedures), which your organization has used in supplying science advice to policy makers. Examples and specific items, (documents, committees, workshops, consultations, ministerial briefings etc) that illustrate these measures, would be very helpful. The intent is to focus this inventory on "general measures" currently in use, but you also might find it useful to track the various measures by following a specific issue through from *early identification* of the issue to *policy formulation*.

To assist you in this task, excerpts of the SAGE report follow, outlining the six *principles*, which CSTA recommends that SBDA's follow in the process of transforming science into policy. A question then follows each principle and space is provided for you to put down a few notes. Furthermore, some key words from the SAGE guidelines are provided at the bottom of the page to remind you of the elements that are used in the science advice process.

### SAGE Principle 1 - Early Identification of Issues

"Departments need to anticipate, as early as possible, those issues, representing, both challenges and opportunities, for which science advice will be required. A broad base of advice can lead to improvements in the timeliness of issue identification. Interdisciplinary, interdepartmental, and international cooperation should be in place to identify, frame, and address 'horizontal' issues."

**Question: What measures are currently in place in your organization for the early identification of environmental issues?**

**Key words:** cast a wide net, internal, external, interdepartmental, international, science/policy staff linkages, horizontal issues

## SAGE Principle 2 - Inclusiveness

"Advice should be drawn from a variety of scientific sources and from experts in many disciplines in order to capture the full diversity of scientific schools of thought and opinion. Inclusiveness enhances the debate and draws in scientific findings that may not otherwise be considered; sound science thrives on the competition of ideas facilitated by the open publication of data and analyses. The market for science advice is global and the growing body of science knowledge available internationally must be brought to bear on policy issues. Inclusiveness aids in achieving sound science advice by reducing the impact of conflicts of interest or biases that exist among advisors."

**Question: What measures are in use in your organization to ensure that advice is drawn from a variety of scientific sources and disciplines, thereby ensuring that it is sound and free from bias?**

**Key words:** "traditional knowledge," multiple viewpoints, external independent scientific panels, range of opinions, solicited and unsolicited advice

## SAGE Principle 3 - Sound Science and Science Advice

"The public expects government to employ measures to ensure the quality, integrity, and objectivity of the science and the science advice it utilizes, and to ensure that science advice is considered seriously in decision making. Due diligence procedures for assuring quality and reliability, including scientific peer review, need to be built into the science advisory process. Where information is proprietary, external peer review needs to proceed with appropriate measures to maintain confidentiality. Science advisors need to contribute sound scientific information, unfiltered by other policy considerations. In developing policy, departments need to involve advisors in assessing the implications of various policy options."

**Question: What does your organization do to ensure the quality, integrity and objectivity of the science/science advice it utilizes and to ensure that it is considered in decision-making?**

**Key words:** Due diligence, peer review, research and policy analysis, professional practice, conflict of interest, distinguish scientific fact from judgment, involve science advisors in policy formulation, other (non-scientific) considerations in decision making

## SAGE Principle 4 - Uncertainty and Risk

"Science in public policy always contains some uncertainty and often a high degree of uncertainty which must be assessed, communicated, and managed. As such, it is important to consider adopting a risk management approach. In addition to hazards, uncertainty may include potential benefits or opportunities, which should not be ignored. The goal of risk management is scientifically sound, cost-effective, integrated actions that reduce risks while taking into account social, cultural, ethical, political, and legal considerations."

**Question: Does your organization use risk management approaches to assess the impacts of uncertainty in science advice? Examples?**

**Key words:** Risk management guidelines, precautionary principle, explicit identification of uncertainty - communicated clearly to stakeholders

## SAGE Principle 5 - Openness

"Democratic governments are expected to employ decision making processes that are transparent and open to stakeholders. Openness implies a clear articulation of how decisions are reached, policies are presented in open fora, and the public has access to the findings and advice of scientists as early as possible. It is essential that the public be aware of what the responsibility of government is in relation to the use of science. In addition, decision makers need to treat the science advisory function as an integral part of the management process. Effective relationships between decision makers and science advisors benefit from an understanding of their differing perspectives and approaches. Policy makers and advice providers need to communicate to ensure that policy makers are convinced the science advice is current and sound. In turn, advice providers need to be confident that their advice is considered seriously in decision-making. Finally, there needs to be consultation with stakeholder groups and public discourse to ensure that public values are considered in formulating policy. Early and ongoing consultation both within government and with the public can mitigate greater negative debate and controversy when policies are announced."

**Question: What measures are undertaken in your organization to ensure that policy decisions, made by decision makers, are made openly, with stakeholders being fully informed of the science and scientists and stakeholders being made aware of how the ultimate decision was made?**

**Key Words:** advance warnings of significant policy/regulatory initiatives, scientific freedom to pursue broad range of inquiry, encourage publication in peer-reviewed publications, publication/dissemination of science advice for policy decisions, public meetings, consultations, balancing timeliness and controversy

## SAGE Principle 6 - Review

"The principle of review includes two elements: a) subsequent review of science-based decisions to determine whether recent advances in knowledge impact the science and science advice used to inform the decision, and b) evaluation of the decision making process. Appropriate accountability mechanisms need to be in place to ensure that these principles and guidelines for sound science advice are followed."

**Question: Does your organization review science-based decisions and policies regularly to ensure that they reflect new scientific knowledge?**

**Key words:** follow-up process, establish "best before" date for policy and regulations

**Question: Does your department evaluate the decision making process and the role of science in the process of decision making?**

**Key Words:** advisors have access to all relevant information to review past decisions, capture of best practices

# Appendix V: SAGE Principles

*i) Early Identification of Issues* - "Departments need to anticipate, as early as possible, those issues (representing both challenges and opportunities) for which science advice will be required. A broad base of advice can lead to improvements in the timeliness of issue identification. Interdisciplinary, interdepartmental, and international co-operation should be in place to identify, frame, and address 'horizontal' issues."

*ii) Inclusiveness* - "Advice should be drawn from a variety of scientific sources and from experts in many disciplines in order to capture the full diversity of scientific schools of thought and opinion. Inclusive-ness enhances the debate and draws in scientific findings, which may not otherwise be considered; sound science thrives on the competition of ideas facilitated by the open publication of data and analyses. The market for science advice is global and the growing body of science knowledge available internationally must be brought to bear on policy issues. Inclusiveness aids in achieving sound science advice by reducing the impact of conflicts of interest or biases that exist among advisors."

*iii) Sound Science and Science Advice* – "The public expects government to employ measures to ensure the quality, integrity, and objectivity of the science and the science advice it utilizes, and to ensure that science advice is considered seriously in decision-making. Due diligence procedures for assuring quality and reliability, including scientific peer review, need to be built into the science advisory process. Where information is proprietary, external peer review needs to proceed with appropriate measures to maintain confidentiality. Science advisors need to contribute sound scientific information, unfiltered by other policy considerations. In developing policy, departments need to involve advisors in assessing the implications of various policy options."

*iv) Uncertainty and Risk* – "Science in public policy always contains some uncertainty and often a high degree of uncertainty which must be assessed, communicated, and managed. As such, it is important to consider adopting a risk management approach. In addition to hazards, uncertainty may include potential benefits or opportunities, which should not be ignored. The goal of risk management is scientifically sound, cost-effective, integrated actions that reduce risks while taking into account social, cultural, ethical, political, and legal considerations."

*v) Openness* - "Democratic governments are expected to employ Decision-making processes that are transparent and open to stakeholders. Openness implies a clear articulation of how decisions are reached, policies are presented in open fora, and the public has access to the findings and advice of scientists as early as possible. It is essential that the public be aware of what the responsibility of government is in relation to the use of science. In addition, decision makers need to treat the science advisory function as an integral part of the management process. Effective relationships between decision makers and science advisors benefit from an understanding of their differing perspectives and approaches. Policy makers and advice providers need to communicate to ensure that policy makers are convinced the science advice is current and sound. In turn, advice providers need to be confident that their advice is considered seriously in decision-making. Finally, there needs to be consultation with stakeholder groups and public discourse to ensure that public values are considered in formulating policy. Early and ongoing consultation both within government and with the public can mitigate greater negative debate and controversy when policies are announced."

*vi) Review* - "The principle of review includes two elements: a) subsequent review of science-based decisions to determine whether recent advances in knowledge impact the science and science advice used to inform the decision, and b) evaluation of the decision making process. Appropriate accountability mechanisms need to be in place to ensure that these principles and guidelines for sound science advice are followed.

Source: (Ref.1)

# Part II

# Environment Canada's Science Advice Measures: Analysis

# ENVIRONMENT CANADA'S SCIENCE ADVICE MEASURES:

# PART II – ANALYSIS

## 1. Introduction

*Part I* of this report is an *inventory* of science advice measures, which Environment Canada currently practices, compared to the principles outlined in the Council of Science and Technology Advisors (CSTA) paper "Science Advice for Government Effectiveness", also known as the SAGE report (Ref.1). The sixty-one measures, which are contained in this inventory, represent the major science advice measures used by Environment Canada – this list is inclusive but by no means exhaustive. The express purpose of *Part II* of this report is to:

*i.* *analyze Environment Canada's performance* against the SAGE Principles and Guidelines;

*ii.* *identify strengths, weaknesses and trends* within the three themes of policy and decision-making (namely: National Policy, Regulatory Formulation, and Regional/Operational Decision-Making); and

*iii.* *propose a series of options* for Environment Canada to improve its performance against the SAGE principles and guidelines.

## 2. Scientific Quality and Credibility

All scientific organizations are guided by the scientific method; and Environment Canada is no exception. The quality and strength of the department, as a scientific organization, lies in the *quality and credibility of its scientific staff*. The *quality* of an individual scientist's research can be determined by the scientist's track record of scientific papers, published in refereed scientific journals – both national and international. Quality scientists are usually active researchers who *publish significant new findings* regularly in international refereed journals. The quality of their work is typically found:

i. in the innovative new concepts and experimental methods they use;
ii. the quality control they use to ensure the validity of their data;
iii. the measures used to verify and check their results; and ultimately,
iv. the significance of their findings to science and society.

In order to conduct quality research and have quality researchers on one's staff it is essential that the scientific organization:

i. recruit and retain the highest quality researchers possible;
ii. provide reasonable facilities, equipment and support staff;
iii. provide challenging research work with general direction; but,
iv. refrain from any and all political direction; and
v. encourage the scientists to publish their findings in the *open scientific* literature

The credibility of the science depends on the credibility of the individual scientist and whether his/her work can stand up to the scrutiny of fellow scientists, nationally and internationally, as well as to challenges from the environmental non-government community and the media. On the other hand, public opinion polls, conducted in Canada, make it abundantly clear that politicians have little credibility with the Canadian public on scientific matters, yet government scientists and university researchers do have credibility. University researchers are perceived as being at arms length from government. The credibility of government researchers depends on whether the public perceives that the researcher is permitted to state the scientific facts or whether their statements are being controlled for policy and/or political reasons by their department.

Items iv and v above deal with the credibility of a scientist with regard to political interference. These are important concepts, because they are essential in providing a department with the scientific credibility it needs to advance and have its policy accepted. Having said this, it is difficult for the Minister of a department to accept that scientists are "the authorities" on an important environmental issue. Furthermore, their scientific findings may or may not agree with the proposed policy path. Obviously, this has the potential to be a very sensitive issue. The scientific community must be given considerable freedom but must also understand that policy is determined not only by scientific facts but by a host of socio-economic factors of which the individual scientist is often not aware.

If the media and the public perceive that the department has "muzzled" its scientific staff, the credibility of the department and its policy approach drops very rapidly to zero. In extreme cases, the public's confidence may never be regained, wherein the best circumstances, it is a long slow recovery.

The SAGE principles are clearly aimed at ensuring the integrity of the science advice by means of due diligence – that is, conducting the science and science assessments in an open and inclusive manner and relying on peer-review to ensure the quality of the science and the advice, which flows from it.

# 3. Environment Canada's Performance Against The SAGE Principles and Guidelines

*Procedure:* The procedure, which has been used in this report, is to analyze the department's performance in the three functional areas (National Policy - NP, Regulatory Formulation - RF, and Regional/Operational Decision-Making - RD) against:

i. each SAGE Principle; and

ii. each of the individual SAGE Guidelines.

The fact that the department's performance is scored against both the Principles and the Guidelines may appear redundant. Scoring for *results* against the *Principles*, however, gives a broad brush treatment, which concentrates on the department's achievements in the areas addressed by the SAGE Principles. This is referred to as Environment Canada's *SAGE Results Score.*

Scoring the department's performance against the individual *Guidelines* moves to another level of detail. It focuses on the *factors* and *processes*, which are considered important to achieving results on the Principles. As such, the guidelines deal with

*process*, but not with *results*. Scoring the department's performance against the Guidelines is important to identify areas of *strength and weakness* and to assist in developing *options,* which might improve the department's performance. This will be referred to as Environment Canada's *SAGE Process Score*.

*Scoring:* A numerical score has been assigned to each class (NP, RF, RD) and the scores are given out of 10 , with the following values representing the respective level of performance:

| | |
|---|---|
| 10 = outstanding | 6 = good |
| 9 = excellent+ | 5 = fair |
| 8 = excellent | 4 = poor |
| 7 = very good | 3 or less = failure |

The complete numerical scoring (with weighting) of the department's performance against the twenty-eight (28) guidelines, for each of three (3) classes for a total of eighty-four (84) scores, is given in full detail in the *Appendix*. An *example* of how this weighting has been determined and applied is given below for one area, namely National Policy (NP). The Regulatory Formulation and Regional Decision Making areas have been weighted in a similar manner.

**Example – Early Identification of Issues**

| Guidelines | Performance | | | |
|---|---|---|---|---|
| | Weight | NP Score | | Weighted Score |
| i. Decision makers need to cast a wide net (consulting internal, external and inter-national sources) to assist in the identification of issues requiring science advice | 0.3 | x 10 | = | 3.0 |
| ii. Decision makers need to communicate to scientists those policy areas requiring advice, and government scientists need to be able to recognize the connections between their research and potential policy issues. | 0.1 | x 8 | = | 0.8 |
| iii. Departments need a sufficient and adaptable internal capacity to identify science issues and to assess, translate and communicate science for policy | 0.3 | x 6.5 | = | 1.95 |
| iv. Departments need to support and encourage their science and policy staffs to establish linkages with each other and with external and international sources. | 0.1 | x 6.5 | = | 0.65 |
| v. Departments need to maximize the use of expertise across government departments to identify and address horizontal issues. | 0.2 | x 6.5 | = | 1.30 |
| **Weighted Average** | | | | **7.7** |

*Weighting Rationale:* It is clear that without sufficient scientific capacity, the department would be incapable of identifying issues on its own, or judging the merits of issues identified by scientists external to the department. Consequently, the "capacity" guideline (iii) was assigned a weight of 0.3. Without a "wide net" (guideline i) the department would have to identify all environmental issues on its own – a difficult and inefficient process. Hence this guideline was also assigned a weight of 0.3. The next most important guideline was judged to be the "cross departmental" guideline (v). It was judged to be less important than guidelines i and iii, but still of considerable importance because of the increasing complexity and interconnectedness of environmental science.

It was assigned a weight of 0.2. The two final guidelines (communicating policy areas – ii, and encouraging linkages with external and international sources -iv) are items which are important but which are dealt with quite well in Environment Canada. Consequently, they were both assigned a weight of 0.1. A similar weighting process was undertaken for each guideline. The weights assigned to each guideline are found in the *Appendix*.

The following Sections (3.1 to 3.6) of this report consist of:

i. an *analysis* of the department's performance against the SAGE Principles ( i.e., Environment Canada's SAGE Results Score); and,

ii. a *summary* of the department's performance against the individual SAGE Guidelines (i.e., Environment Canada's SAGE Process Score).

It is apparent that the SAGE Principles and Guidelines were formulated with a national level research organization in mind. Scoring the three departmental components (NP, RF and RD) against the SAGE guidelines is informative but somewhat inequitable, because a region cannot be expected to have, for example, the depth of scientific talent or the international connections that a national research institute must have. A similar circumstance arises with the Regulatory Formulation component, since it has a limited depth of scientific staff and less international exposure than the national laboratories. Hence, it is to be expected that the National Policy class should have the highest score against the majority of the Guidelines and Principles.

It should be pointed out, however, that both the Regulatory Formulation and Regional/Operational Decision Making areas both benefit, directly and indirectly, from the strength and depth of scientific knowledge which exists in the National laboratories. The knowledge base of the National Laboratories is accessible by regional and regulatory affairs staff. This is known and respected by provincial officials, university staff and environmental non-government groups – hence the quality and credibility of the National Laboratories is of benefit across the complete breadth of the department.

## 3.1 Early Identification Principle

**Sage Principle Performance: Environment Canada's SAGE Results Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **9** | **8** | **8** | **8.3 Excellent** |

Rating the department's performance against the Early Identification Principle, Environment Canada achieves an *Excellent* rating.

The SAGE Inventory, in Part I of this report, documented ten early identification measures ranging from monitoring networks to computer modeling to international scientific networks. Environmental issues are identified early; by detection of environmental trends from ongoing monitoring networks (e.g., CAPMon, NAPS, EEM) by analyzing data from various sources for assessment purposes, by predictions of future trends (e.g., Climate Change, Ozone) in physical parameters (temperature, precipitation, ozone

concentration) from numerical modeling, and by predictions of chemical toxicity from chemical models. The early detection of these issues is communicated and verified in the scientific community through national and international scientific networks (e.g., World Climate Research Program, Society of Environmental Toxicologists and Chemists, international scientific conferences).

The greatest strength occurs in the National Policy area (score = 9) based primarily on the depth/breadth of the research and monitoring capability and the extensive national and international scientific networks which Environment Canada's scientists have built over the past three decades. The Regulatory Formulation area and Regional/ Operational Decision Making are scored only slightly lower at a score of 8, because of their heavy involvement in monitoring networks and field programs where many of the trends in environmental parameters are found.

The fact that these measures have worked in Environment Canada at a very high level of performance is verified in that the department and its Ministers, have never been known to be unaware and unprepared, as a result of a "new" environmental issue brought forward by the public.

Further evidence of Environment Canada's ability to identify environmental issues early, lies in the fact that the department has an enviable international record in both identifying and researching new environmental issues (e.g., Acid Rain, Ozone, UVB radiation, Arctic Contaminants, Pulp Mill Effluent, and the POPS concept) and providing the science and leadership to address their solution. Canada has benefited directly from this by achieving environmental protection over its very large land mass and indirectly, internationally, by its accomplishments in moving global environmental legislation forward. Many of these accomplishments would not have happened without the ability to identify environmental issues early and to conduct the requisite research and science assessments.

The following is a summary of the analysis of the department's performance against the individual SAGE *Guidelines*. The full text of the SAGE Principles, Guidelines, and the numerical weighting and scoring system utilized, are found in Appendix I. The titles that follow, in italics, characterize the thrust of the SAGE guidelines. An overall score is given and whether the performance *is improving, steady or declining.*

**SAGE Guideline Performance: Environment Canada's SAGE Process Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **7.7** | **6.2** | **6.4** | **6.8 Very Good -** |

*i. Broad Network for Issues Identification:* Environment Canada casts a very wide net indeed, when identifying new environmental problems and issues. By the nature of the process, this net is regional, national and international for National Policy issues (e.g., NAPS, CAPMon, EMAN, EEM, Ozone and UVB monitoring) but, often less so, for Regulatory and Regional/Operational issues. Consequently, Environment Canada has scored at the 10 level in the National Policy area and 7 for both the Regulatory Formulation area and

the Regional/Operational areas. Few countries have a track record as good as Canada in this regard. However, it is questionable whether it is necessary to "go international" on all of Canada's regional environmental problems. Hence, the lower score on this front is more a reflection of the thrust of the SAGE Guidelines and less of a matter of concern in terms of performance. *Overall score - 8.0 - and steady*

*ii. Policy Areas for Advice:* Over the years Environment Canada's decision makers have made their policy needs and priorities quite clear. Whether it is a ministerial action plan, a call letter from the Deputy Minister, planning documentation, or a specific published set of priorities, the staff are made aware of the areas where advice is needed. On rare occasions, the need for policy advice on environmental issues drives the science - Pulp and Paper effluent being one of the few occasions of this sort in the department's history. The typical case is that the science community identifies the issue and performs limited research to ensure that it is really a matter of concern. Then the media raises the profile of the issue over time and public support grows for policy and action. The request for policy advice is usually formulated with significant input from the scientific component that actually performs research on the issue. This is to be expected when the department is in the lead, identifying issues and researching them before they become policy issues in the public forum. Having said this, there is room for improvement. The documentation of policy needs for science advice could be *more explicit, deliberate and frequent.* The current drafting of a Research Agenda is a positive move as it will document the department's R&D direction formally. *Overall score - 7.3 - and improving*

*iii. Scientific Capacity:* Environment Canada has had a considerable, but not excessive capacity, to identify science issues and to assess, translate and communicate science for policy. This capacity has been reduced by Program Review, while the issues have increased. There are areas where capacity has *eroded dangerously.* Additionally, new issues, e.g.: Biotechnology, Heavy Metals, Endocrine Disrupters, which have been identified, will require new scientific/technical staff whose skills are not present in the department today. Hence, Environment Canada has scored low on this component. Since the greatest expertise is typically, but not always, in the National laboratories the National Policy area has been scored highest. *Overall score - 5.7- and declining*

*iv. Science/policy Linkages:* Presently, there is a lack of a designated formal channel for science advice to flow through the department into the policy area. Part of the reason for this, is that the National Policy issues are few and need policy attention for only a short period of their total lifetime in the department. Consequently, the need for a formal mechanism is intermittent and ad hoc arrangements have tended to suffice. The fact that science is done in two of the services, and policy in the other two services, does not assist in the process. As a result, science advice often flows through the hierarchy of management channels into the policy arena. There is room for improvement here, not only in the transfer of advice, but in the necessary interactions between policy advisors and science advisors, which should follow. There is some evidence that the new *"business line tables"* may help with this science/policy linkage.

It must also be understood, however, that this process involves bringing together staff with very different educational and cultural backgrounds and with very different objectives. This "marriage" will always present difficulties. The scientist will want to file his report and get on with more research. The policy analyst finds the science incomprehensible and needs to be taken through it carefully to understand the implications for society and the economy. This requires patience on both sides. During

the policy formulation process, questions will arise which will require further clarification, expansion, new computations and perhaps additional research. The individual scientist is often not keen to participate in this process because it detracts from his/her time to do research and publish papers. In addition, the scientist's view is that science assessments do not enhance one's career or lead to promotions. In a culture where one's prestige and rewards depend on "journal refereed publications" this circumstance is perhaps understandable, though regrettable.

Conversely, the policy analyst is often under considerable pressure, from the Minister's office, and has little time to be patient with the "prima donna" scientist. Frequently, the solution to this cultural dilemma is to have the science represented by a senior scientist or research manager, who is familiar with the science and who is not under the threat of "publish or perish." These "science advisors" or "science brokers" are often more capable of communicating the science in lay terminology, that can be understood by the policy analyst. Improving this vital science/policy interface will require patience, persistence and understanding on both sides. Unfortunately, there is no magical formula. *Overall score – 6.2 and improving*

*v. Horizontal Issues:* Prior to the 5NRD MOU, there was no formal mechanism which brought the science departments together to discuss horizontal science issues. This has changed substantially; there is a mechanism which encourages discussion (e.g., from the Inventory include UVB Science Assessment, and the Heavy Metals and Endocrine Modifying Substances Working Groups). Unfortunately, action requires resources and without a joint resourcing, mechanism, many of the issues identified do not progress for lack of resources. Approximately a decade ago, the ADM Science Committee had resources for new areas of research (e.g. Artificial Intelligence, Biotechnology, etc), which inspired a lot of interest and competition amongst departments. A similar mechanism, with funds earmarked for work on crosscutting issues, might well stimulate more action amongst the 5NRD departments, if properly set up and operated.

In spite of the 5NRD MOU being an NCR mechanism, in many instances, the regional components of federal departments have cooperated more actively than their headquarters counterparts by way of regional management councils and joint S&T committees (Inventory examples include Sydney Tar Ponds Cleanup, and the Northern River Basins Study). *Overall Score - 6.5 - and improving*

*Summary:* Judged against the SAGE Guidelines, Environment Canada's scores in the Good – Very Good range with respect to the *processes* laid out in the SAGE Guidelines for Early Identification. This is in contrast to the *results* score which were judged to be Excellent. As previously noted, it is quite possible for a department to achieve good results in terms of science policy without having a series of perfect processes. While this is clearly an area of strength for Environment Canada, there is room for improvement particularly in the areas of both *physical/biological science* and *social science* capacity.

## 3.2 Inclusiveness Principle

**Sage Principle Performance: Environment Canada's SAGE Results Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **8** | **7** | **8** | **7.6 Very Good +** |

Environment Canada's performance, rated against the Inclusiveness Principle yields a score of Very Good+. Part I *(Inventory)* of this report lists fifteen measures by which Environment Canada includes scientists, from other government departments, provinces, universities and international institutes in its research and science assessment work. These include: Environment Canada's scientists working in research partnerships in international research programs, participation in international science assessments, conducting national science assessments in cooperation with provincial and university scientists participating with provinces in Ecosystem Research Initiatives and Environment Canada's scientists contributing to environmental assessment panel hearings as expert witnesses.

The breadth and strength of measures found in the National Policy area is rated as *Excellent.* One of the most innovative and most inclusive mechanisms, however, involving industry and non-governmental environmental groups, is in the Regulatory Formulation area in the *Environmental Effects Monitoring Program.* This program has received accolades from environmental groups, industry and Natural Resources Canada for the successful inclusive approach it has taken to set guidelines for Mining and Pulp and Paper Mill Effluent. Another long standing, highly inclusive program, under the leadership of the Canadian Wildlife Service, has been the *Committee On the Status of Endangered Wildlife In Canada (COSEWIC)* process which draws on federal, provincial, and territorial scientific staff to identify Canadian wild species at risk.

Regional scientific work has evolved further and frequently includes provincial and university researchers in cooperation with Environment Canada scientists. This is reflected in the score (8) assigned to Regional/Operational Decision making.

Canadian contributions, by government and university staff alike, to the global topic of Climate Change through the World Climate Research Program and the Intergovernmental Panel on Climate Change, not only in the natural sciences but in the social sciences as well, indicate a very *positive trend* toward including the policy sciences in environmental assessment work.

Overall, it is difficult to comprehend how Environment Canada could be much more inclusive in its scientific/technical work. While minor improvements might be made, this is a *strong and healthy part* of Environment Canada's science policy measures.

**SAGE Guideline Performance: Environment Canada's SAGE Process Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **7.6** | **7.0** | **7.0** | **7.2 Very Good** |

*i. Wide Range of Sources:* Environment Canada cooperates with a wide range of sources in its research work. The inventory points out that a full 48% of all journal papers, published by department staff in 1995, were in cooperation with researchers outside government (see Ref. 2). Environment Canada has a considerable depth of scientific resources internal to the department, and has had difficulty, on occasion, finding comparable scientific talent working on the same topic external to the department, within Canada. This has changed considerably over the last decade, with increased involvement with the provinces, OGD's, university staff and with increased participation in international projects – many conducted in Canada, but drawing on scientific talent from the USA, Europe and Japan. *Overall Score - 7.7 - and improving*

*ii. Traditional Knowledge*: Use of Traditional Knowledge has increased significantly in recent years. Outstanding work with Canada's aboriginals, has put the Canadian Wildlife Service at the forefront in the use of *"traditional knowledge"*, a practice which has spread to regional projects and national field projects. Recently, as pointed out in the Inventory, traditional knowledge has been a very real source of information on the location of open water leads in the study of winter ice in Voisey Bay.

Traditional knowledge is not applicable to regulatory formulation under CEPA, since it is primarily based on laboratory toxicological testing. The Regulatory Formulation area has not been scored under this Guideline for this reason. Both national and regional research projects, such as the Northern River Basins Study and regional work on Voisey Bay, have benefited significantly from the collective knowledge of aboriginal elders. *Overall Score - 8 - and improving*

*iii. External Sources:* Although Environment Canada's Services rarely use external advisory panels, this is the "process of choice", as the Inventory documents, for the Canadian Environmental Assessment Agency (CEAA) because of the political sensitivity of the topics and the necessity to provide credible decisions on major development projects.

This will change, in the near future, as a result of the recent adoption of an *Environment Canada External Review Policy,* which will bring external scientists into the department to review both *planned and ongoing programs.*

This apparent lack of the use of external scientific talent is due, in large part, to the fact that much of Environment Canada's science is subject to science assessment procedures that are *both external and international in nature.* As a consequence, the requirement to create advisory panels or solicit external advice has been limited. This is a case where the department uses a different process but accomplishes the same end as the SAGE guideline recommendations by means of external peer review. Strict adherence to the guideline in scoring the department's performance, however, reduces, Environment Canada's apparent performance. Overall Score – 5.3 and improving

*iv. Solicited/Unsolicited Advice:* Environment Canada has been open to both *solicited and unsolicited advice* for many years, receiving counsel from a broad range of non-governmental environmental groups, industry associations and the public. The Green Plan consultations involved hundreds of individual groups and tens of thousands of individuals. Furthermore, as the Inventory points out, a formal *S&T Advisory Board* was established, some three years ago, and is now very active in advising the Deputy Minister on a broad range of topics. This Board has already filed its recommendations to the department (Ref. 3) on the implementation of the SAGE Principles. *Overall Score - 7.7 - and improving*

*Summary:* Environment Canada's rating against the Inclusiveness Guidelines is Very Good. The only low score was in the *External Advice* area, which is used extensively in environmental assessment and in science assessments, but infrequently by the department in general. This situation *is improving.*

## 3.3 Sound Science and Sound Science Advice

**Sage Principle Performance: Environment Canada's SAGE Results Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **9** | **8** | **7** | **8.0 Excellent** |

The *Inventory,* in Part I, of this report lists thirteen measures, in the department, which contribute to sound science/science advice. Environment Canada's science and science advice has been *strong* since the inception of the department. The scientific community in the department comes from a very rigorous scientific background, primarily in the biological, physical and mathematical sciences, where the scientific method and peer review are practiced fully and diligently. As the Inventory documents; Environment Canada's internal and external publications are subjected *to both internal and external review*, publications in refereed journals are subject to external anonymous review, and the practice of undertaking in-depth science assessments has come to maturity in the department and Canada has contributed significantly to this process on the international environmental scene. These assessments typically involve international scientists and are peer-reviewed externally. This is without question one of *Environment Canada's trademarks.* A recent policy will see the commencement of the external review of large, new and ongoing research programs. Finally, as the Inventory points out, an S&T Advisory Committee now provides external advice to the Deputy Minister.

The above measures apply on the whole to the National Policy area, and to a lesser extent to the Regulatory Formulation and Regional/ Operational Decision Making areas which are subject to fewer peer and external review processes. Hence a score of 9 was assigned to the National Policy area, 8 to Regulatory Formulation and 7 to the Regional/Operational Decision Making area. *Overall Score - 8.0 - and steady*

**SAGE Guideline Performance: Environment Canada's SAGE Process Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **7.5** | **6.9** | **6.7** | **7.0 Very Good** |

*i. Due Diligence:* Environment Canada has practiced a tight publication policy for over two decades. As the Inventory documents scientific reports produced internally and destined for the public, are subject to both internal and external review. Scientific papers submitted for journal referee publication are reviewed externally. All papers, submitted for journal publication, are reviewed to ensure that the papers are fully focused on science and avoid making statements about policy. Finally, as the Inventory points out an Environment Canada External Review Policy is being implemented and an S&T Advisory Committee provides the DM with external advice on S&T. *Overall Score – 7.8 and steady*

*ii. Research and Policy Analysis:* Resources devoted by Environment Canada to *policy research and policy analysis* have not, been in the same league as those devoted to the physical and biological sciences. It is clear that the total resources allocated to policy research and analysis need not equal those allocated to the physical and biological sciences, but there has been a very real need, in the department, for good socio-economic and political research. This was a common thread in all of the interviews conducted with senior managers in the department. Contracting portions of this work, outside the department, may assist in the short term. In the longer term, however, the department requires policy staff with quality economic, social, and political science expertise. Continuity, in such a group, would bring a depth of experience on environmental matters to bear on new issues as they develop. The science assessment group in the Meteorological Service of Canada has moved in this direction, and it will be interesting to see the results of the new Policy Research unit in Communications and Policy. *Overall Score - 6.3 - and improving*

*iii. Selection of Advisors:* Science Advisors are, typically, *not appointed formally* in Environment Canada. They are usually middle level research managers with a substantive knowledge of the scientific topic as well as some appreciation of government policy. On other occasions, they are senior scientists, or individual scientists, who are performing core research on the particular issue. They are *not rotated regularly*, as is advocated by the SAGE Guidelines, but rather kept in the position to maintain continuity on the topic. Science advisors have been chosen from the relevant scientific area they advise on – not from some other discipline. This latter point of the SAGE guideline appears to be in direct contradiction to the first point in part iii – "selection of advisors needs to be matched to the nature of the issue." An alternative interpretation of this point is that the SAGE report refers to "advisors" in the general sense - in which case it is very clear that there is a need for other advisors to advise on the economic aspects, socio aspects etc,. *Overall Score - 6.7 - and steady*

*Conflict of Interest/Scientific Fact/Limits of Science Advice*: This guideline deals primarily with the ethical considerations of science advice. Government staff are required to declare *conflicts of interest* and conduct their affairs in a manner, not only to *avoid actual*

*conflict of interest,* but also to avoid the *perception of the conflict of interest.* The consequences of not adhering to these conflict of interest guidelines are harsh indeed. One of the recent tasks of the S&T Management Committee was to take simple but specific measures to avoid putting scientists in a conflict of interest circumstance, as a result of accepting unpaid appointments as adjunct professors. This was the result of a very broadly stated part of the Criminal Code dealing with fraudulent behaviour by civil servants.

Scientists in the department have had a very good track record with respect to sticking to the *scientific facts* and not getting these confused with their *personal views*. They are aware that their credibility is at stake if their scientific viewpoint cannot stand up to the scrutiny of their peers. Credibility is the scientist's only currency and few are willing to risk damaging it. There is a legitimate need for scientists to voice their *scientific opinion.* It can be very valuable because, while based on scientific fact, it reaches beyond and can guide the formulation of policy, which has to contend with the future.

Recognizing the limits of science advice and the existence of other considerations in decision making comes with a breadth of knowledge and experience acquired over the years. Science advisors in Environment Canada, for this simple reason, are rarely fresh university graduates but rather seasoned professionals, either research scientists or research managers, who appreciate that science may form a basis for policy but that "science does not equal policy". *Overall Score – 7.0 and steady*

*Summary:* Environment Canada scores in the *Very Good to Excellent* category when rated against the Sound Science/ Science Advice Guidelines. Due diligence is practiced very carefully by the department and its scientific staff are required to abide by a very strict *Conflict of Interest Code.* Science advisors are normally senior researchers and research managers with broad experience in science and science advice. That Environment Canada has rarely suffered from "rogue scientists", amongst its scientific cadre, is testimony to the fact that its scientific culture is one that is committed, responsible and ethical.

## 3.4 Uncertainty and Risk

**SAGE Principle Performance: Environment Canada's SAGE Results Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **7** | **8** | **7** | **7.3 Very Good** |

The SAGE report recommends that departments *"adopt a risk management approach as the basis for scientifically sound, cost-effective integrated actions, while taking into account social, cultural, ethical, political, and legal considerations."* In this regard, Environment Canada is the classic example of a risk management department since the SAGE recommendation is exactly what Environment Canada has practiced increasingly over the past three decades. The science component of the department undertakes research and produces science assessments that identify the current and future risks to

human health and the environment – i.e.: *a risk assessment process.* The *Inventory*, in Part I of this report documents *four substantive measures* which contribute *risk assessment* measures to this process. These include the use of science assessments, regulatory impact assessments, remedial action plans and environmental impact assessments as a means of risk assessment.

In the policy integration process, the risk assessment is balanced with socio-economic, political and legal considerations to produce policy and regulations, guidelines, etc, where applicable – i.e., a risk management process. This process is practiced in the most formal manner in the Regulatory Formulation area under CEPA. The risk assessment process is very distinct in the National Policy area but the policy integration process is less so, since it becomes part of Cabinet Memoranda, which are *Secret.* Regional decisions on environmental remediation projects follow very clear risk assessment/risk management principles.

Environment Canada has a remarkably good track record of *practicing risk management*, one that many environment departments around the world envy. The senior managers of the department are, however, perplexed by the fact that the department *does not appear to practice risk management* nor does it very well. A risk management approach must be developed for *each and every case* and cannot be computed readily by a piece of software. Consequently, the department's Results Score is rated as *Very Good.*

**SAGE Guideline Performance: Environment Canada's SAGE Process Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **5.2** | **7.2** | **5.2** | **5.9 Good** |

*Risk management guidelines:* Although the precautionary principle is now included in CEPA, the department does not have a *formal set of risk management guidelines.* Consequently, the National Policy and Regional Decision Making area score is 3, and Regulatory Formulation scores 6. *Overall Score - 4.0 - and steady*
*Uncertainty Identified:* Environment Canada, and its scientists, have been very forthcoming about stating the *uncertainties* of its science and science advice and communicating this to decision makers. *Overall Score – 7.7 - and steady*

*Communicating Uncertainty/Risk Management Approach to the Public and Stakeholders*: This guideline is satisfied remarkably well, in the department in the Regulatory Formulation area, by the procedures used in setting regulations under CEPA. Regional Decision Making is also conducted in a very open and communicative fashion with citizen's committees and stakeholders being directly involved. While the uncertainties are made quite clear in the formulation of National Policy, *the Westminster style of government does not permit the risk management approach to be revealed* – hence a lower score in the National Policy area. *Overall Score – 7.8 and steady*

*Summary:* Environment Canada has practised *risk assessment explicitly* and *risk management implicitly* over the past three decades providing Canadian society with a

responsible but realistic level of environmental protection. As a consequence, the Results Score rates *Very Good.* The Process Score is much lower at the *Good minus* level.

## 3.5 Openness

**SAGE Principles Performance: Environment Canada's SAGE Results Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **7** | **8** | **9** | **8 Excellent** |

Openness is one of Environment Canada's strengths and has been so for at least two decades. The Inventory, in Part 1 of this report, lists *twelve* measures that are in common use throughout the department, including a *Policy on Partnerships.* In fact, internal to government, Environment Canada has often been criticized *for being too open and too consultative.*

Examples of the measures documented in the Inventory follow. Environment Canada publishes extensively to keep the public informed about progress on environmental issues. It operates an *Internet web site* and posts a great depth of material there for public access. The CEPA regulatory process is very open with *stakeholder participation and challenge* functions being the order of the day. Regional research and remediation work involves scientists from the provincial government, local government, other federal departments, environmental groups and community interest groups. On the National Policy level, the research work is published internationally and science assessments are performed both nationally/ internationally and subjected to *external peer review.* In terms of results with respect to Openness, the department's overall performance is rated as *Excellent.*

**SAGE Guideline Performance: Environment Canada's SAGE Process Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **7.6** | **7.7** | **7.2** | **7.5 Very Good +** |

*i. Policy /Regulatory Warnings:* Environment Canada keeps the public well informed about the *formulation of new policy* and exceptionally well informed about forthcoming new regulations. As pointed out in the Inventory, there is a prescribed process within CEPA whereby notice is served publicly in the Canada Gazette and a generous time schedule followed for stakeholders and the public to make their views known to government. On the topic of National Policy, there is usually a period of several years of public discussion and comment on the topic, as the public becomes familiar with the

issue prior to policy being formulated and implemented. The policy formulation is often undertaken internationally, which means that Canada does not have complete control over the final outcome. Nonetheless, Environment Canada has an exceptional track record of protecting both *Canada's self interests* and the *global environment* as well. *Overall Score - 8.7 - and increasing*

*ii. Scientific Freedom:* As documented in the Inventory, Environment Canada's scientists are strongly encouraged to publish their findings in the open literature. The department's policy, for many years, has been to appoint *designated spokespersons* to address the media on scientific areas. While these spokespersons have typically been senior research managers, some have been senior scientists. There have been two benefits to this policy. The manager is often more capable of answering questions in lay terms than the scientist, working on the specific topic. Secondly, the manager is more knowledgeable about the department's policy and where to direct questions on these matters. The byword of most of Environment Canada's Ministers to the science community has been: *"You stick to the science, and I'll stick to the policy."* While some would argue that the scientist should be able to address policy aspects, the brutal truth is that ill-placed comments by members of the science community can hamper the proper and responsible formulation of public policy by elected representatives of a democratic country. In this regard the government scientist has a responsibility to report on the science and its inaccuracies and to interact during the policy formulation process to ensure that the science is understood. Government scientists are not responsible for the ultimate policy decision. *Overall Score - 7.7 - and steady*

*iii. Wide Dissemination of Scientific Evidence/Analysis*: Environment Canada publishes its science assessments and makes them available to the public. Part I (Inventory) lists references for these documents, many in multiple volumes of several hundred pages each. Under CEPA scientific assessments and Regulatory Impact Analysis Statements (RIAS) are published and made available publicly, often on the Internet. Cabinet documents, which outline the rationale for the policy formulation, are, of course, Secret. This is the only component of the SAGE guidelines that Environment Canada does not adhere to, as will be the case with all other science departments as well. *Overall Score - 7.0 - and steady*

*iv. Explanation of Use of Information/Why Decision Made:* Ministers in Environment Canada have rarely breached Cabinet secrecy to explain the rationale for a Cabinet Decision on an environmental topic. There is more latitude for this in the Regional Decision Making context, and limited latitude in the formulation of regulations under CEPA. As a consequence this guideline is not applicable to the National Policy area and has not been scored with respect to this guideline. *Overall Score - 6 - and improving*

*v. Public Meetings:* Environment Canada meets regularly with stakeholder groups, industry association representatives, and ENGO's to discuss the formulation of policy. It does not often hold open public meetings, to present policy, and have scientists and policy officials explain their advice and the framing of the policy. But the department does meet with stakeholder groups on a regular basis to discuss policy and regulation. This is particularly so with respect to National Policy. There are, conversely, many regional decisions where the scientists, public and decision makers meet to explain and discuss decisions made with respect to environmental research and remediation projects. *Overall Score - 6.7 and steady*

*vi. Balance of Timeliness/Controversy:* Rarely is the timetable for policy making in any department in the control of the policy makers. It is not that there has not been ample time to discuss the scientific evidence and review policy options but rather that public support for policy is usually determined by the media and is, therefore, quite unpredictable. Environment Canada and its various Ministers have, within the constraints of a parliamentary system, managed to achieve a *reasonable balance between timeliness and controversy.* Part of this is due to the *early availability of sound science advice* and some of it is due to the fact that very few of Environment Canada's policies involve *livelihoods or life/death decisions.* For example, in the case of Pulp Mill effluent, the urgency for a policy decision was driven by the fact that the Nordic countries were about to implement policy based on *incorrect science.* Time was bought to do the requisite research and provide the proper science basis for policy, by the *principal scientist,* explaining the circumstance in detail to various *opinion-making groups in both Canada and Europe.* The result has been a far better policy, and hundreds of millions of dollars of savings on capital expenditures. *Overall Score – 5.7*

*Summary:* Environment Canada's willingness to be open to public discussion from the early days of the department has met with the approval of the public even when it was considered inappropriate in official Ottawa. Hence the *Excellent* rating in terms of results *performance.* Judged against the SAGE *guidelines,* the department's score drops to the *Very Good+* category due, primarily, to the fact that Cabinet decisions cannot be discussed publicly.

## 3.6 Review

**SAGE Principles Performance: Environment Canada's SAGE Results Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **8** | **7.7** | **7.5** | **7.7 Very Good +** |

The Inventory, in Part I of this report, documents seven science advice *measures* relating to the review of policy/regulatory decisions. As the Inventory indicates, in the National Policy area, Environment Canada is required to participate in reviews (scientific, and in some instances socio-economic/ political) as processes mandated within *international* environmental protocols. If changes are necessary, then the department is obliged to undertake the appropriate changes in Canadian policy and regulations. The Canadian Environmental Protection Act is, by law, to be reviewed every five years – although this does not extend to reviewing the science behind every regulation. Regulations are reviewed on an exception basis, and challenges to the regulations can be made by any individual or corporation. These regulations are then reviewed, based on existing science, and changes made if appropriate. Presently, the Canadian Environmental Assessment Act is undergoing review after five years of operation. This is a very open, review with public meetings being held in major centres across the country. *Overall Score - 7.7*

**SAGE Guideline Performance: Environment Canada's SAGE Process Score**

| Class / Principle | National Policy | Regulatory Formulation | Regional/Opnl Decision-making | Average Score |
|---|---|---|---|---|
| Openness | **5.3** | **4.7** | **5.0** | **5 Fair** |

*i. Institutionalized Follow-up:* There is, currently no procedure in the department for the provision of written responses to the findings and recommendations that emerge during the advisory process. This results in a failing grade for the department. *Overall Score – 3*

*ii. Impact of Scientific Advances:* As explained above, policy decisions on internationally based regulations are tested regularly against recent scientific advances. As documented in the Inventory, there are also provisions for review in CEPA but they must be triggered by a challenge to the regulation. Regional Decision Making is reviewed on an informal basis at regional management committees. It should be pointed out, however, that these decisions are rarely, if ever, policy/regulatory in nature. *Overall Score – 7 and improving*

*iii. Access to Relevant Information for Review:* There is no record of an instance in the department where advisors were required to review a past decision. It is assumed that, if the information existed, it would be available for review. *Overall Score – 5*

iv. *Best Practices:* Environment Canada has benefited from exposure to *"best practices"* in the international context, and conversely has transferred an equal or greater amount back. There is not, however, a standard procedure to trade "Best Practices" of this sort among departments, although it might well be accomplished via the 5NRD MOU process. *Overall Score – 5*

*Summary:* Environment Canada does *review its past policy decisions* and regulations, in some cases formally, in others on an as-needed basis. It does not undertake a number of the processes advocated in the SAGE Guidelines. *In conclusion, in spite of not satisfying the SAGE Guidelines completely, Environment Canada's performance on the policy and regulatory front permit it to stand tall amongst its international peers.*

# 4. Strengths and Weaknesses

Environment Canada's track record, nationally and internationally, as a leader in the environmental field has been earned, over the years, as a result of its strengths and abilities to identify important environmental issues, perform international class research on these issues and then use the science to advise on appropriate and effective policies and regulations. The myriad of science policy measures listed and documented in Part I of this report are indicative of how the department accomplishes this task.

*Early Identification:* Amongst environmental agencies Canada is known as being one of the first to identify and bring forward new environmental issues at the international level. This *strength* comes about, primarily as a result of its significant environmental science capability and the field research and monitoring, that the department undertakes on a

regular basis. These factors have permitted Environment Canada and its Ministers to be on top of the issues, both nationally and internationally, and to play a leadership role on both fronts.

Unfortunately, the factors which contribute to this strength are *weakening* and it is quite possible that Environment Canada will no longer be able to maintain a leadership position in the environmental field. The impact of *Program Review* on the scientific cadre and the monitoring networks operated by Environment Canada (often in cooperation with the provinces) has been substantial. This could impact on much more than the early identification of environmental issues. Federal/provincial negotiations would take on a new perspective if it were perceived that Environment Canada was no longer leading the monitoring of environmental trends and research and that university or US researchers were more knowledgeable. Similarly, on the international front, Canada has enjoyed immense respect and leverage by virtue of its environmental science capability. While Canada has a small population, it has a large land mass impacted by Climate Change, UVB radiation, and the airborne transport of a variety of inorganic and organic chemicals. With a weakening environmental science capability, Canada's ability to offer strong and convincing arguments, on international environmental issues of significance to Canada, could decrease very rapidly.

While this declining strength has been discussed primarily with respect to National Policy formulation, it impacts in a parallel manner on the themes of Regulatory Formulation and Regional/Operational Decision Making.

It should be noted that both Doern (Ref. 4) and Halliwell (Ref. 5) have outlined deep concern about this *"science deficit"* which has developed in the federal government.

*Sound Science:* Because of the dependence on a strong scientific capability, it is appropriate to discuss the topic of sound science and science advice at this juncture.

Environment Canada's significant scientific capability has been a major contributor to the provision of sound science and science advice to all three classes of environmental decision making in the department and is, unquestionably, one of the department's true *strengths*. As has been mentioned earlier in this report, a scientific organization depends not only on the numbers of its staff to be strong but also the *quality* of its scientists, their abilities, and the new concepts and findings that they contribute to the body of scientific knowledge and society at large.

In general, Canada is a major contributor to the environmental sciences. According to "*Environment Canada's Publications in 1995*", (see Ref. 2), Canada contributed almost 8% of all journal refereed scientific papers in the environmental science field in 1995, second only to the United States. One quarter of these scientific papers were authored by Environment Canada staff.

Quality science is the primary ingredient of sound science and science advice. Environment Canada, however, has been a leader in converting this scientific knowledge into broader science assessments, which are subjected to rigorous external review. *Acid Rain, Ozone Depletion, Pulp and Paper Organochlorines, Climate Change, Biodiversity, UVB Radiation, and NOx/VOC's* are the major science assessments which have been undertaken by Environment Canada or where major scientific contributions have been made to international science assessments by Environment Canada and its collaborators in universities and the private sector.

*The Meteorological Service of Canada* has been particularly active in contributing to and conducting science assessments both on a national and international basis and employs *a small but experienced group* that leads and participates in science assessment activities. In the toxic chemical area, the science assessments have been accomplished through SETAC (Society of Environmental Toxicologists and Chemists), an equally valid but different mechanism.

These *science assessments* have been a mainstay of Environment Canada's policy and regulatory activities. Clearly, they are not the only ingredient but they form the basis for policy considerations. Unfortunately, as is the case with the early identification of issues, science assessments depend on quality scientific staff and fully equipped laboratories, field experiments and monitoring networks. Once a scientific organization is no longer contributing substantially, its scientists are no longer invited to the specialty workshops, international field experiments nor are they asked to participate in international science assessments. As a consequence, the loss is compounded by not having the opportunity to participate and gain from the knowledge and findings of the best scientists in the business, in a timely manner. This means that the whole department is forced to operate with information which is either old, incomplete or both.

A simplistic counter argument to this is to engage the university community. The reality today is that the university community is already engaged. But the university community depends in large part on Environment Canada for facilities, grants, field experiments and major computing capability. When Environment Canada is weakened, so is the university community.

Is this a trend? Presently, there is no obvious and clear trend. Aside from the substantial reduction in scientific staff, the loss of a number of Environment Canada's senior scientific staff to US laboratories is not, however, a good sign. While the loss may appear small in number, the leadership capability of these few scientists is a much larger factor. High quality younger scientists will undoubtedly follow, which means that Environment Canada will either lose them or be denied the opportunity to hire them as they graduate from university.

*Inclusiveness:* This is an area, which has been on a *clear upward trend* in Environment Canada, which has yet to reach its peak. Environment Canada has, for at least two decades, practiced science on an international basis. More recently, it has begun a major effort to involve university staff and students in its research work. In the regions, Environment Canada scientists work side by side with their provincial counterparts, and with university staff and students. Engaging university staff in work of consequence to Environment Canada, is not always simple. The academic community guards its freedom to pursue research of its own choosing very jealously. There are also jealousies between government and university staff members relating to facilities, access to graduate students, etc, which are slowly breaking down as a result of today's fiscal realities.

Collaboration with other scientists and institutions is usually a positive circumstance, for both parties, providing there is a reasonable sharing of the burdens and the results. In many instances it is the only way to accomplish a large scientific endeavour in a reasonable length of time.

The fact that Environment Canada's rate of collaboration with other scientists in refereed journal publications (see Ref. 2) was 47.6%,against a collaboration rate of 40.1% for the

whole of the federal government, is a very healthy sign. The collaboration rate with university staff alone was 33.4%.

*Openness:* Environment Canada has unquestionably been one of the most open federal departments over the years; it has been a constant *strength* for the department. It has solicited input from the general public, non-government environmental groups, industry, and provinces in a wide variety of ways. It continues to do this regionally on a day-to-day basis in the *Ecosystem Initiatives* programs, which are cooperative environmental research and management programs aimed at preserving and rehabilitating ecosystems.

The CEPA process, of regulatory formulation, involves stakeholders in a very open manner and offers opportunities for its regulations to be challenged by industry and environmental groups. National policy issues involve stakeholders and solicit public input at virtually every stage of the science/policy process.

There is one obvious exception to this policy of openness. Science assessments are *specialized* scientific endeavours, which involve *experts* – albeit a wide range of experts both internal and external to the department. They *should not involve non-experts* in their formulation. A similar conclusion was reached in the "*Bush report*" (Ref. 6).

Nonetheless, these assessments are subject, after formulation, to review by independent experts in the field. Thus, aside from insisting on a requisite level of expertise, these assessments are remarkably open.

There is a positive trend in openness, largely related to the operation of *Ecosystem Initiatives,* in the regions – where provincial representatives, stakeholders, local citizens and aboriginal bands are involved from the project planning stage through to the final stages of the project. Additionally, the *Environmental Effects Monitoring* process involves stakeholders fully and has won a number of accolades from both industry and environmental groups for its equity and accomplishments. Undoubtedly, these programs, or their successors, will be enlarged or broadened to cover other circumstances.

*Uncertainty and Risk:* The SAGE report does not distinguish clearly between risk assessment and risk management. *Risk assessment* in the environmental field is almost solely undertaken by the scientific community. This is typically done through science assessments which indicate the risk to the *environment, wildlife population, or human health.* Environment Canada's performance on this front has been exemplary and a true *strength* of the department. Some improvement might come from addressing specific classes of risk, preferably in quantitative terms where possible, although this is usually a very difficult and controversial technique since it is often based on a subjective assessment of risk transferred into quantitative terms.

*Risk management* belongs rightfully on the policy integration and formulation end of the science/policy process. It draws on the risk assessment, economic analyses, socio-political input, etc. and formulates an approach to reduce, minimize or eliminate one or more environmental hazards. As such, this is what Environment Canada is all about and over the years it has served Canada well. Having said this, it has not necessarily been the result of guidelines, a risk management model or other formal techniques. In this regard the department does not earn performance points when compared to the SAGE guidelines. *In summary, the result is strong and positive, but the process needs attention to gain acceptance under the SAGE Guidelines.*

*Review:* This is an area where the department does have a *weakness.* A number of the *international and bilateral accords* contain regular review mechanisms, which require a *regular review* of the recent science and its implication for policy/regulation. Environment Canada participates in these reviews (science, technology, socio-economics) and follows the decisions of the contracting parties. It is hard to assess what fraction of the total environmental risk management this covers but 50% is likely a minimum.

The Canadian Environmental Protection Act does require a review every four years but this review does not necessarily include a review of the science behind each and every regulation. As a matter of fact, this is also true of the international environmental protocols – the science assessment is an update on recent science findings and their implications. The assessments do not focus on individual substances unless this is warranted. Within CEPA, there are opportunities for challenges, to the regulation by industry or environmental groups, and the department then conducts a thorough review of the recent science, to determine whether modification of the regulation is indeed necessary or not.

The task of subjecting literally thousands of chemicals regulated under CEPA to a full scientific review on a regular, say five year, basis is enormous. It is probably also not cost-effective and would definitely detract from the task of reviewing existing chemicals on the Priority Substances List, which are known to be toxic but have not yet been reviewed nor regulated. Bluntly put, the substances under CEPA are reviewed on *an exception basis* and this is probably one of the most *cost-effective* ways of accomplishing the task. Nevertheless, this is an area worthy of more detailed examination to arrive at an effective screening and review process, which would be more inclusive without incurring an unjustifiable cost.

*Documentation/Tracking:* While Environment Canada undertakes many of the processes advocated by the SAGE Guidelines and meets the Principles in terms of results, it lacks a formal integrated system that documents and tracks these actions. This is not surprising because there has never been a requirement for such a system. The SAGE report does not mention this as a requirement, but it is essential to any process that insists on accountability. An audit, on the department's adherence to the SAGE Principles/ Guidelines, within five years is very likely. While much of the relevant material exists, it is not in a readily available location or format. A number of measures, such as Early Identification and Review, have little or no documentation. In addition to documenting its actions, there is also a necessity to track the science advice from point to point in the process of translating science into policy. While this is a low profile issue today, an audit could turn it into an embarrassment for the department. *In conclusion, the department must not only do the job but also document clearly that it was done.*

Although not specifically addressed as one of the SAGE guidelines, the principle is quite clear in regard to *undertaking the review of decisions* taken by decision makers and *briefing the science community* with respect to the rationale for these decisions.

This *feedback to the science community* would undoubtedly be appreciated, in spite of the fact that it would not necessarily agree with the views of the individual scientist. At least the scientists would know that the science advice was used. This is something, which could be done, particularly in the regional context and in some instances in the CEPA context.

With respect to National Policy formulation, however, under the Westminster form of government, the rationale for policy determined by Cabinet Committee is *secret and*

*cannot be revealed.* This prevents the Minister from explaining the compromises and tradeoffs necessary to achieve agreement on a policy issue. Unless our form of government is to change drastically this is a circumstance, which will not change.

# 5. Options for Change

## 5.1 Option I - The Status Quo

The sixty-plus science advice measures, practiced by Environment Canada over the years, have been remarkably successful in providing Canada with environmental policy/regulation based on sound science. Besides the domestic environmental situation, Canada has provided leadership on environmental issues globally at a level that far surpasses Canada's population, gross domestic product or even Canada's percentage contributions to the world's environmental scientific literature. This has benefited Canada's self interests, contributed to Canada's image internationally in considerable measure, and helped to preserve the global environment.

It is fair to ask the question: if Environment Canada has been this successful, should it risk changing the system? Many countries would be thrilled to have a similar track record and would gladly trade places. Graded *absolutely* against the SAGE guidelines, however, Environment Canada does not fare as well as its track record would indicate. There are individual areas which could use improvement, and the senior managers of the department agree at a high level of confidence. *Attractive as the status quo may be, some change is advisable.*

The resources necessary to effect this change, however, must be kept in mind with respect to the *return on investment.* The existing system is *remarkably close to optimum and major expenditures are not likely to improve service to the public*, although they may be regarded *as exemplary actions on the science management front.* While the status quo cannot be viewed as a viable option, it is essential that the resource commitment to implement the changes must not impinge heavily on *the department's ability to supply sound science and science advice*, which is one of the department's main responsibilities.

## 5.2 Option II – Evolutionary Change

This report has reported on the department's strengths and weaknesses. What can be done about them, in a sensible and sensitive fashion, in order to *meet the SAGE report Principles and Guidelines and improve* the science advice system in the department? There is a broad spectrum of possibilities to choose from. In this option, the low impact side will be discussed.

There are several principles, which apply to the department, with respect to changes that might be made regarding the SAGE Principles and Guidelines. They are:

i. Keep the changes as *simple* as possible;
ii. *Consult* with the S&T community;
iii. Improve the *documentation and tracking* of science/policy measures;
iv. *Increase feedback* to the S&T community.

There are five top priority items, which are *recommended for* the department to address. These are listed below in approximate order of priority. A detailed discussion follows:

1. **Risk Management** formalize and implement a set of risk management guidelines;
2. **Review:** establish a formal mechanism for the review of policy decisions;
3. **Early Identification:** commence documentation of the early identification of environmental issues;
4. **Sound Science:** upgrade policy research/integration capability;
5. **Sound Science:** identify critical needs in scientific staff and hire aggressively.

*Risk management:* Although Environment Canada has done a remarkably good job of managing risks to Canada's environment, the SAGE report strongly recommends that departments undertake to write and implement a set of risk management guidelines. This is the single most obvious item which detracts from meeting the SAGE Principles and Guidelines.

As discussed previously in this report, this will not be an easy task. Furthermore, attempts to draft a set of guidelines common to all science departments will be even more difficult as the requirements will differ substantially from department to department.

Explicit inclusion of the "Precautionary Approach" in this task is essential. Clearly this has already been recognized in the department with its inclusion in the new CEPA.

*Review:* This is the other obvious *weakness* in the department, following the SAGE Guidelines. Although there are formal reviews of some policy/regulatory measures, a number of these are invisible. The remaining policy/regulatory reviews are conducted rather informally or by exception.

A simple way to address this matter would be to commence a review of policy decisions by considering it formally, on an annual basis, at departmental/service management committee meetings and at regional management committee meetings. The results, recommendations and actions should be documented and published.

This would require the preparation of background papers and may result in decisions to commence in-depth studies or reviews of particular items needing attention. It would *meet the requirements under the SAGE guidelines* and would bring to the department's attention policy decisions that need revision or updating.

*Early Identification:* While Environment Canada's performance in identifying environmental issues early has been exemplary, there is *no documentation* that indicates that the department does the job. Such documentation is an essential part of meeting the SAGE guidelines and maintaining a good track record.

The documentation of early identification could be as simple as having staff fill out an *early identification form* and forwarding it to their supervisor. These could be discussed at various levels of management committee meetings, at an annual science forum or at an environmental scan meeting. Tracking such documentation over a period of years and feeding information back to the initiator is a more difficult but essential task.

*Policy Research/Integration Capability*: The provision of science advice is a necessary but not sufficient condition for the formation of policy. As was discussed earlier, science is only one of a series of information streams, which need to be taken into account, in

the process of policy making. Economic aspects, social aspects and political aspects are essential to complete the task. This is an area in the department which has been weak. The *formation of a new policy research group is encouraging,* but it is essential that this group be staffed with experienced and highly competent people.

*Science Capacity:* As was discussed in the analysis of sound science, there is no question that the scientific staff capability of Environment Canada has declined quite significantly as a result of Program Review. This is doubly difficult because many of the staff that left the department took with them a great deal of experience, knowledge and contacts, which the next generation of staff will have, no choice but to duplicate. It also comes at a time when there are increased issues in the department, which need attention by the science community, such as heavy metals, endocrine disrupters, and genetically modified organisms. It is clear, that in many areas, the scientific staff cannot cope with the workload. Innovative mechanisms to address this shortfall are also showing stress. It is time the department took a very close look at where it stands, and what scientific staff are critical to its operation over the next 5-10 years, in order to commence aggressive recruitment of the best possible staff. Environment Canada has influence and authority by virtue of its scientific capability. If this capability is seriously eroded, it will lose this authority and leadership role.

*Lower Priority Items*: In addition to the *five top priority* items that this report recommends the department address as soon as possible, there are *six lower priority* items that should also be addressed. The urgency to address these items is lower and some can only be undertaken over a period of several years. Listed in approximate order of priority, they are as follows:

*i. Science/Policy Linkages:* the department should clarify the route which science advice should follow from *research* to *science assessment* to *policy integration* to *policy*. Responsibilities should be *formally* assigned, as necessary, to managers and the relevant structures (committees, external advisory boards, assessment groups, policy integration groups, etc) put in place either *permanently or "as needed."* The *mandate* of each component in the process should be clear as well as the responsibility for moving the file, in a timely fashion, and the provision of responses to queries from the next component in the chain.

*ii. External Sources:* Environment Canada should engage external scientists to provide advice, particularly on topics where the internal science capacity is weak. For example, an external advisory committee to examine the potential impacts of genetically modified organisms (or a subset thereof) would be an appropriate place to commence.

*iii. Public Meetings to Present Policy:* the department should commence the use of public meetings to present both science advice and policy alternatives prior to finalizing the policy. These might be hosted and televised in a manner similar to CBC's Town Hall Meetings.

*iv. Institutionalized Follow-up:* after policy and regulations have been set, the department should provide written responses to individuals and organizations who provided findings and recommendations during the advisory processes.

*v. Selection of Advisors:* advisors should be appointed, formally, for both the science and policy processes. Their mandate, role and responsibilities should be provided in written form. Furthermore, they should be required to sign off on conflict of interest and

professional ethics guidelines. If considered necessary, training should be provided for interaction with the media and for interaction with policy makers.

*vi. Learning from Best Practices:* the department should draw on its companion departments' knowledge base for science advice measures which have proven successful in those departments. Conversely, the department should share its own successes openly with other departments.

## 5.3 Option III - Revolutionary Change

The most expensive and most radical action that the department could take is to move to a *Quality Management process* for its science advice system. This would include very detailed descriptions of all the standard procedures in the process, documentation that each step had been taken, and sign-off that it had been completed by the responsible staff or managers. This would be necessary from the early identification of an environmental issue through the research stages, science assessment, external review, inclusion of the scientific community and stakeholders, etc. The department could also contemplate *"certification" by an external agent* that would require audits of the department - probably on an annual basis. Alternatively, an audit function internal to government might be undertaken by the Auditor General. (NB. such a possibility is mentioned in the SAGE Report – but without reference to a Quality Management process or "certification"). It should be noted that the US EPA is moving toward a Quality Management system. It is not clear at this time whether it will extend into *research and science policy areas.*

Whether this is an appropriate route for the department to take or not is a decision the department will have to make based on its perception of whether it will be essential to satisfy the government and the public that the appropriate tasks as defined by the SAGE report are indeed being undertaken. It is probably not essential to take such a radical route unless this is prescribed by Cabinet or unless it is the collective view of all science departments that it is the only way to satisfy the government's needs.

Independent of whatever action is taken, it is clear that the department, and its individual scientists, will have to undertake science advice measures *more formally and document both the process and the outcome.* It will be essential to communicate this in a very sensitive fashion to the science community to ensure that every scientist understands why it is essential, and what the consequences of non-compliance may mean – such as failure to convince stakeholders of the validity of the science because there is no evidence that it was peer-reviewed. Alternatively, the policy might well be formulated on the basis of input from self interest groups, without the benefit of science input.

# 6. Summary and Conclusion

Environment Canada has served the Canadian public well, but cannot afford to rest on its laurels. Besides, excellent performance, judged on an international scale, does not necessarily translate into accolades from vocal Canadian environmental groups or the media. In an age where "perception is reality" the shining knight's armor can rust overnight.

It is essential that Environment Canada move toward meeting the SAGE Guidelines by addressing the priorities outlined in Section 5, while increasing its documentation and tracking capability for all six SAGE Principles.

The question is how should Environment Canada proceed and at what pace? Section 5 outlines three different options. There are an infinite variety of possibilities in between. The least expensive option (Option II) could be implemented quite quickly and would move the department toward the SAGE goals. One might consider this the Precautionary Approach. It is relatively low in administrative cost, pre-emptive and would demonstrate Environment Canada's commitment to the SAGE process. If a more aggressive approach were required later on, these first steps would still be part of a more extensive process.

Embarking on the much higher cost Quality Management route (Option III) would demonstrate leadership. At this juncture it is not clear how the government will move toward implementation, following the adoption of the SAGE Principles and Guidelines. Will it expect each department to implement the guidelines on its own? Or, will there be a requirement for conformity across the science departments. How would this be coordinated – by the Science ADM's Committee, the 5NRD MOU or by some other means? Until there is clarification on this front, a departmental commitment to a full Quality Management process appears premature. This does not mean the department need sit idle. It could commence work on the priority areas previously mentioned, and prepare for inter-departmental implementation.

In conclusion, it is clear that the existing science and science advice measures that have evolved over the years have served the public well. Nonetheless, the increased profile of science-related issues and the use of science advice coupled with the need for transparent government make implementation of the SAGE Principles/Guidelines essential. Inevitably, this will cause the department some difficulty. The benefits that accrue will be worth the effort in terms of increased acceptance by Ministers, Parliament and the Canadian public, of Environment Canada's ability "to do the job".

# Appendix I: References


1. SCIENCE ADVICE FOR GOVERNMENT EFFECTIVENESS (SAGE). A Report of the Council of Science and Technology Advisors. May 5, 1999 11 pages
2. ENVIRONMENT CANADA'S SCIENTIFIC RESEARCH PUBLICATIONS IN 1995. Science Policy Division Environment Canada June 1998. 16 pages
3. SCIENCE ADVICE FOR GOVERNMENT EFFECTIVENESS: RECOMMENDATIONS FOR IMPLEMENTING THE SAGE PRINCIPLES AT ENVIRONMENT CANADA. A Report prepared by Environment Canada's S&T Advisory Board for the Deputy Minister. November 1999. 12 pages
4. SCIENTIFIC ADVICE IN GOVERNMENT DECISION-MAKING: THE CANADIAN EXPERIENCE. A Report in Support of the work of the Council of Science and Technology Advisors. JEH Associates March 22 1999. 73 pages
5. RISKY BUSINESS: CANADA'S CHANGING SCIENCE-BASED REGULATORY REGIME. G. Bruce Doern 1998. Cruise Conference
6. SCIENCE ASSESSMENT: A REPORT ON SCIENCE POLICY LINKAGES IN THE ATMOSPHERIC ENVIRONMENT SERVICE. A report prepared for the Science Assessment and Policy Integration Group by Elizabeth Bush. December 1998. 31 pages

# Appendix II: Environment Canada's Performance Against The SAGE Principles and Guidelines

The procedure that will be used in this Appendix is to analyze the department's performance against each SAGE principle for each of the classes (National Policy (NP), Regulatory Formulation (RF), and Regional/Operational Decision-making (RD)). Environment Canada's performance will be tested by examining how well Environment Canada meets the SAGE "Guidelines." A numerical score will be assigned to each class and an overall score given for the measure. The scores will be given out of 10, with the following values representing the respective level of performance:

i. 10 = outstanding
ii. 9 = excellent+
iii. 8 = excellent
iv. 7 = very good
v. 6 = good
vi. 5 = fair
vii. 4 = poor
viii. 3 or less = failure

The rationale for proceeding in this manner is to maintain the validity of the analysis. By choosing this method, there can be no question about whether the department was in fact evaluated against the SAGE Guidelines. In the body of the report there is a commentary on whether the author considers whether this technique represents fairly the department's *general performance on science advice measures.*

Each SAGE Principle is listed in full and followed by some 3-6 guidelines. One assumption that can be made is that all these guidelines are of equal importance and therefore of equal importance. Instead these guidelines have been weighted according to the importance that the individual guideline has in the science advice process. The weightings (W) are given for each Guideline in the following sections.

### Principle 1 - Early Identification

Decision makers need to be convinced of the importance of seeking science advice and recognize when science advice is needed. Departments need to anticipate, as early as possible, those issues (representing both challenges and opportunities) for which science advice will be required. A broad base of advice can lead to improvements in the timeliness of issue identification. Interdisciplinary, interdepartmental, and international co-operation should be in place to identify, frame, and address 'horizontal' issues.

| | ***Guidelines:*** | **Performance** | | | |
|---|---|---|---|---|---|
| | | **Wt** | **NP** | **RF** | **RD** |
| *i.* | Decision makers need to cast a wide net (consulting internal, external and international sources) to assist in the identification of issues requiring science advice. | 0.3 | 10 | 7 | 7 |
| *ii.* | Decision makers need to communicate to scientists those policy areas requiring advice, and government scientists need to be able to recognize the connections between their research and potential policy issues. | 0.1 | 8 | 7 | 7 |
| *iii.* | Departments need a sufficient and adaptable internal capacity to identify science issues and to assess, translate and communicate science for policy. | 0.3 | 6.5 | 5.5 | 5 |
| *iv.* | Departments need to support and encourage their science and policy staffs to establish linkages with each other and with external and international sources. | 0.1 | 6.5 | 5 | 7 |
| v. | Departments need to maximize the use of expertise across government departments to identify and ad dress horizontal issues | 0.2 | 6.5 | 6 | 7 |
| **Weighted Average** | | | **7.7** | **6.2** | **6.4** |

NP = National Policy
RF = Regulatory Formulation
RD = Regional/Operational Decision Making

## Principle 2 – Inclusiveness

Advice should be drawn from a variety of scientific sources and from experts in many disciplines in order to capture the full diversity of scientific schools of thought and opinion. Inclusiveness enhances the debate and draws in scientific findings that may not otherwise be considered; sound science thrives on the competition of ideas facilitated by the open publication of data and analyses. The market for science advice is global and the growing body of science knowledge available internationally must be brought to bear on policy issues. Inclusiveness aids in achieving sound science advice by reducing the impact of conflicts of interest or biases that exist among advisors.

| *Guidelines:* | Performance | | | |
|---|---|---|---|---|
| | **Wt** | **NP** | **RF** | **RD** |
| i. Science input and advice needs to be sought from a wide range of sources; | 0.4 | 8 | 8 | 7 |
| ii. due weight needs to be given to the "traditional' knowledge of local peoples; decision makers need to balance the multiple view-points received. | 0.2 | 9 | n/a | 7 |
| iii. While advice from external and international sources needs to be sought regularly, it is especially important to seek such advice in the following situations. Government also needs to consider engaging external, independent agencies to create advisory panels or to solicit advice in the following circumstances:<br>• the problem raises scientific questions that exceed the expertise of the in-house staff,<br>• the issue is 'horizontal' or cuts across lines of jurisdiction within or among departments,<br>• there is significant scientific uncertainty,<br>• there is a range of scientific opinion; or<br>• there are potentially significant implications for sensitive areas of public policy and where independent scientific analyses can strengthen public confidence. | 0.2 | 5 | 5 | 6 |
| iv. Decision makers need to be open to both solicited and unsolicited advice from external sources. | 0.2 | 8 | 7 | 8 |
| **Weighted Average** | | **7.6** | **7.0** | **7.0** |

## Principle 3 – Sound Science and Science Advice

The public expects government to employ measures to ensure the quality, integrity, and objectivity of the science and the science advice it utilizes, and to ensure that science advice is considered seriously in decision making. Due diligence procedures for assuring quality and reliability, including scientific peer review, need to be built into the science advisory process. Where information is proprietary, external peer review needs to proceed with appropriate measures to maintain confidentiality. Science advisors need to contribute sound scientific information, unfiltered by other policy considerations. In developing policy, departments need to involve advisors in assessing the implications of various policy options.

| *Guidelines:* | Performance | | | |
|---|---|---|---|---|
| | **Wt** | **NP** | **RF** | **RD** |
| i. All advisory processes, including those involving traditional knowledge, need to be subject to due diligence. This should include rigorous internal and external review and assessment of all input, analyses findings, and recommendations of advisors. The fact that information is proprietary should not preclude external review, although confidentiality of such information should be appropriately maintained. | 0.3 | 9 | 8 | 7.5 |
| ii. Science advice needs to be supported by research and policy analysis:<br>• Decision makers need to ensure there are sufficient resources for supporting policy research and analysis to underpin the science advisory process.<br>• Scientists need to have the flexibility to explore the range of conclusions and interpretations that the scientific findings might suggest.<br>• A strong coupling needs to exist between the science advisors and the departmental policy and analytical support mechanisms.<br>• Science advisors need to assist decision makers and science managers set research priorities and design an R&D base that will support future science-based decision making. | 0.2 | 6 | 7 | 6 |
| iii. Selection of advisors needs to:<br>• be matched to the nature of the issue and the breadth of judgement required;<br>• be balanced to reflect the diversity of opinions and to counter potential biases;<br>• include at least some experts from other, not necessarily scientific, disciplines; and,<br>• be regularly rotated, with replacements chosen to preserve balance of representation. | 0.1 | 7 | 7 | 6 |
| iv. Advice providers need to:<br>• adhere to professional practice and conflict of interest guidelines;<br>• clearly distinguish scientific fact and judgement from their personal views in formulating their advice; and<br>• recognize the limits of science advice and the existence of other considerations in decision making. | 0.1 | 9 | 6 | 8 |
| v. Departments need to:<br>• ensure in-house expertise to assess and communicate science (whether generated internally or externally) to decision makers;<br>• promote professional practices for those involved in the conduct, management and use of science;<br>• provide and enforce conflict of interest guidelines. Considerations include:<br>  • advisors need to be required to declare any conflicts of interest prior to serving in an advisory capacity and to update such declarations throughout their term of service;<br>  • while the responsibility for documenting and avoiding conflicts of interest should be placed on the advisor, decision makers need to have the ultimate responsibility for protecting against actual or perceived conflicts of interests.<br>• clearly document the science advice received and report back to the advice providers how decisions are made. | 0.2 | 7 | 6 | 6 |
| vi. Decision makers need to:<br>• take care to separate scientific fact and judgement from personal views and judgements in formulating the questions to be addressed;<br>• be conscious of possible biases in the advice providers and be alert to indications of bias in the advice received; and<br>• involve science advisors in policy formulation, to help maintain the integrity of the advice throughout the decision making process. | 0.1 | 6 | 6 | 6 |
| **Weighted Average** | | **7.5** | **6.9** | **6.7** |

## Principle 4 – Uncertainty and Risk

Science in public policy always contains some uncertainty and often a high degree of uncertainty which must be assessed, communicated, and managed. As such, it is important to consider adopting a risk management approach. In addition to hazards, uncertainty may include potential benefits or opportunities which should not be ignored. The goal of risk management is scientifically sound, cost-effective, integrated actions that reduce risks while taking into account social, cultural, ethical, political, and legal considerations.

| | ***Guidelines:*** | Performance | | | |
|---|---|---|---|---|---|
| | | **Wt** | **NP** | **RF** | **RD** |
| i. | Departments require a clearly defined set of risk management guidelines, including how and when the precautionary principle should be applied, in order to maintain confidence that a consistent and effective approach is being used across government. | 0.5 | 3 | 6 | 3 |
| ii. | Science advisors need to ensure that scientific uncertainty is weighted fairly, is explicitly and fully identified in scientific results, and is communicated directly in plain language to decision makers; decision makers need to ensure that scientific uncertainty is given appropriate weight in policy decisions. | 0.3 | 8 | 8 | 7 |
| iii. | Science advisors and decision makers need to communicate to the public and stakeholders the degree and nature of scientific uncertainty and the risk management approachutilized in reaching decisions. | 0.2 | 6.5 | 9 | 8 |
| **Weighted Average** | | | **5.2** | **7.2** | **5.2** |

## Principle 5 – Openness

Democratic governments are expected to employ decision making processes that are transparent and open to stakeholders. Openness implies a clear articulation of how decisions are reached, policies are presented in open fora, and the public has access to the findings and advice of scientists as early as possible. It is essential that the public be aware of what the responsibility of government is in relation to the use of science. In addition, decision makers need to treat the science advisory function as an integral part of the management process. Effective relationships between decision makers and science advisors benefit from an understanding of their differing perspectives and approaches. Policy makers and advice providers need to communicate to ensure that policy makers are convinced the science advice is current and sound. In turn, advice providers need to be confident that their advice is considered seriously in decision making. Finally, there needs to be consultation with stakeholder groups and public discourse to ensure that public values are considered in formulating policy. Early and ongoing consultation both within government and with the public can mitigate greater negative debate and controversy when policies are announced.

| *Guidelines:* | | Performance | | |
|---|---|---|---|---|
| | Wt | NP | RF | RD |
| i. Decision makers need to provide early warning of significant policy and regulatory initiatives to key interest groups, other governments or international organizations, as appropriate. | 0.3 | 9 | 10 | 7 |
| ii. Departments need to allow scientists freedom to pursue a broad base of inquiry and undertake widespread and thoughtful discussions. Departments need to make every effort to support and encourage scientists to publish their research findings and conclusions in external peer-reviewed publications. However, inevitably, circumstances will arise where the findings and conclusions will conflict with existing government policies. In these cases, departments need to review both the policies and all of the relevant scientific findings and advice in order to determine how to proceed. | 0.3 | 8 | 8 | 7 |
| iii. Departments need to publish and disseminate widely all scientific evidence and analysis (other than proprietary information) underlying policy decisions, and show how the science was taken into account in policy formulation. | 0.1 | 7 | 7 | 7 |
| iv. Decision makers need to explain how the advice they received was used and why the ultimate decision was made. | 0.1 | n/a | 4 | 8 |
| v. Departments need to consider using public meetings to present policy; scientists need to have a leading role in explaining their advice and policy officials need to describe how the advice was secured and how the policies have been framed in light of the advice. | 0.1 | 5 | 7 | 8 |
| vi. The level of expected risk andcontroversy and the need for timely decisions should guide the nature and extent of consultation undertaken, with higher levels of risk and controversy demanding a greater degree of public consultation. Decision makers need to balance the need for timeliness in reaching decisions with the need for effective consultation. | 0.1 | 5 | 5 | 7 |
| **Weighted Average** | | **7.6** | **7.7** | **7.2** |

## Principle 6 – Review

The principle of review includes two elements: 1) subsequent review of science-based decisions to determine whether recent advances in knowledge impact the science and science advice used to inform the decision, and 2) evaluation of the decision making process. Appropriate accountability mechanisms need to be in place to ensure that these principles and guidelines for sound science advice are followed.

| *Guidelines:* | | Performance | | |
|---|---|---|---|---|
| | Wt | NP | RF | RD |
| I. Departments need to institutionalize a follow-up process that includes, once decisions have been made, the provision of written responses to the findings and recommendations that emerged during the advisory process. | 0.3 | 3 | 3 | 3 |
| II. Policy decisions need to be reviewed subsequently to determine whether recent advances in knowledge impact the science and science advice used to inform the decision. The period for review will depend on the state of the science (e.g., the level of uncertainty, rate of change in the scientific knowledge) and a maximum period before review should be identified at the time the decision is taken (e.g., establish a"best before" date). | 0.3 | 8 | 6 | 7 |
| III. When asked to review past decisions, advisors should have access to all relevant information including previous analyses and official responses. | 0.2 | 5 | 5 | 5 |
| IV. Departments should capture best practices that emerge from the advisory process and feed these into their guidelines for use of science advice in the future | 0.2 | 5 | 5 | 5 |
| **Weighted Average** | | **5.3** | **4.7** | **5.0** |

# Part III

## Business Line Tables: an Approach to Science/Policy Linkages at Environment Canada

# Business Line Tables: An Approach to Science/Policy

## Linkages at Environment Canada

## 1. Introduction

The Council of Science and Technology Advisor's Report entitled "Science Advice for Government Effectiveness" (SAGE) published in May 1999 (see Ref. 1) was the basis for the work reported in Part I and Part II of this three part report namely, "Environment Canada's Science Advice Measures: Part I - Inventory and Part II – Analysis (see Ref. 2). These two components list some sixty science advice measures in active use by Environment Canada, and graded the department's performance in terms of *results* against the six SAGE Principles and in terms of *process* against some eighty-four SAGE Guidelines.

Aside from the obvious essential aspects of conducting focused research on environmental issues of consequence to Canada, one of the most important aspects of transforming science into policy is the manner by which the science information is *communicated* from front-line researchers to policy analysts, managers and decision-makers. The studies mentioned above did not undertake an in-depth analysis of this process in Environment Canada, but there was concern about how this was accomplished in the department. In particular, whether it was formalized, who had the mandate to link the science to policy and how well it functioned.

This current report, which constitutes the third part of this study, focuses on a particular linkage mechanism, namely Environment Canada's Business Line Tables and examines their role in the process of transferring science issues:

i. along business lines,
ii. across business lines, and
iii. to other government departments

## 2. Context:

It is essential to set the context for a study of science/policy linkages within Environment Canada, as it is necessary to understand:

i. the decision making *environment*
ii. the *consequences* of decisions on environmental matters, and
iii. the *importance of sound science* and its *communication* to decision makers.

*Decision Making Environment:* - Environment Canada's mandate is extremely broad extending across the complete spectrum of environmental concerns affecting air, water, land, and wildlife with joint responsibility for environmental contaminants that affect

human health. This includes the prevention of pollution as well as the regulation of hazardous substances, daily weather prediction services for public and commercial air traffic, operational advice on hunting quotas for migratory birds and the protection of endangered species. All of these topics are based on sound scientific principles, research, monitoring and analysis conducted by Environment Canada's scientific and technological staff based in several national laboratories, regional laboratories and in field programs and frequent intensive field projects from coast to coast.

Environment Canada has clear jurisdiction over the international aspects of environmental matters affecting Canada and its neighbours. In this regard Environment Canada is responsible for conducting research, advising and often negotiating international conventions/protocols on such topics as the water quality of the Great Lakes, air quality matters between Canada and the USA – acid rain, ground level ozone and particulate matter, protection of the stratospheric ozone layer, international trade in endangered species, protection of migratory birds, and the protection of species at risk – both flora and fauna, as well as negotiations on matters relevant to global climate change.

At the provincial level the responsibilities are shared. The provinces develop and enforce provincial regulations, but rely very heavily on the science provided by Environment Canada's laboratories and scientists as a basis for decision-making. Among the provinces, only Alberta operates an environmental laboratory that is devoted primarily to technology development and analytical measurement. The other provinces contract research and analysis to universities and the private sector and have limited or no in-house scientific capacity. As a consequence, Environment Canada bears a heavy responsibility in undertaking a complete range of environmental research, development and analysis to support the formulation of policy and regulations internationally, nationally and regionally. This does, however, place Environment Canada in a position of considerable strength since it possesses the knowledge base and the national and international scientific networks to back up its policy and regulations in domestic or international disputes.

To deliver its program responsibilities, Environment Canada has a national policy formulation capability located in the National Capital Region but also delivers services and interfaces with provincial environmental departments across the country. Additionally, in recent years there has been an increasing environmental role taken on by *municipal* as well as *aboriginal governing bodies.* The regional delivery capability of the department also interacts with these counterparts and advises them on the federal science and policy view. As a result, both the headquarters and the regional components of the organization must be aware not only of the existing science and policy, but also what the future is expected to bring in the way of scientific findings and requisite policy and regulations.

Hence, it is essential that the two major elements (science/policy) of Environment Canada communicate and interact on a regular basis to keep one another informed of the advances in scientific knowledge and the policy being formulated. This is very much a two way process. While scientific findings frequently give rise to the need to formulate policy, the reverse happens as well. Pulp mill effluent regulations and bulk water exports are two cases in point of policy driving the need for science.

Maintaining this communication and interaction across Environment Canada is complex, time consuming and difficult. The range and scientific complexity of environmental

matters has increased steadily over the past three decades. In addition, the political reality of greater public involvement has added to the task of conducting business on environmental matters. Gone are the days of fighting smokestacks and making regulations in Ottawa. The problems are subtle and unseen (e.g. endocrine disruptors, genetically modified organisms, and the transport of heavy metals) and the public is better informed, organized and politically involved.

*Consequences of Decisions:* - The consequences of improper environmental decisions can be very expensive and/or hazardous to both humans and wildlife. In the 1990's, Canada narrowly escaped proclaiming regulations on pulp mill effluent based on research undertaken in Scandinavia which has since been proven incorrect by a team of federal and university scientists spearheaded by Environment Canada. The cost of capital plant which would have been required in the pulp and paper sector to meet the regulations advocated by the Scandinavian countries was in the range of hundreds of millions to billions of dollars (see Ref. 7). Fortunately this policy issue was addressed and the research accomplished which proved that the toxic component in the effluent was not the organochlorines but rather originated from naturally occurring substances in the trees themselves. This research work was undertaken and accomplished in record time because Environment Canada had the basic scientific capability and expertise and was able to recruit partners in both Fisheries and Oceans and three Canadian universities while providing a focus and leadership for this significant research effort.

Although the cost of regulating CFC's has not been inconsequential – the alternative of destroying the ozone layer and subjecting every living organism on earth to heavier and heavier doses of UVB radiation would have been much more costly, if in fact, not fatal for all biological forms on earth.

The debate about climate change continues, and it is only beginning on genetically modified organisms. These are both environmental issues with immense economic, political and social ramifications, which will impact many generations to come. The cost of errors in the science could be staggering – yet the risk of errors must not paralyze decision-making.

*The Importance of Sound Science:* - While Canadian society will choose collectively what to do in each of these instances, it is paramount that there be a sound base of scientific knowledge for the public and decision makers. This is the thrust of the recent report of the Council of Science and Technology Advisors (CSTA) – namely, "Science Advice for Government Effectiveness" (SAGE). The SAGE report is insistent that the science input of the federal government be of the highest quality, broadly based, inclusive, and reviewed by peers both nationally and internationally.

Aside from the performance and peer review of science, one of the more important factors in the SAGE report was the recommendation that science must be communicated to decision makers in a timely, concise and understandable fashion and that decision makers in turn must make their policy needs known and feed back the rationale for their decisions. In summary, a system where science and policy interact with one another in a regular and ongoing manner.

A formalized system of this sort has not been in place in the past in Environment Canada. Although the problems were simpler, there was limited horizontal communication on science and policy in the early days of the department. As the department matured the communication of science improved but it has tended to travel

along relatively narrow Service channels through the management structure in the department. The conduct of science and the formulation of policy have for some time been conducted by separate Services in the department. While one can dispute whether this was good or bad, it is fair to say that at the very least it constrained the horizontal communication of science within the department.

The science was simpler and more readily understood in the past. Today, it requires highly educated, devoted specialists to comprehend and deal with the problems nationally and internationally. Adding the regional dimension with interactions with provinces, municipalities and aboriginal bands means that it is paramount that Environment Canada communicate across the department fully in an interactive manner on science and policy.

## 3. The Nature of Science/Policy Linkages

***Science/Policy Life Cycle: -*** To address the matter of science/policy linkages it is instructive to review the typical life cycle of an environmental science issue. Figure 1 below illustrates a simple, schematic diagram of the life cycle of an environmental issue from a *science viewpoint.* Not every issue will behave exactly in this fashion, and it is possible for an issue to go through several cycles of this type. For simplicity, the science aspects will be dealt with here, and the *policy and regulatory aspects* will be dealt with in the following section.

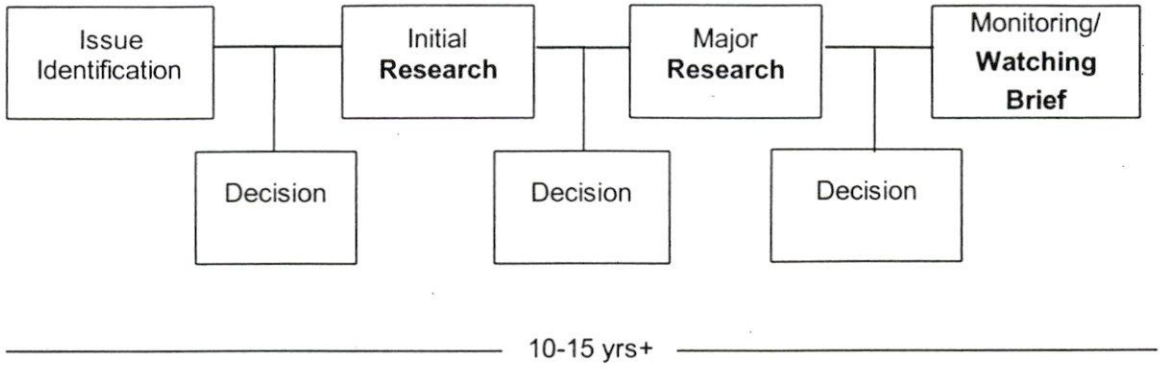


**Figure 1. Schematic of the Life Cycle of an Environmental Issue from a Science Viewpoint**

*Issue Identification:* - This is the first phase of an environment issue from a science viewpoint. It could occur as the result of the analysis of another issue, a newly discovered trend in monitoring data, or perhaps it is the result of a *prediction* from a numerical model based on physics, chemistry or biological principles.

*Initial Research: - Based* on the level of concern about the particular emerging issue, a *decision* is made regarding the undertaking of initial research on the particular topic to determine with a greater degree of confidence whether this issue is truly one of significant environmental concern. This would typically mean one or two scientists working part time with limited technical support for a period ranging from a year or so to

as many as five years. In some instances, the issue is found to be of limited consequence and "put on the shelf". In other instances, the *decision* is made to continue to the next stage.

*Major Research:* - Assuming that the environmental concern is substantial, a review of the scientific status and (possibly) its socio-economic and political consequences is usually undertaken prior to making a *decision* about funding a major research program on the topic. This might be quite simple and obvious, or it may be complex as is the case of global climate change. The research program can be domestic or international in scope depending on the particular problem. It will almost certainly involve a minimum of half a dozen or more Environment Canada scientific staff as well as university and/or provincial government scientific staff plus technical support. Such research is complex and expensive (millions of dollars per annum) and can take upwards of a decade or more to complete. It will usually, however, delineate the problem, its magnitude, extent, impact and how it might be corrected or controlled outright, or in phases, as additional information becomes available. Armed with this more complete picture of the environmental problem and its potential solution, *national policy* can be formulated to address the issue.

*Monitoring/ Watching Brief:* - Although monitoring almost certainly will have been a component of the major research phase, it typically becomes the dominant aspect of this particular part of the "science life cycle". Following the completion of a major research effort a *decision* is typically made to reduce (but not necessarily eliminate) the level of the research, as it is important to analyze the results of the monitoring phase to confirm that the policy/regulations are having the intended effect. From a program viewpoint this phase is often the most difficult to justify and maintain as the problem is perceived as "being solved" and there is a propensity to collapse monitoring networks before they supply sufficient data to indicate that the policy and regulatory actions taken have accomplished what was intended. While this is understandable when resources are scarce, decreasing monitoring programs at this stage in the life cycle often wastes prior significant funding which was used for monitoring. In brief, monitoring at this time is like an investment that does not pay until maturity. Cancellation is not recommended.

*Summary:* - *It* must be emphasized that the "science life cycle" described and illustrated above is typically 10 to 15 years or more in length. As such it can span half or more of an individual scientist's career, the tenure of at least 5 or 6 Deputy Ministers and easily 8-10 Ministers. During this time period, it will typically become an item for decision as a matter of "national policy" at Cabinet only once or twice, and a matter for regulatory action under the Canadian Environmental Protection Act only once unless there are numerous hazardous substances that must be regulated. Hence, the number of occasions where "national policy" on a particular environmental issue is formulated is quite infrequent indeed.

In the context of the linkage between science and policy, however, there are a number of places along the science life cycle where *decisions* must be made that will impact on policy or program priorities as well as on resourcing. As such these are science/policy linkages in the true sense of the term in spite of the fact that the Minister will typically not be involved in the decision making process. They may be made at the department, service, and region or laboratory level --- or at one of the Business Line Tables.

*Policy, Decision Making and Science/Policy Linkages:* - Figure 2 is a schematic diagram of the science policy linkages and policy decisions that accompany the science cycle

described above. The decision or action is indicated and who or what body makes the decision.

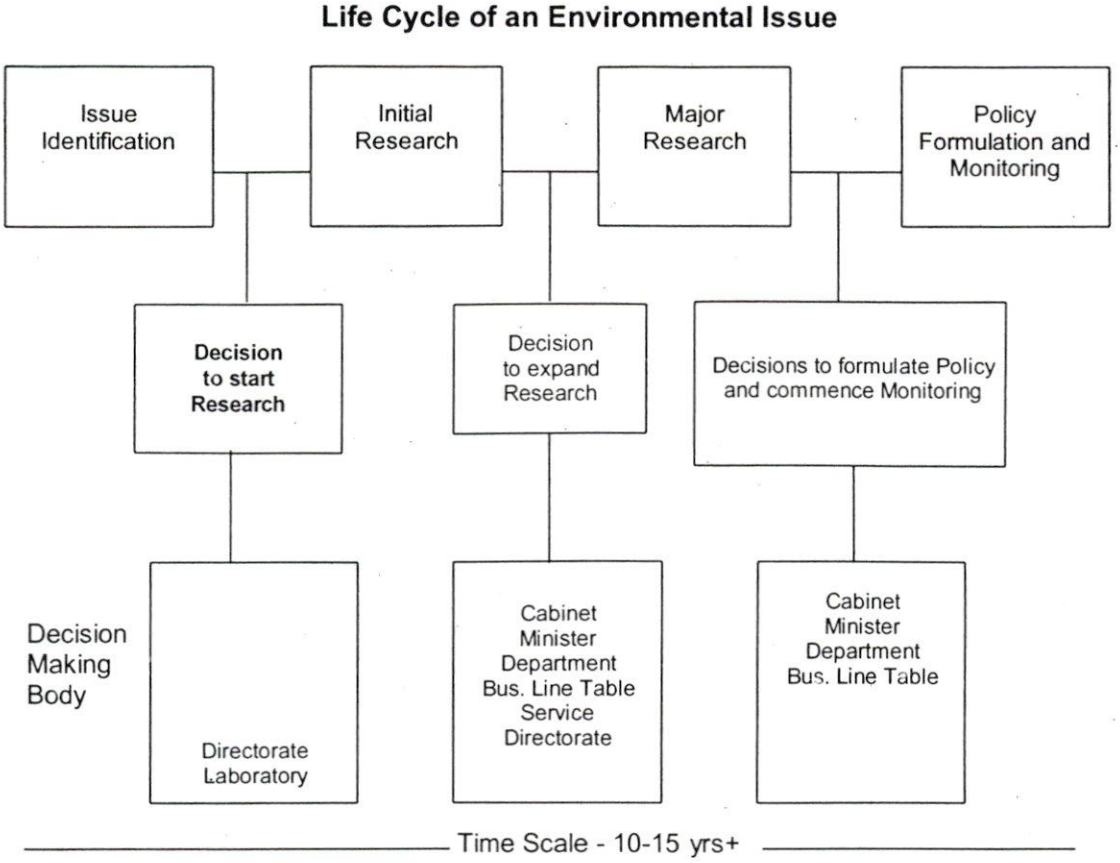


**Figure 2. Schematic of the Life Cycle of an Environmental Issue from a Policy Decision and Science/Policy Linkage Viewpoint**

*Initial Research Decision:* - Following the identification of a particular environmental science issue, a *decision* needs to be made regarding whether it is appropriate to proceed (or not) with an *initial research phase.* This is the first *science/policy linkage,* as the department now knows the issue, at least at the laboratory level. The *decision* to proceed with research, or not, as the case may be, will require a research proposal outlining the research proposed, manpower, capital equipment, support, approximate time anticipated and budget. The *decision* might be made within the laboratory or Directorate or it may be briefed forward to the Service for funding. It is unlikely at this stage that the issue will be briefed forward to the DM or Minister for policy formulation unless it is something that has a potential for major environmental consequences immediately. The DM and Minister's Office are usually informed and kept informed with respect to progress on an on-going basis. This initial research phase is normally required to confirm the initial concern about the environmental consequences. This knowledge becomes input for the next decision-making science/policy linkage.

*Major Research Decision:* - With the knowledge that flows from the initial research phase a *decision* can be made regarding increasing the level of research effort. Although schematically this is shown as one phase, it is often a *series of decisions* with increasing levels of resources involved. The decision on a major environmental matter would typically be made at the departmental level, although laboratory, Directorate and Service committees will inevitably screen it. The level of resourcing is often in excess of what can be funded by an individual Service, so that new funding or a prioritization of departmental funding will be necessary. This will involve the Minister if the item goes forward in a Cabinet Memorandum – in which case all levels in the department will be briefed on the issue and its environmental implications.

*Policy Formulation, Monitoring/Watching Brief:* - The results of the major research program will usually lead to socio-economic studies, consideration of political issues, and the formulation and review of various policy and regulatory stances. This is the phase where the policy aspects are at their peak and the Minister and his/her staff are heavily involved as well as the DM, ADM's and the relevant "Science Advisors". Ad-hoc committees may be formed, involving policy analysts, researchers, and various members of senior management (Directors through to the Deputy Minister) as well as Communications staff, etc. Other departments may be involved at this stage as well. Health Canada, Fisheries and Oceans, and the Canadian Forestry Service are typical partners. The formulation of policy will require a submission to Cabinet as there are usually consequences for industry, and economic and social considerations as well as environmental and health effects. The rationale for the decision is Secret, and consequently the Minister cannot provide feedback to the department.

*Decisions* about monitoring and continuing research at a "watching brief" level are typically ancillary issues for the department at this stage. In the longer term they will inevitably become more important, particularly if they are not funded and the department has insufficient data to prove that the policy and regulations, formulated, have done, or have not done their job for Canada.

## 4. The Business Line Tables

*Background:* Environment Canada's Business Line Tables are relatively new to the department. In their current form they have existed in the department since November 1998, some seventeen months at the time of writing this report. As a consequence, this report will examine a relatively new mechanism that has not yet reached full maturity. Environment Canada's Planning, Reporting and Accountability Structure (PRAS) document (see Ref. 3) outlines that Environment Canada is "involved in three broad lines of business;

i. controlling and preventing pollution in order to secure for Canadians a **Clean Environment**,
ii. conserving Canada's rich legacy of **Nature**,
iii. and providing **Weather and Environmental Predictions** that enable Canadians to adapt to changing weather and related environmental influences and impacts.

Environment Canada's fourth Business Line, **Management, Administration and Policy**, supports the delivery of its three principal business lines."

Business Line Tables have been established for each of the above Business Lines. The *mandate* of each table (see Ref. 4 for example) is to provide a focus for:

i. *priorities, strategies*, and *results* shared across business lines,

ii. *resource issues* that have *impacts across business lines*, and

iii. *business line-based scientific issues* affecting the department.

Each business line table is chaired by the Assistant Deputy Minister (ADM) having major responsibilities for the business line. Membership includes the other ADM's in the department, the Regional Director Generals, Director Generals from the chairperson's Service, and Corporate Advisors from Finance, Communications and Human Resources.

Meetings are typically held three times per year and are less than a day in length. The attendance at a typical meeting varies from table to table but lies in the range from 15 to 40 persons. Teleconferencing is used on occasion. Documentation is required a week in advance and the Corporate Secretary of the relevant Service keeps minutes.

# 5. Methodology

The methodology followed for this report was:

i. to interview a selection of the members of each business line table, using a questionnaire (see Appendix III) to guide the interview.

ii. to obtain relevant documentation such as reports, agenda supporting documents, and meeting minutes that demonstrated the consideration of science advice provided to the business line tables and to document decisions made in these matters.

iii. to follow these decisions forward to determine whether policy was formulated based on the science advice provided to the business line tables and thereby determine whether the mechanism has been successful in providing a channel for science advice to flow from the investigator to the decision maker successfully or otherwise.

iv. to analyze these cases and report on them with the requisite documentation and recommendations.

# 6. Findings

*General:* As the current Business Line Tables in Environment Canada were established some seventeen months ago, it is paramount not to draw final conclusions about the performance of this mechanism prematurely, since the business line tables have extremely important long-term implications for the department.

Most federal government departments are still struggling to come to grips with the consequences of Program Review, and the inevitable resource shifts and balances. Consequently, substantial time and energy has been spent by the Business Line Tables dealing with major shifts in both resourcing and structure that have resulted from Program Review, leaving less time than normal for the full consideration of environmental science issues.

It is clear that the Business Line Tables have dealt with matters that are likely to have *national policy implications* in the future. To date, however, they have transferred relatively little science forward to the Minister's Office for policy formulation and decision. This is not totally unexpected since major national environmental policy items, based on science, occur infrequently (probably less than once per year). Additionally, no single issue is currently at the point in its life cycle to be considered for policy formulation. The issues are either early in their life cycle, or reappearing for a second time around. As outlined in Section 3, however, there are multiple decisions which impact the conduct of research as it is being planned and performed before the requisite knowledge is available to support the formulation of policy and regulations. Many of these decisions are now being made in an integrated fashion at the Business Line Tables with both Regional and multiple Service input. Previously, such decisions were made primarily within individual Services.

The Clean Environment Table may well become a very important element in transferring science into the policy arena though it will not necessarily formulate national policy on its own. Communicating and marketing an environmental issue to senior management is an important step in moving the issue forward and convincing the department as a whole that it should be made a priority for further research and policy formulation. The makeup of the Business Line Tables is sufficiently broad that a sizeable fraction of the department's senior management sits on all of the Business Lines Tables. Consequently, the Business Line Tables are a critical link in transferring the science to decision makers as well as feeding back to the research community the science requirements for policy purposes.

***Clean Environment Table:*** -This Table primarily serves the needs of the Environmental Protection Service (EPS), which is a consumer of science for policy and regulatory matters. The findings of this study are that a number of "science issues" have been brought forward over the past 17 months for consideration and/or funding. These include:

i. Endocrine Disruptors

ii. Acid Rain

iii. Air Quality Forecasting

iv. Ozone Annex to the Can/USA Air Quality Agreement, and

v. Canada Wide Standards for Ozone and Particulate matter.

vi. Pulp/Paper Environmental Effects Monitoring

In terms of the life cycle concept put forward in the previous section, the issues mentioned above can be categorized as follows:

*Endocrine Disrupters* – studies of these substances, both naturally occurring and man-made are still generally in the early phase of their life cycle. More research is required on their sources, impacts and ultimate fate in the environment before a policy and/or regulations can be formulated based on sound science for such substances. Nonetheless the current knowledge can be utilized to inform industry and government of the potential problems that might occur as well as suggestions on how one might proceed to mitigate any effects.

*Acid Rain* – this is not a new topic as acid rain has been a public issue since the early 1980's and acidic emissions have been regulated (to the 50% level domestically). These were the main topic of negotiation between Canada and the USA during the Canada/USA Air Quality Agreement. Much of the original concern about acidic emissions and acid rain was due to the impact on aquatic species in Cambrian shield lakes.

More recent research indicates that both agricultural crops and forests are more sensitive to acid rain than was originally thought to be the case. This will require further research and a refurbished monitoring network to delineate the effects and the extent of the areas affected. Thus the problem is new, but it originates from an old issue. The Business Line Tables have reallocated money from a variety of sources to resource this recurring priority. This is a major achievement in Environment Canada and a powerful illustration that the Business Line Tables can work across the department not only to agree on priorities but to reallocate funding across the department to tackle the required science. On this front, policy formulation and regulation awaits the outcome more definitive research and monitoring. In the meantime the Business Line Tables have contributed toward an early resolution of this issue.

*Air Quality Forecasting* – current numerical weather prediction models used for weather forecasting on a twice daily basis provide wind forecasts and air trajectories which, when combined with air pollution sources and strengths can be utilized to forecast air quality on a regional basis 24-48 hours in advance for human health purposes. Clearly, this issue has advanced beyond the environmental science life cycle to the point that technology and operations are involved. This technology has been tested and is now operational in New Brunswick. The policy decision remains as to whether to extend this capability to other parts of Canada as a regular service to Canadians. Presently, this is primarily a question of resource availability.

It is interesting to note that this complex service to Canadians did not come about as a result of focused concerns on this topic, but rather was the result of combining two existing capabilities from within Environment Canada. The weather component was available from the MSC and the pollution data from EPS. To tackle such a problem without these two existing capabilities would have been prohibitively expensive. Nonetheless, the availability of the scientific/technological capability in Environment Canada has made it possible, at relatively small cost.

*Ozone Annex to the Canada/USA Air Quality Agreement* – Canada has had an Air Quality Agreement with the United States since 1991. This proposed annex represents an update to the agreement that will extend it beyond the topic of acidic air pollutants to include ozone and its precursors in the lower atmosphere. In terms of life cycle, research on agricultural and human health effects is at the stage where regulations on low level ozone and its precursors are fully warranted both domestically and internationally. As such, this is a mature science topic that is ready for policy-making and decision. In policy-making terms, this topic is at the stage where negotiating teams have met on several occasions and public consultations will be held in the near future.

There is an interesting interaction with the following topic. From a science viewpoint, there is growing evidence that sub-micron particulate matter should also be considered along with ozone precursors in air quality standards across the US/Canada border as it has already been considered on a Canada-wide basis. The outcome of this, however, is

expected to be governed by the status of research and policy review in the United States.

*Canada Wide Standards for Ozone and Particulate Matter* – Both the federal and provincial governments have had air quality standards individually for some time. Research on particulate matter in the past five years or so has brought to the fore considerable concern about sub-micron particulate matter as a health matter in elder persons and infants in particular. In terms of the concept of life cycle, not all the science is complete, but there is sufficient evidence to warrant action now. The Canadian Committee of Ministers of the Environment (CCME) has met and agreed on standards that will take effect across Canada in 2010. This is a topic where ongoing research results will bring this issue back to the Business Line Tables and to Ministers for further consideration as knowledge increases.

*Pulp and Paper Environmental Effects Monitoring* – Environmental effects Monitoring (EEM) is a technique that uses environmental monitoring downstream from the pollution source as feedback to determine and maintain pollution control levels. In the case of Pulp and Paper EEM, fish and fish habitats are monitored downstream from pulp mills to determine whether they are affected by the pulp mill effluent or not. This technique is currently at the stage in its life cycle where regulations are now being modified based on EEM field observations. This is an example of technology-forced regulations with a relatively short feedback time.

Various views were put forward during the interviews with members of the Clean Environment Business Table. Although it is clear that this Business Table has not transferred any specific science issues forward to the Minister for policy formulation in the past 17 months, it has been quite active in moving the science forward, increasing the information flow to policy staff, and keeping the Minister's Office informed of selected environmental science issues as progress is made towards the full knowledge required as a basis for policy. In time, this table is expected to become more strategic, reviewing the status of the science and triggering policy analyses when the issue warrants such action.

While this meets the needs of EPS and its policy staff, it has been and will probably continue to be frustrating to the science community that has typically been concentrating on a specific scientific topic for a number of years and is eager to see increased resources to accelerate the research or to commence the formulation of policy. This is not an unusual circumstance. It has prevailed in Environment Canada for over two decades and is not likely to change. It is essential that both the scientists and policy analysts become better acquainted with the realities of the other's tasks and time scales. The very existence of this Business Line Table is a significant improvement over past mechanisms because it informs both sides (policy and science) well in advance and will provide continuity on important environmental science issues through their multi-year life cycle.

In the past, EPS has funded relatively small amounts of science because the science Services (MSC and ECS) had their own budgets to fund research directly. With resources being generally scarcer, the science community will inevitably view the Clean Environment Table as a funding source, even though it has relatively little funding to allocate for research and monitoring purposes. This will probably add frustration to the science community in that the policy side of the department will be viewed as slowing down the science and having control of the resources for research.

This implies continuing education of both sides so that each can understand and appreciate the constraints and problems faced by the other partner. In spite of the frustrations, it is far preferable to not having a forum where the major components of the department can discuss these issues openly. This fact has been recognized by the senior research managers in the department and in time will be appreciated by the rest of the scientific community.

Without question, the policy staff in EPS is now far better informed about the science issues today than at any time in the past. This is a very positive benefit to the department. It should be fostered aggressively, even if it means undertaking one-day science for a on important issues that may not be attended by all members of the Business Line Table. Although it would increase the "briefing load" on the science community, it is a prime responsibility of all government scientific staff to communicate their research to non-experts in an interesting and comprehensible manner. Otherwise their research efforts and the necessary public expenditures are wasted.

*Proponents* - In each instance science issues brought to the table were represented by a working scientist and/or a research manager fully familiar with the science topic. Aside from being in concert with the SAGE principles, this permits, an informed, intelligent and interactive discussion on the topic rather than a "canned" performance without feedback.

*Decisions* - It appears that decisions were made by the table in each instance, although the players around the table met these decisions more or less favourably. The fact that there were working scientists present means that the outcome will be relayed back to the scientific community for future reference. Thus, the scientific community has not only participated in the decision making process, it has learned what influenced the decision and will be better prepared to tailor its presentations for optimum use by the Business Line Tables.

*Nature Table:*- This business line table has spent a significant portion of its time over the past 17 months laying down a sound strategic base for its various components and integrating these into a Nature Business Plan and a Nature Research Agenda.

The Nature Business Line Plan sets the stage for this substantial task by delineating the Biodiversity Challenge, the mandates for the various components of Environment Canada which contribute, as well as the various items which influence the direction of the Nature Business Line Table such as Environment Canada's Sustainable Development Strategy, The Biodiversity Convention, Canada's Biodiversity Strategy and the Nature Research Agenda itself. It outlines three results, namely:

i. Biological Diversity is conserved,

ii. Human impacts on the health of ecosystems are understood and reduced, and

iii. Priority Ecosystems are conserved and restored.

There are, of course, detailed sub-results that are not included here along with accountabilities and strategies for achieving these results.

The Nature Research Agenda 1999-2004 addresses strategic research issues over the next five years, responds to the federal S&T strategy and the Fall 1999 Speech from the Throne and lays down concise and integrated contributions for the Nature Business Line. The Nature Research Agenda is based on three themes:

i. What is changing?

ii. How is it changing? and

iii. What is needed to conserve, protect and rehabilitate ecosystems, wildlife and biodiversity?

The more detailed components of the Nature Business Line Plan and Nature Research Agenda that have also been undertaken under the auspices of the Nature Business Line Table are the *Canadian Wildlife Service Strategic Plan*, and the *Ecosystem Health Result Strategic Plan*. Discussions and consultations are currently underway toward the drafting of an *Ecosystems Initiatives Strategy* that would deal with the Ecosystems Initiatives Programs currently operated by EC's regions.

This overall task has been difficult as it involves staff and research programs from very different disciplines as well as regionally managed programs. It has obviously been a very substantial exercise in matrix management as staff from the Canadian Wildlife Service, the National Water Research Institute and regional program staff have had to agree on priorities, work out strategies and integrate anticipated results to meet the business line requirements. Nonetheless, this is a basic requirement of the department's strategy and is in concert with the federal S&T strategy.

While the Nature Table dealt with these strategic matters, ECS also provided support to the Minister in the development and announcement of the Species at Risk Act (SARA), which addresses what Canada proposes to do about endangered species by means of legislation. Herein lies an example of the formulation of national policy within the organization, which, for reasons having to do with timeliness, was not brought forward through the Business Line Table System.

The Nature Table has also dealt with the science aspects of bulk *water removal* as a priority for the Minister, and is preparing to review the scientific responsibilities of the department on the topic of *Genetically Modified Organisms.*

Unlike the Clean Environment table, scientists have not given science briefings to the Nature Table, primarily due to the nature of the business being conducted. Rather, these briefings have been given to the sub-structure committees that support the Nature Table. This is a matter which should be reviewed in the future in order to keep the members of the Nature Table fully informed about the progress on various scientific issues of consequence to the department on Nature Topics.

As is the case with the WEP table, the Nature Table is a science-based business line and will typically bring scientific topics and issues forward to the Clean Environment Table for discussion and review. Conversely, there will be policy questions asked of the Nature Table that will require scientific review and on occasion research. Genetically Modified Organisms, e coli in water supplies, and a scientific base for a federal water strategy are but a few examples.

In summary, the Nature Table has been doing its homework to ensure that the *strategic direction* and *focus* are clear and that the *expected results* are understood clearly by the business table management team. This has been an arduous task but essential in view of the breadth of the components of the organization involved.

*Weather and Environment Prediction Table:* - This particular table differs quite substantially from the two previous tables in that policy discussions at this table are primarily operational issues internal to the Meteorological Service of Canada and impinge on the service provided to the Canadian public. As such they are not national

environmental policy issues in the same sense as issues that are discussed at the Clean Environment and Nature Tables. For similar reasons, this table is smaller than the previously discussed tables.

Having said this, there are important atmospheric environment issues that have been researched by the MSC and forwarded to both the Clean Environment and Nature Tables (namely, Acid Rain, Clean Air/Human Health, and Climate Change Impacts on Endangered Species).

Additionally, there are aspects dealing with water that have implications for the whole department and should be brought forward at this table from the Nature and Clean Environment Tables. The WEP table is not solely an atmospheric issue table and should not function as such. There are also important environmental prediction issues that deal with water and terrestrial factors that need to be reviewed at the WEP Business Line Table.

The fact that the Nature and Weather/Environmental Prediction Tables have made relatively few policy decisions relating to science is to be expected. On the whole, the Clean Environment Table and its primary customer (EPS) is where the science will be heard and decisions on resourcing and policy made. The scientific source is, and will remain, the other two tables – i.e. the Nature Table and the Weather/Environmental Prediction Table.

*Management, Administration and Policy Table:* - The MAP Business Line Table's *role,* as excerpted from the MAP Table Terms of Reference, is as follows:

"The MAP Business Line is concerned primarily with supporting EC's capacity to exercise leadership on the environment and sustainable development. Its focus is on medium and long-term direction setting and in ensuring EC has the necessary capacity, tools and systems in place, all essential components of a well-performing organization. The MAP Table can perhaps best be visualized as working horizontally across the program-related Business Lines to help the managers within these business lines be most effective in achieving their results. It is also concerned with EC's ability to bring together the right partners to ensure EC's objectives are strongly supported and acted upon by others.

MAP has three important functions in relation to the other EC business lines. First, it has a strategic role in examining and understanding the implications of "bigger picture," external realities and trends, and factoring them into EC's strategic directions. For instance, the impact of the changing ways in which Canadians will seek and receive information on EC's modus operandi in future years will need to be factored into EC's approaches to consultations and to partnerships. This in turn, has an impact on EC's recruitment priorities and skills development priorities. Second, MAP is responsible for making EC's agenda a coherent, understandable and achievable one. This means integrating the priorities of the Clean Environment, Nature and Weather and Environmental Prediction business lines into a coherent plan and ensuring necessary actions are taken in an integrated, mutually supportive manner. In the spirit of the third function, stewardship, the MAP Table plays a leadership role by ensuring that the capacity, frameworks, principles and other tools to guide good management decision making across the department are in place.

Management should be considered a broad term throughout this document and includes all the normal considerations of the term (planning, directing, etc.), but also within the strategic context of EC, effective partnerships and communication.

It is the role of the Table to assess broadly the management, administration and policy capacity and challenges of the department and make recommendations to EMB as to how the department can be more effective. The Table is concerned in the broadest sense about: the capacity, well-being and security of the department's employees; stewardship of the financial resources of the department; the capacity to use information and technology effectively; the ability of managers to integrate performance information with financial information for making informed choices and trade-offs; the coherency of the department's policy and international agenda and partnerships, including aboriginal relations and other direction established by central agencies; and the effectiveness of the department's communications and public outreach.

The MAP Table has a particular role to enhance the departmental capacity for sustainable development that needs to be highlighted in this time period as the federal government enhances its overall capacity for sustainable development through departmental sustainable development strategies. Other Business Line Tables are responsible for setting and achieving particular sustainable development objectives, as the MAP Table is for greening EC's operations. However, beyond this, MAP has a role in ensuring that overall the department becomes a more effective advocate for sustainable development.

The Table does not direct the day-to-day operations of the functions within its domain but rather ensures there is a clear and strategic context and cohesiveness to these functions. In this regard, the Table's objective is to ensure that these functions can maximize their impact on the management of the department overall.

The MAP Table is not the only mechanism the department has for this broad agenda. EMB remains the key forum for strategic departmental direction setting and policy making; and it is assisted by other senior policy making fora as required. Other bodies exist to add effective management, perhaps most notably the Science and Technology departmental management structure. Given the overlap in membership amongst these committees, it is not anticipated that there will be duplication of work. Perhaps the major value-added of the MAP Table can be described as its ability to look most broadly at the management of the department and assess in perhaps an "early warning" sense and consensus around the need to take action to build departmental capacity. The actual specifics of actions required, implementation, etc. may be carried out by other fora. Section VIII identifies the key structures for the MAP Table."

It is clear that while the MAP Business Line Table includes "policy" in its title, it is to be interpreted in the broad sense of policy for the department and not the specific task of formulating policy based on science input. In fact, the MAP Table very specifically transferred the Climate Change policy role to the Clean Environment Table in spite of the fact that this is a topic that is extremely broad in its impact on departments, industries and citizens. The MAP Table exists to ensure that these tasks are done effectively and efficiently in an integrated fashion. As a consequence, the MAP table will not be considered in greater depth in this study, as it is not involved directly in the ongoing transformation of science into policy.

*Impact on Policy Themes:* - The report completed on "ENVIRONMENT CANADA'S SCIENCE ADVICE MEASURES"

(See Part. II of this report.) classified the decision making processes in Environment Canada into three themes:

| | |
|---|---|
| i. National Policy Formulation | - typically involving major issues, the Minister and Cabinet decisions |
| ii. Regulatory Formulation | - involving EPS under CEPA in the formulation of regulations for the approval of the Ministers of Environment and Health |
| iii. Regional/Operational | - involving decisions by senior management Decision Making in the Regions and the CWS that require science input |

*National Policy Formulation:* - The direct impact of the Business Line Table's efforts on national policy formulation in its first 17 months of implementation appears to be limited. Nonetheless, decisions such as the Clean Environment Table's decision to reinstate the funding of acid rain science and monitoring will inevitably lead to knowledge which will be used for decision making and new policy formulation on acidic emissions in Canada and the United States. This will likely occur in 5 years time or more – so the linkage between the original decision and the impact on the policy will be lost unless deliberate efforts are made to track this decision and its impact. The same can be said of items that are now being considered for policy - such as Species At Risk and Bulk Water Exports. Both issues rely heavily on monitoring data and research, which was funded many years ago by the department either as a basic operational requirement or for a special purpose – such as studies of individual bird species whose population was decreasing. In this sense, the science/policy linkages can become rather tenuous because of the length of time that it takes to get to the policy formulation stage.

The existence of the Business Line Tables will make documenting and tracking these linkages much more obvious and visible. The decisions made at a departmental business table are also much more open and more likely to have broad departmental management support than singular decisions made within an individual Service. The priorities of the department as a whole should become more clearly understood and the complexities of the science should become better appreciated with time. In the future, establishing priorities within the Business Line Tables should also become a less difficult task because of this two way understanding.

The inevitable conclusion that one must come to is that in spite of its teething problems, the Business Line Table System has distinct advantages for national policy formulation over the long term when compared to the method of making decisions in the past.

*Regulatory Formulation*: This area of policy making is typically less lengthy than the national policy formulation route in terms of the science/policy linkage because the basic policy is already in an Act (CEPA) and much of the science is available "off the shelf" or in completed form within the department.

Previously in Environment Canada there were few if any formal linkages between the regulatory formulation Service (EPS) and the two Science Services (ECS and AES – now MSC). The transfer of science knowledge across these Service boundaries was accomplished largely by individuals on a rather informal basis, and often through different channels on different topics. The system did work, but it was not consistent and there was little "over the horizon" information transferred in a consistent manner.

This appears to have changed quite drastically, with the policy community in EPS receiving science briefings on a range of science issues from the emerging phase through to re-examinations of old issues that are once more demanding attention as the result of new scientific findings. This is a vast improvement over the circumstances of the previous two decades in spite of the transactional costs. It is obvious that EPS staff feel far better briefed on the current science in the department and have a better view of "what is coming down the pipe". Additionally, this provides feedback to the science community as to what the requirements of the policy community are and when it is appropriate to take science briefings forward.

This "knowledge transfer" function of the Clean Environment Business Line Table also impacts on the "national policy formulation" area since many of the players perform both functions. The fact that policy analysts in EPS are better informed has implications both for regulatory formulation and national policy formulation. The time scale on the national policy front is just a bit longer.

*Regional/Operational Decision Making:* - Regional/Operational decisions are more frequently policy oriented because of the interface with provincial, municipal and aboriginal governments each with increased interests in environmental issues. It is difficult, if not impossible, for senior regional managers in the department to interface successfully with their counterparts and input intelligently on environmental policy issues without knowing Environment Canada's policy stance and the science on which the policy is based. The knowledge exists in the department and it is essential that it be transferred to regional managers for this purpose.

The view from the regions is equally valuable as an acid test of the policy that the federal government may be working on at any one time. Centrally determined policy needs to be sensitive to the needs and the views of the country as a whole. This is rarely derived from meetings amongst Ottawa -based policy staff.

With time, it is predicted that the planning, implementation and analysis of regional scientific programs will increasingly come under the scrutiny of the Business Line Tables. This is likely to result in a more rigorous treatment of the science, suggestions for alternative approaches, etc. all of which will assist in improving the quality and credibility of regional science programs.

In summary, in spite of the costs in terms of time and travel, the Business Line Tables have made the tasks of regional senior managers easier in that they are exposed to the science, and the policy rationale of important environmental issues in the department. In fact, one RDG interviewed allowed that his job would be impossible to perform without the Business Line Table structure and the information transfer that takes place as a result of this structure.

*Intra-departmental Linkages:* - as an intra-departmental science policy link the business line tables appear to be quite effective. Both the Nature table and the Weather and Environmental Prediction tables have made science presentations to the Clean Environment Table. When this topic was probed a bit deeper --- it was found that the table as a whole did not make the decision to take the topic forward but rather it was the chairperson of each table who took the topic to the Clean Environment table. This is a subtle difference indeed but it points out that the chair is frequently the decision maker in such matters. For SAGE reporting purposes it is essential that these decisions be documented and tracked.

Over the rather short lifetime of the tables there have been quite a number of such presentations, which is indicative of a healthy and functional mechanism. In fact, such intra-departmental science policy linkages appear to have been a significant feature of the Clean Environment Table. It should be noted that wildlife and nature policy topics related to flora and fauna have been processed within the CWS – which has been the case in the department for some time. There appears to be room here for the CWS to explain its science and policy rationale to a broader audience, at the very least the Nature Table itself. Whether it is necessary to go beyond the Nature table may well be questionable, but there certainly appear to be relevant aspects that should be open to discussion at the Nature Table itself.

*Inter-departmental Linkages:* - A number of issues which have been addressed at Business Line Tables have also come under consideration at interdepartmental committees and particularly at the 5NRD MOU Committee. They include, Climate Change, UVB Radiation, Acid Rain, Heavy Metals in the Environment, Pulp Mill Effluent and Endocrine Disruptors. Questioning members of the Business Line Tables has revealed that while these issues have become topics at interdepartmental committees, the Business Line Tables themselves did not refer them there as a result of conscious decisions.

This is not a matter of major concern, as the issues are being exposed and discussed interdepartmentally in a timely fashion. Nonetheless, in the context of the SAGE Report, the department should be tracking these issues and formally referring them from the Business Line Tables to other departments by way of the department's senior management committee and the DM's Office.

*Success or Failure:* - The eleven members of the three Business Line Tables who were interviewed all considered that the tables were neither a full success nor a failure but rather fell somewhere in between. The individuals with the longest experience at senior levels in the department were quick to add, however, that the tables are a major improvement over past mechanisms in the department.

This generally positive view of the Business Line Tables was held by RDG's and by members of the Clean Environment Table. Both groups felt far better informed about the science and research directions in the department than ever before in the department's history. Several were convinced that without this increased level of knowledge they would be incapable of performing their own responsibilities thereby underscoring the importance of the science/policy linkage mechanism provided by the Business Line Tables.

There was considerable concern voiced about the "transactional costs" of the Business Line Tables. It was stated, however, that in spite of this cost, the Tables were still a far more effective and efficient means of providing a science/policy linkage than previous structures in the department. It was also pointed out that other science departments were following Environment Canada's path with similar committee structures.

Several senior members put forth the view that the tables should schedule more "science briefings" either separately or in common with one another and/or with Environment Management Board. This was not a universally held view as there was some concern that longer meetings might well lead to decreased attendance by the senior members of the tables. This is an important and difficult issue that requires careful and balanced consideration.

The junior and less experienced science members of the tables exhibited great frustration with the painfully slow progress of the Business Line Tables and felt that the science was being neglected. This is a perfectly normal reaction. This was not, however, the view of the more experienced science members who are aware that "Rome was not built in a day". It is clear that some education is necessary to guide the expectations of the junior table members.

A sign of the maturing of the Business Line Tables as a matrix management mechanism is the fact that following a science briefing on the status of Acid Rain Monitoring and Research, the Business Line Tables have reallocated some $2.5M across Services and Regions to address this priority. One individual interviewed commented that this normally could only have been accomplished by the Deputy Minister reallocating the monies from various components of the organization.

In summary, it is concluded that the Business Line Tables are an essential element in the department's role of interpreting "science for policy" and "policy for science" in spite of the current teething problems and transactional costs. As such this mechanism should be encouraged and developed further.

*Other Policy Routes:* - the Business Line Tables are by no means an exclusive mechanism for transferring science into the policy arena. Most of the major policy issues are brought to the Minister's attention by the Deputy Minister and ADM's. This is the responsibility of senior officials and has been the department's "modus operandi" for many years. Additionally, the Business Line Tables meet on a quarterly basis at best, and do not necessarily provide a mechanism for the review and transfer of science to policy makers that meets with the Minister's schedule. This does not mean that the Business Line Tables have not played a role in sensitizing ADM's and Regional D/G's to the issue, its importance or the need to formulate policy, but rather that the Business Line Tables were just not directly involved in the process at the senior level.

There are obviously other routes through the department that transfer science into the policy arena. Many of these are informal and between individual scientists and managers within Services and across Service boundaries. Communications of this sort are both normal and healthy. But in the context of the SAGE Report, it is essential that these transfers ultimately become open, transparent and inclusive to ensure that all aspects of the science and policy are fully considered. This is the role that the Business Line Tables can perform in a formal and documentable fashion. There is evidence that the Business Line Tables are becoming a focal point for the discussion of science/policy issues and that senior management are generally better informed about scientific progress as a result of the science briefings at the Business Line Table meetings. The next step should be to ensure that the communications on science-based issues are documented and that it is clear that the Business Line Tables were responsible for this linkage.

*Improvements:* - There are a number of ways in which the Business Line Tables can improve their performance and function more effectively as the major science/policy linkage in the department.

i. Mandate - it must be very clear in the mandate statement for the Table that the science/policy linkage task is a specific and important role for each Table. This is essential to meet the SAGE Principles and Guidelines

ii. Documents - documentation must be available well prior to the meeting in order to permit informed discussion and decisions to be made at the meeting. The chair should refuse all write-in agenda items except items of the highest urgency.

iii. Tracking - science/policy items should be tracked and recorded in order to demonstrate that these items were addressed by the Tables and decisions made or transferred forward for decision purposes. Also items transferred to another Table or recommended for the consideration of another department should be recorded and tracked. This information is essential for SAGE Reporting purposes.

iv. Science Briefings - should be scheduled regularly on topics of concern both for policy and program decision-making as well as for information purposes. Every attempt should be made to include as broad an audience as possible, including Environment Management Board where appropriate.

v. Strategy Sessions - consideration should be given to undertaking strategic sessions of the Tables where resources are not discussed. This is best done in a retreat setting where the members of the Table can be immersed in one topic for a day or more and think about all the ramifications of a given strategy on a science topic or other issue.

# 7. Summary, Conclusion and Recommendations

Environment Canada has moved into a new phase of doing business, albeit one, which is somewhat cumbersome and time consuming. The involvement of a wide range of players, both headquarters and regional, in the decision making process is a bold step in integrating the actions of the department. This step into the realm of matrix management is not however, without its downside in view of the number of staff involved and, in particular, the number of senior managers.

In spite of the downside to such a process, it is clear that it is already showing positive results in that policy staff in the department are better informed about the science issues both current and developing. This is a substantial improvement over the past where the science was moved forward primarily along line management channels, leaving many of the policy staff poorly informed about the science. The converse is also true. The scientific community is getting a better look at the problems of the policy community. This educational process will hopefully make for better communications in both directions; *more focused science and better informed policy.*

Another important aspect about the role of the Business Line Tables is its ability to keep RDG's informed about the evolving science and its implications for current and future policy. In the RDG's interface role with interested provincial, municipal and aboriginal environmental officials it is paramount that they be aware not only of current science and policy but also of future science and policy possibilities. Without this, the federal role in regional environmental matters will fade rapidly. It is also a means of transferring the results of federal science to provinces, municipalities and aboriginal bands.

The department should continue to foster the development of the Business Line Tables where scientists brief the members and where the impacts and future consequences of the science are discussed. As such briefings require significant time it is appropriate to schedule them in conjunction with Environment Management Board, where possible, to include all members of senior management, and in particular, the Deputy Minister.

With respect to the strategic aspects of science related topics in the department, it is essential that the Business Lines Tables specifically reserve time to review and discuss such matters at least once annually and more frequently if possible. Topics might include, the relative priorities of the various research programs and flowing from these the future requirements in terms of specialized manpower and facilities. As an example, how will the department face the question of genetically modified organisms (GMO's) released into the environment? Is it expected to be a priority? Where does it rank with respect to Climate Change and Endocrine Disruptors? Does the department have the staff to conduct the relevant research? If not, where will it obtain such talent? What are the time lines?

It is important that such discussions be conducted away from and without consideration of resources. These are strategic issues that may well impact on the viability of Canadian agriculture, the fishing industry, forestry etc and should be conducted, at least initially, in a collegial cross-departmental fashion without artificial resource constraints dictating the breadth of the discussion. Resources can be dealt with later – it is essential to have the department discuss the strategy first.

The Business Line Tables are the appropriate level for the discussion of such important and far reaching topics. Managers at the Director and D/G level, in particular, are most often career specialists with a scientific base and a decade or more of experience with the department and five to ten years more to serve prior to retirement. They are familiar with the department's history, with its issues and identify strongly with its future and objectives. As such these are the individuals who can formulate a rational and realistic strategy for the department based on sound science.

The formulation of such a strategy requires a collegial approach that is essential in a matrix management organization. Environment Canada has embarked on this path and shows signs of achieving the kind of results that can only be achieved when managers agree on the departmental priorities and are prepared to move their resources to address the priority issue.

This report must make it abundantly clear that the Business Line Tables are not the only mechanism that the department uses to transfer science to policy makers. It is one mechanism along the way that can inform an important and influential part of the department. Nonetheless, ADM's and the Deputy Minister have been and will continue to be the major route for the transfer of science into the national environmental policy arena. The role of the business line tables must be, in large part, to ensure that the science is done in an efficient and timely manner and that the policy makers are informed regularly of the status of the science and policy analysis. Part of the rationale for this is that the time frame of the staff at the business line tables is comparable to the lifetime of the environmental issues, whereas this is definitely not the case for ADM's, the D/M and Ministers. The Business Line Tables and their supporting structures provide the support for the science and policy analysis over a long time frame thereby ensuring continuity and corporate consistency. The ADM's, DM and Minister, on the other hand function on a shorter time scale and are responsible for completing the policy formulation

task and getting it through Cabinet and Parliament where necessary. In this sense, it is clear that each component of the team has its role and is important in its own right. The Business Line Tables are not in competition with the D/M and Minister but rather they constitute a formalized way of supporting the formulation of policy based on strong science.

*Recommendations:* - The mitigating factor in this study has been that the Business Line Tables have only met on approximately five occasions, and have not yet reached a stage of maturity to fully assess their value and success. Major national level policy issues are not that frequent in the environmental field. They usually commence with a number of years of exploratory research with confirmatory research following the first round of policy analysis. While each issue is different there is a cycle that most issues go through. There is evidence of this occurring in each of the Business Line Tables, the most obvious being the Clean Environment Table, because this is the major policy arena in Environment Canada. The Nature Table and the Weather and Environment Prediction Tables are the substantive "science" tables that feed the Clean Environment Table.

**Recommendation 1:**

Environment Canada should continue to foster, and develop the Business Line Tables as fora where science issues can be brought forward and discussed, particularly in the context of pursuing future policy/regulatory action and conversely what the science requirements are for policy/regulatory purposes.

**Recommendation 2:**

The Business Line Tables should ensure that there is a science sub-committee with the mandate of bringing forward environmental science issues to the individual Business Line Tables, and that the Tables schedule regular science briefings to the Tables and, where possible and appropriate, in conjunction with Environment Management Board. These science briefings should be conducted by scientists accompanied by the relevant research manager (Director or D/G).

**Recommendation 3:**

The Business Line Tables should budget time to review and make decisions on strategic science issues. These should be considered, at retreat meetings separate to table meetings where resource allocations are under discussion.

**Recommendation 4:**

Business Line Tables should have clearly stated mandates with respect to science/policy linkages in concert with the CSTA SAGE Report. These linkages should be recorded and tracked.

**Recommendation 5:**

Every attempt should be made to supply background papers well in advance of meetings. No exceptions should be made. A smooth functioning secretariat function will make optimum use of each Table member's time and reduce frustration.

# Appendix I: References


1. SCIENCE ADVICE FOR GOVERNMENT EFFECTIVENESS (SAGE) . A Report of the Council of Science and Technology Advisors. May 5, 1999. 11 pages
2. ENVIRONMENT CANADA'S SCIENCE ADVICE MEASURES: Part I – Inventory and Part II - Analysis. A report completed by Wintergreen Consulting. March 2000. 97 pages
3. PLANNING, REPORTING AND ACCOUNTABILITY STRUCTURE. Environment Canada. Draft document, March 14, 2000. 22 pages
4. WEATHER AND ENVIRONMENTAL PREDICTION BUSINESS LINE TABLE TERMS OF REFERENCE. Environment Canada. 1998 2 pages
5. THE CLEAN ENVIRONMENT TABLE PROPOSED MANAGEMENT FRAMEWORK. Environment Canada. 1998 14 pages
6. DRAFT: CLEAN ENVIRONMENT BUSINESS PLAN. Environment Canada. December 1, 1998.
7. MEASURING THE IMPACT OF ENVIRONMENT CANADA'S R&D. CASE STUDY: PULP & PAPER EFFLUENT RESEARCH. Final Report prepared by Marbek Resource Consulting/ Secor Inc. September 1997 143 pages

# Appendix II: List of individuals interviewed

| Name | Date |
|---|---|
| 1. McMillan, Ann | Tue 21 Mar 00 |
| 2. Beland, Michel | Wed 22 Mar 00 |
| 3. Shantora, Vic | Wed 22 Mar 00 |
| 4. Wright, Cynthia | Mon 27 Mar 00 |
| 5. Bangay, Garth | Tue 28 Mar 00 |
| 6. Moore, Jennifer (with Sharon Lee Smith and Nancy Cavill) | Fri 31 Mar 00 |
| 7. Bruce, Catherine and Bondy, Dan | Fri 31 Mar 00 |
| 8. Martell, Art | Tue 04 Apr 00 |
| 9. Mills, John | Wed 19 Apr 00 |
| 10. Carey, John | Tue 11 Apr 00 |
| 11. McKay, Don | Wed 19 Apr 00 |
| 12. Blake, Ivan (with Ruth Brydon) | Tue 27 May 00 |
| 13. Ann McMillan | Fri 16 Jun 00 |

(second interview on A/Q forecasting and Ozone Annex to Can/USA Agreement)

# Appendix III: Questions – Science/Policy Linkages

1. Is there an instance (or example) of an environmental science issue which has been brought forward to your business line table which required action – research, policy, implementation, remediation, or regulation. If so, could you outline it and what transpired?

Who brought the science issue forward? Was the scientist present? Did he/she brief the business table? Or was it done by the scientist's Director or D/G?

Was a decision made? Did someone act on it? What were the results? Did it involve a policy decision? Did the decision reflect the scientific concerns? Was there feedback from the decision-maker?

2. Have you seen an instance where a scientific concern has come forward at your business line table which has significant impacts and/or implications for another business line table?

If so, what happened? Was the concern transferred to the other business line table? Do you know what happened to this issue – dropped, pursued vigorously, etc.?

3. Have you seen an instance where the science issue has clear implications for another science department? If so, what happened? Did it go to the 5NRD MOU ADM Committee?

4. Are there other channels in the department through which science issues/science advice are transferred to decision-makers? Elaborate.

5. Do you consider the business line table system an appropriate and effective mechanism for transferring science advice to decision-makers?

Could the process be improved? How?

6. How would you characterize the business line tables as a linkage mechanism between science and policy? A success, failure or somewhere in between?

7. Could you describe the mandate and responsibilities of your business line table in particular with respect to the use of science in policy formulation?

Is there a document which outlines these items: mandate, role, responsibilities? Could you have it forwarded to me?

If not, do you think there should be such a document?

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1 *Environment Canada's Scientific Research Publications in 1995*

2 *Science for Sustainable Development*

3 *Communicating Science at Environment Canada: A Brief Review of Lessons Learned from Communications on Acid Rain and the Depletion of the Stratospheric Ozone Layer*

4 *The Precautionary Principle, Risk-Related Decision Making, and Science Capacity in Federal Science-Based Regulatory Departments: A Discussion Document*

5 *Strengthening Environmental Research in Canada: A Discussion Paper*

6 *Environment Canada's Scientific Research Publications 1980-1997*

7 *Research & Development and Related Science Activities at Environment Canada*

8 *Measuring The Impacts Of Environment Canada's R&D: A Case Study of Pulp & Paper Effluent Research*

9 *Measuring The Impacts Of Environment Canada's R&D: A Case Study of Stratospheric Ozone Depletion Research*

10 *Measuring The Impacts Of Environment Canada's R&D: Notes On Methodology*

11 *Science Advice in Environment Canada*

12 *Environment Canada University Research Partnership Expansion Strategy: A Discussion Paper*

13 *Environment Canada's S&T: Expenditures & Human Resources, 1990-1999*