CCME CLIMATE CHANGE INDICATORS WORKSHOP REPORT
November 6 and 7, 2000

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Executive Summary

In 1999, the Canadian Council of Ministers of the Environment (CCME) saw the need to give Canadians an understanding of the climate change issue and what it means to them. To meet this need, CCME decided to develop a suite of indicators for climate change impacts and to communicate them to Canadians.

Through an invitation sent to all provinces and territories, a Project Working Group was created to identify and assemble a set of climate change indicators that is scientifically valid, useful and meaningful to the public. To engage experts from across the county in discussions on indicators, the Project Working Group convened a two-day workshop in Toronto on November 6th and 7th, 2000. This Report presents the major outcomes of that workshop.

Before the workshop, by way of a "faxback form", participants provided the Project Working Group with information on the climate change indicator work that had been done in their jurisdiction and reference material that they felt would be useful for the discussion. Participants at the workshop developed a "Made in Canada" framework for indicators that included indicators for climate trends ("drivers") and indicators for climate change impacts. In this framework, climate change impacts were divided into five categories: physical environment, personal health and safety, jobs and economic well-being, social and community well-being, and ecosystem health.

After much discussion and analysis, participants developed lists of "most promising indicators" – 9 for climate change drivers and 27 for climate change impacts. The Project Working Group will continue to refine these in the coming months. These are listed in the following tables.

Most Promising Indicators for Climate Change Drivers

Indicator	Chosen by Both Groups?
Air quality	
Concentration of GHG in the atmosphere	
Precipitation (rain and snowfall)	yes
Air temperature	yes
Sea temperature	
Humidity	
Barometric pressure	
Changes in the jet stream	
Solar radiation (number of hours of sunshine)	

Most Promising Indicators for Climate Change Impacts

Indicators	Chosen by Both Groups?
Physical Environment	
Shrinkage of polar ice caps / glacier mass Change in permafrost	yes
Change in river, lake or sea levels	yes
Number of frost free / heating / cooling days	yes
Date of ice in / ice out	
Salinity of Arctic marine environment	
Ground and surface water levels	yes
Water quality	yes
Severe weather events	
Personal Health and Safety	
Change in range or frequency of disease vectors	
Illness / death due to extreme weather (i.e., heat)	yes
Smog days and smog advisories	
Stratospheric ozone depletion	
Number of sunshine days / hours	
Number of snow and ice days	
Jobs and Economic Well-Being	
Water supply / restrictions	yes
Crop damage	yes
Impacts on forestry, fisheries and hydroelectric power generation	
Weather-related losses / insurance costs	yes
Tourism impacts	
Social and Community Well-Being	
Recreational opportunities	yes
Disruption due to extreme weather events	
Traditional lifestyles	
Ecosystem Health	
Reproductive cycles for indicator species	
Intensity and frequency of major disturbance events (e.g., fires, insect outbreaks)	
Moisture of soil	
Impacts on wildlife (e.g., changes in bird populations)	

Participants spent a good portion of the workshop discussing how to communicate indicators of climate change to the Canadian public. Major outcomes of the discussion included suggestions for the elements of a communication plan, key audiences, key messages, and communication tools that could be used. These will form the basis of a communications plan to be developed by the Project Working Group. An issue raised by participants was the need to integrate communication on the impacts of climate change with other initiatives that are addressing mitigation and adaptation.

The Project Working Group will be consulting on the indicators with those jurisdictions that were not able to attend the workshop. Work will continue on the preparation of a communication plan for the project and on data collection with member jurisdictions. CCME's goal is to have the indicators ready for communication by September 30, 2001.

1.0 Background

The Canadian Council of Ministers of the Environment (CCME) has been involved in climate change issues for many years. In 1999, CCME saw the need to give Canadians an understanding of the climate change issue and to communicate what climate change might mean to them. The challenge that CCME set for itself was two-fold: to develop a suite of indicators for the impacts of climate change and to communicate them to Canadians.

CCME established a Project Working Group to identify and assemble a set of climate change indicators that is scientifically valid, useful and meaningful to the public. These indicators will be used to provide a general Canadian audience with a snapshot of the climate change issue and the impact of climate change on the things they value. To develop the indicators, the Project Working Group is:

- consulting with experts from across the country at a workshop;
- relying on the contribution of member jurisdictions for data and related information on a preliminary set of indicators;
- developing selection criteria to ensure that a sound package of indicators is developed for the Ministers; and
- ensuring that the presentation media are accessible, innovative and relevant to Canadians.

To engage experts from across the county in discussions on indicators, the Project Working Group convened a two-day workshop in Toronto on November 6th and 7th, 2000. This Report presents the major outcomes of that workshop.

2.0 Workshop Objectives, Format and Presentations

Objectives

The purposes of the Workshop were to:

- develop an indicator framework for communicating the impacts of climate change;
- identify a set of scientifically valid and useful indicators of the impacts of climate change; and
- discuss the creative package by which the indicators can be communicated to Canadians.

Format

Before the workshop, by way of a "faxback form", participants provided the Project Working Group with information on the climate change indicator work that had been done in their jurisdiction and reference material that they felt would be useful for the discussion. This material has been transcribed and is included as Appendix A.

The Workshop began in plenary session, but much of the two days was spent in small group discussions (see Agenda, Appendix B) with the small groups reporting back to plenary at the completion of each session. In addition to the Co-Chairs, fifteen participants took part in the workshop (see Appendix C). Mike Gill participated in most of the plenary sessions by telephone link-up from the Yukon.

Presentations from Roger Street and Ron Zukowsky, Co-Chairs of the Project Working Group and Anne Kerr from Environment Canada opened up the workshop on Day One and provided background information on the Working Group's mandate, climate change impacts, indicators and communication strategies. After the presentations, the participants discussed and developed an indicator framework in plenary. Following this, participants were divided into two groups and began their discussions in a small group format.

Opening Presentations

In his opening remarks, Roger Street set the stage for the two-day workshop. He outlined the challenge facing CCME: to develop indicators for climate change and to communicate the results in an effective manner. In his remarks, Mr. Street stressed that the focus of the indicators was to be on the climate

system and the impacts of climate change, not on mitigation efforts or adaptation measures. He challenged participants to think about what is unique to Canada with respect to climate change, and how that could be communicated in a unique way.

Mr. Street reiterated the goal that CCME had set for itself, as expressed in the Backgrounder that had been forwarded to participants:

> To provide Canadians with a national snapshot of trends of climate change in Canada and associated implications for those things that Canadians value.

He also reviewed the major outcomes of the Canada Country Study. The Study assessed the state of knowledge about the impacts of climate change in Canada. It looked at six Canadian regions, twelve sectors, cross-cutting issues and knowledge gaps. The identified impacts were categorized as: international, domestic, infrastructure, industry, transportation, social well-being and food and fibre. A copy of Mr. Street's presentation is presented in Appendix D. Note that Fred Wrona of Environment Canada, who was scheduled to make a presentation on northern issues, was not able to attend the workshop.

Anne Kerr from Environment Canada then presented a survey of climate change indicators used around the world. She noted that the most commonly used indicators were those that measured human activity or stress (i.e., CO_2 emissions). The second most common indicators used were state/condition indicators (i.e., temperature trends). There are very few examples of jurisdictions using indicators on climate change effects. Ms. Kerr's handout is included as Appendix E.

Ron Zukowsky from Saskatchewan Environment and Resource Management followed with a presentation on Communicating Indicators. He stressed the need to select indicators that are strongly linked to values that Canadians cherish. Currently, Canadians put the highest priority on health care and education. In a longer term (5 year) view, Canadians place health care first, education second, children third and the environment fourth in terms of priority. Mr. Zukowsky identified four key audiences for climate change: the general public, educational institutions, the media and decision-makers. To reach these audiences effectively, we need to know what they know about climate change, what they value, and how they want to be informed. Survey results show a number of important factors: the public is generally aware of climate change, believe that climate is changing, and believe that humans are causing the change. However, the public has mixed views on whether climate

change will be positive or negative. Mr. Zukowsky's presentation is included as Appendix F.

3.0 Highlights of the Discussion

3.1 A "Made in Canada" Indicator Framework

Workshop participants were asked to brainstorm the characteristics that they felt should apply to a Canadian framework for climate change indicators. Participants suggested the indicator framework should:

- be relevant;
- be concrete;
- be valid;
- be easily understood;
- meet the selection criteria outlined in the Backgrounder document;
- allow rapid and easy access;
- provide a balance among quality of life, economic and environmental components;
- incorporate some traditional environmental knowledge;
- be hierarchical or multi-level for different users and audiences;
- consider holistic assessments;
- reflect differences in geography;
- provide regional flavour; and
- provide the relevance to audiences of impacts that are taking place in other areas of the country (e.g., the north).

After discussing various approaches that could be used for organizing indicators, the group accepted the approach outlined below as being most useful in the Canadian context.

GOAL:
To provide Canadians with a national snapshot of trends of climate change in Canada and associated implications for those things that Canadians value.

APPROACH TO ORGANIZING INDICATORS:

1. Observed trends of drivers of climate change

2. Observed trends of impacts of climate change
   - Physical Environment
   - Personal Health and Safety
   - Jobs and Economic Well-Being
   - Social and Community Well-Being
   - Ecosystem Health

3.2 Potential Climate Change Indicators

In small groups, participants brainstormed a list of potential indicators of impacts of climate change. Each of the potential indicators on these "long lists" were then analyzed with respect to the following criteria:

- suitability for a general audience;
- whether they were of high interest, utility or value as indicators;
- whether they were likely to encourage action (i.e., greenhouse gas reduction and/or adaptation); and
- whether data were available.

Details of this analysis are provided in Appendix G.

Subsequently, both groups created a list of the indicators they felt would be of most use or were most promising to communicate changes in the climate system (drivers) and the impacts of climate change on the things that Canadians value. These are listed below.

Most Promising Indicators for Climate Change Drivers

Indicator	Chosen by Both Groups?
Air quality	
Concentration of GHG in the atmosphere	
Precipitation (rain and snowfall)	yes
Air temperature	yes
Sea temperature	
Humidity	
Barometric pressure	
Changes in the jet stream	
Solar radiation (number of hours of sunshine)	

Most Promising Indicators for Climate Change Impacts

Indicators	Chosen by Both Groups?
Physical Environment	
Shrinkage of polar ice caps / glacier mass Change in permafrost	yes
Change in river, lake or sea levels	yes
Number of frost free / heating / cooling days	yes
Date of ice in / ice out	
Salinity of Arctic marine environment	
Ground water levels	yes
Water quality	yes
Severe weather events	
Personal Health and Safety	
Change in range or frequency of disease vectors	
Illness / death due to extreme weather (i.e., heat)	yes
Smog days and smog advisories	
Stratospheric ozone depletion	
Number of sunshine days / hours	
Number of snow and ice days	
Jobs and Economic Well-Being	
Water supply / restrictions	yes
Crop damage	yes
Impacts on forestry, fisheries and hydroelectric power generation	
Weather-related losses / insurance costs	yes
Tourism impacts	
Social and Community Well-Being	
Recreational opportunities	yes
Disruption due to extreme weather events	
Traditional lifestyles	
Ecosystem Health	
Reproductive cycles for indicator species	
Intensity and frequency of major disturbance events (e.g., fires, insect outbreaks)	
Moisture of soil	
Impacts on wildlife (e.g., changes in bird populations)	

Other comments on indicators:

After reviewing the lists of "most promising indicators", a number of comments were made by participants.

- Participants noted the importance of selecting indicators that show a clear trend or "story", and that aren't "too noisy" or confounded by too many factors.
- It may be that it is difficult to directly link some of the proposed indicators to climate change. When telling the story, we need to be clear about which links are direct and which are indirect or not yet clearly proven.
- A caution was raised about using indicators that are overly complex; it may be better to pass over them at this stage.
- Relating to the above point, it was suggested that we should be careful not to oversimplify the issues.
- The suggestion was made to strike a balance between indicators that are complex and those that are easily understood and clear.
- A key challenge will be to show the links and interactions among the indicators.
- It was recognized that information on some indicators should be collected for its scientific and reference value, regardless of whether it was useful for communicating to the general public.
- It was also recognized that climate change may have both positive and negative impacts and this needs to be communicated.
- An additional indicator of climate change impacts was suggested: the date of spring freshet.

3.3 Communicating Climate Change Indicators

What should be in the Communication Plan?

In plenary, workshop participants identified the **key elements of a communication plan** for climate change indicators. These included:

- goals and objectives of the Plan;
- audiences;
- key messages;
- forms of product;
- translation;
- costs;
- release strategy;
- timing;
- partnerships;
- roles and responsibilities;
- implementation plan;
- evaluation and feedback; and
- links to other events and processes.

Other **project tasks** were also identified including:

- reviews;
- approvals;
- monitoring;
- reporting out;
- communicating change in indicators; and
- involving communities and organizations in data gathering.

Who are the key audiences?

Both groups identified the general public as being the **primary audience** for communication purposes, and both groups identified the need to reach that audience using a sector approach that reflected values and self-identification. Possible sectoral approaches include targeting people as:

- consumers;
- householders;
- earners;
- parents;
- youth or children;
- users of recreational resources; and
- rural or urban dwellers in a particular region.

Secondary audiences that were identified included:

- educators;
- students;

- decision-makers;
- Aboriginal and northern people; and
- other ethnic audiences.

What are the key messages?

The key messages, or story line developed by both groups included:

- Climate change is happening now and will affect you.
- Climate change is linked to human activities.
- Although climate change is a global issue, it will affect you locally.
- Climate change is a complex issue that is affecting many aspects of our lives and things that we value including our: health, food, recreational activities, methods of travel, cost of living, economy, biodiversity and the natural environment.
- Climate change poses both opportunities and challenges (i.e., will lead to positive and negative changes).

Although both groups acknowledged the need to recognize other processes and initiatives including those that deal with mitigation and adaptation strategies, the groups differed as to the extent that they felt this should be incorporated into the communication carried out by CCME. (See Other Issues).

What methods and tools should we use to reach audiences?

One of the groups suggested that it would be important to **organize the indicators of climate change impacts by theme**. This would allow information and narratives to be targeted to particular audiences. These themes would cut across the indicator framework and would illustrate the linkages and interdependencies among the indicators. Possible appropriate themes include:

- Water
- Seasons
- Recreation and tourism
- Householder (urban)
- Rural dwellers and farmers
- Natural resources
- Traditional lifestyles
- Health
- Nature / ecosystem health / wildlife

The groups identified a number of **communication tools** that they felt would be useful for communicating the impacts of climate change. Tools identified by both groups included:

- Print materials;
- Community newspapers;

- Web sites;
- Partnering with other organizations and initiatives doing similar reporting (e.g., Canadian Atlas, SOE reporting, Insurance Bureau of Canada, etc.);
- Tapping into community-based networks and providing them with information on climate change indicators or tools (e.g., the Toolkit being developed by the PEO Table);
- Recruiting opinion leaders or celebrities and providing them with information to use; and
- Using the Weather Channel for features and/or reporting of climate trends indicators.

Other points about communication:

- Both groups noted the importance of involving representatives of key audiences and using focus groups during the development of communications materials to ensure that materials are effective.
- It was suggested that CCME consider putting its climate change indicator "products" on an existing site, rather than creating a new one.
- The need to use different communication approaches in the north was stressed. In the north, many people don't like print documents and Internet access is limited. Information needs to be presented in clear and pragmatic terms.
- Interactivity was stressed as being a very important consideration for communication. It was noted that CCME intended the initiative to be, or at least begin, a dialogue with Canadians on the impacts of climate change.

3.4 Other Issues

After the final presentation from the small groups on communicating indicators of climate change impacts, participants discussed to what extent CCME's communication should address adaptation strategies for climate change. Mr. Street articulated that the Project Working Group felt that it was beyond CCME's mandate to address adaptation issues. Key comments made were:

- Perhaps CCME's concern can be addressed by making linkages to other groups and initiatives that are dealing with these issues without explicitly discussing adaptation.

- Some participants argued that the end of the climate change impact "story" should deal with what people can do (i.e., to mitigate or adapt to climate change).
- Some participants argued that in our selection of indicators, we are already dealing with adaptation, and should describe what is already going on (e.g., in case studies). An example is the length of time ice roads can be used: people are already adapting to a shrinking ice road season by spraying water on the roads
- Given the long time period in which we can expect climate will continue to change – potentially hundreds of years -- perhaps we need to say "climate change is happening now, it will continue to happen for a very long time, and we have already started to adapt to it."

Participants generally agreed that the message about adaptation to the impacts of climate change does need to be included in communication materials, but the focus should clearly be on the indicators and the impacts of climate change.

4.0 Next Steps

The Project Working Group Co-Chairs provided a wrap up of the workshop by outlining the next steps in the process. A workshop report will be prepared by the end of November and circulated to participants. With the aid of Environment Canada's Climate Change Bureau, Quebec Environment and Saskatchewan Environment and Resource Management, the Project Working Group will be preparing a communication plan for this project. The Project Working Group will also continue to refine the indicators that have been developed. They will be looking to member jurisdictions for data collection and will be consulting on the indicators with those jurisdictions that were not able to attend the workshop. The goal is to have the indicators ready for communication by September 30, 2001.

The Co-Chairs ended the workshop by thanking the facilitators and the participants for their hard work, ideas and creativity.

Appendix A
Pre-Workshop Suggestions for Indicators

PARTICIPANTS' TRANSCRIBED FAXBACKS

Reference Material[1] / Other Information	Potential Indicators[2]	Communication Approaches[3]
• http://www.scotland.gov.uk/cru/kd01/ccsi-15.htm, Socio-economic drivers for change and climate impacts in each sector • http://www.ecn.ac.uk/CCI/indicators.htm, Indicators of Climate Change in UK, Department of Environment, Transport and the Regions (DETR); set of 34 indicators of climate change and its impacts for the UK • http://environment.govt.nz/climate/, Environmental performance indicators in New Zealand (including climate change)	*Social and economic indicators are more important levers in engaging non-scientific and environmental stakeholders*	• Refer to Climate Change Communication Conference, Waterloo, Ontario, Jun 2000
• Arctic Borderlands Ecological Co-op – has the most advanced collection of indicators currently being used to monitor climate change in northern Canada [http://www.taiga.net/coop/] *Data collection programs:* • Wolfe Creek Research Basin – hydrometric monitoring and research, International Tundra Experiment (ITEX) research site, biodiversity monitoring [www.taiga.net/wolfcreek/about.html] • Parks Canada Monitoring Programs – Ivvavik, Vuntut, and Kluane National Parks (in its infancy) • St. Elias Climate Change Program – research focused but teaming up with Parks Canada for a monitoring program (glaciers, temperatures etc.), [www.biology.ca/courses.hp/step/objectives.htm] • DIAND Water Resources Monitoring Programs – ongoing monitoring of snow depths (Yukon Snow Survey,); hydrometric stations • Environment Canada Arctic Ice Atlas [www.cis.ec.gc.ca/csu/atlas_e.html] • Meteorological Service of Canada Climate Monitoring Stations – temperature, precipitation, wind speed • YTG Dempster Highway Snow Stations		

[1] Specific reference material that the participant felt was relevant to the workshop discussions.
[2] Potential specific indicator(s) that the participant felt was relevant to the workshop discussions.
[3] Interesting approaches seen by the participant for communicating climate change indicators.

Reference Material[1] / Other Information	Potential Indicators[2]	Communication Approaches[3]
• NOAA, DND, US Military and Geological Survey of Canada – ongoing monitoring of Beaufort Sea seasonal sea ice extent and oceanographic factors related to sea ice extent (current, water temperatures etc.) • Geological Survey of Canada – periodic coastal erosion monitoring along Arctic coast • Permafrost research in Mayo area by Chris Burn • Many indicators part of EMAN North Sites (approximately 15 across Canada)		
• Taiga Cooperative indicators [http://www.taiga.net/coop/indics/index.html] • Environment Canada - SOE report (1996); climate change indicator (and annual updates) • Environment Canada – climate normals (1961-1990) *Indicators should be chosen with several scientific criteria as basis:* • Direct linkage to climate parameters / climate change • Length of record • Ongoing availability of data • Integrity / quality of data		• Map format - allows stories to be told at a variety of levels (particularly with good accompanying text)
	Top indicators for Saskatchewan: • Temperature patterns – seen as direct measure of climate change; data available (most weather stations in south; Forest Management and Fire Protection Branch of SERM collects weather data from April to September, an additional source of information for Saskatchewan's north) • Growing degree days – data available about degree days needed for plant growth and for temperature • Lake and river break-up – ice free season has significant effect on lake productivity (some historical data) • Rocky Mountain glaciers – glacier melt • Precipitation – data sources same as for temperature • Snow cover season – date of first and last snowfall, depth and area of snow, and melting • Streamflows and lake water levels – important measure of moisture and aquatic habitat (data requires	• International Energy Agency model for stimulating policy impacts on GHG emissions levels • Project Wet; Project Wild • Template to allow individuals to record and assess personal climate change indicators

Reference Material[1] / Other Information	Potential Indicators[2]	Communication Approaches[3]
	interpretation since affected by human activity) • Water quality – needs discussion • Groundwater levels - interpretation needed • Extreme climatic events – damage to property and/or persons (e.g., thunderstorms, rainstorms, hail, tornadoes, snowstorms, Chinooks, extreme winds, dust storms) • Habitat and biodiversity – data collection problematic • Phenology – response of plants and animals to seasonal and climatic change (data collection problems) • Human health - deaths, hospitalizations, medical treatment records • Socio-economic impacts – agricultural yield, energy use, transportation, water use, forest industry, fishing, recreation, insurance claims	
• Environmental Trends in British Columbia (2000) - released every 2 years by BC Government • Canada Country Study: Climate Impacts and Adaptation • Papers by David Schindler e.g., Shindler, D.W. 1997. Widespread effects of climate warming on freshwater ecosystems in North America. Hydrological Processes, 11: 1043-1067.	*State of the Environment-type:* • Trend on ice-free season (18 year trend in work by Schindler) • Freeze-up and melt dates • Severity of climate index being developed by Canadian Centre for Climate Studies – intensity of precipitation data available for BC) • Glacier retreat since turn of century (data for 3 BC glaciers and others through Int'l Glacier Monitoring Program) • First time flowering (AB data, perhaps NS and some for BC) • Temperature changes (sea / land temperature) *Impacts:* • Economic value of resources sensitive to climate change (e.g., forestry, fisheries) • Vulnerability of selected communities to rising sea level (e.g., Richmond BC) and stream flow changes • Change in range of disease vectors • Cost of climate change to insurance industry	• Check http://www.elp.gov.bc.ca/sppl/soerpt • Quest and Prism PC games allowing user to make policy decisions and see the sustainability outcomes • Need easy to read hard copy report, graphic, few words which gives overview of indicators; details placed on web site; promote product; presentations to speak on topic
• Climate Change Issues Maps for National Atlas of Canada Draft Proposal - this series is aimed at providing informational support for the policy process of climate change • Climate Change Portal (allows users to search		

Reference Material[1] / Other Information	Potential Indicators[2]	Communication Approaches[3]
various climate change related data), http://ceodeve.ccrs.nrcan.gc.ca/prototypes		
• UK Indicators Report	• Temperature (max / min) • Streamflow normals (max / min) • Lake levels • Glacier storage • Crop yield • Hail crop insurance data	
• Comment sensibiliser les Canadiens aux changements climatiques, Une stratégie de sensibilisation du public. Table de concertation. Processus de mise en oeuvre national. Novembre 1999. • Rapport du groupe de travail québécois sur la science et l'adaptation. Novembre 1999. • Sondage sur l'impact de la tempête de verglas sur les attitudes et les comportements de la population du Québec en matière d'énergie – Aspects commnicationnels. SOM. Juin 2000. • Indicators of Climate Change in the UK. Department of the Environment, Transport and the Regions, UK, February 1999. • Impacts and Adaptation to climate variability and change in Quebec. Association de climatologie du Québec. Synthesis summary, volume V of the Canada Country Study: climate impacts and adaptation.	• Health – the relation between number days with a temperature of over 30°C during the summer of the last 10 years and the health of elderly people: the number of hospitalizations (heart and lung diseases) due to heat stroke and also the increase of allergens in the air and their effects (more heat = air of less quality) • Lakes, rivers and oceans – their water level during the summer and the date they freeze over as well as when they melt (the number days water covered with ice and thickness) • Floods and forest fires – number, frequency, location year to year, and size and duration • Agriculture – number days without frost • Extreme events – number and frequency of tornadoes and hail • Recreation – number days with rain and for winter, number of colder and warmer days as well as snow thickness (ski and other winter spots)	• Brief TV or radio updates (main networks, Meteo Media) on climate change for the weather bulletin on main
• Berjer, I. (Ed.). 1996. Geoindicators: Assessing Rapid Environmental Change in Earth Systems. A.A. Blakema, Rotterdam. • Wolfe, S.A., Kotler, E., Nixon, R.M. 2000. Recent Warming Impacts in the Mackenzie Delta, Northwest Territories and Northern Yukon Territories, Coastal Areas. Geological Survey of Canada, Chivent Research, 200 – B1, 9p. • Wolfe, S.A. and Nickling, W.G. 1997. Sensitivity of Eolian Processes to Climate Change in Canada. Geological Survey of Canada Bulletin 421. 30p. • Ryder, J.M. 1998. Geomorphological Process in the	• Thermal and physical response of permafrost in Artic environment • Vegetation cover and wind erosion of sandy, dune soils in the southern Prairies • Glacier mass balance • Peatland responses to climate change • Coastal (sea level) and hydrological responses of glacial systems	• Posters – e.g., (1) Temperature Rising: Climate change in southern BC. Geological Survey of Canada Misc. Report 67; (2) The Winds of Change: Climate change in the Prairie Provinces. Geological Survey of Canada Misc. Report 67; and other climate Change Posters for Canada and related websites • Atlas – e.g., Sensitivities to Climate Change in Canada

Reference Material[1] / Other Information	Potential Indicators[2]	Communication Approaches[3]
Alpine Areas of Canada: the effects of climate change and their impacts on human activities. Geological Survey of Canada Bulletin 524. 44p. • Shaw, J., Taylor, R.B., Forbes, D.L., Ruz, M.H., Soloman, S. 1998. Sensitivity of the coasts of Canada to sea-level rise. Geological Survey of Canada Bulletin 505.		
• IISD: Compendium of sustainable development indicators initiatives • US EPA: global warming indicators • Batekke – Pacific Northwest National Laboratory: Assessing Vulnerability to Climate Change: Indicators and Assessments Methods • Science Magazine: The Global Carbon Cycle: A Test of our Knowledge of Earth as a System. Vol. 290 No. 5490 Issue 13. 13 October 2000, pp. 291-296. • Sustainability Reporting Program: http:www.sustreport.org/issues/climate_ch.html • Basher, R. (1998, 24 December). Environmental Indicators for the Physical Climate System and Climate Change Impacts. National Institute of Water and Atmospheric Research, New Zealand Ministry for the Environment.	• Recommend focusing on key meteorological variables, preferably generated from a long-term monitoring site in MB (e.g., mean seasonable temperature or change in seasonable precipitation) • Percent change or percent reduction in soil moisture • Mean seasonal water temperature, "ice-in" and "ice-out" dates (good records kept by/at: Hudson's Bay Co.; Upper Fort Garry in Winnipeg; and York Factory) • Northern MB and northern Can.: southern extent of permafrost line (affects tree growth, infrastructure – roads, rails, buildings etc.); winter road duration (affects northern communities); ice free season in Arctic (affects shipping, polar bear health etc.) • Ecosystem health: shifts in forest, agriculture etc. zones; forest health (e.g., with increased temperature may see increased insect infestation, forest fires etc.) • Shifts in location and number of insect species (e.g., there has been speculation that some insect species will move north with increasing temperatures, others may die out) • Agriculture: length of growing season (e.g., date of last spring frost, date of first fall frost, number of degree-days during season etc.); types of crops grown (other crops may be grown in the Prairies with longer growing season or crops may not be feasible if conditions were drier); water availability for agriculture (e.g., ground / surface water; take into consideration increases in water-intensive agriculture or other users) • Human health: changes in morbidity and mortality extreme temperatures; changes in disease incidence (tropical / sub-tropical diseases may move north with migrating insects) • Air quality: levels of particulates in air (need to consider changes in transportation and industry,	• Interactive website (e.g., EPA's National Air Toxics Assessments Activities, http://www.epa.gov/ttn/uatw/nata • SDRI's climate change calculator, http://www.climcalc.net • Video games like Sims City where each decision has impact

Reference Material[1] / Other Information	Potential Indicators[2]	Communication Approaches[3]
	programs to manage particulates – CWS, Crop Burning Regulation etc.) • Weather statistics – how are current conditions such as temperature, precipitation levels, extreme weather events compare with past climate record with what might be expected with a changing climate; probably most important link to Canadians cause of preoccupation to weather and its affects on lives) • GHG emissions and energy use stats (total GHG emissions, GHG release per capita, GHG release per GDP, energy intensity, renewable : fossil fuel ratio etc. (each statistic should be benchmarked and assessed for trend against our own annual record and those of our major trading partners, G8 countries and other developed countries who are similar to us • Insurance industry's weather-related losses • Emissions themselves (National total emissions, sectoral total emissions, national emissions per capita, sectoral emissions per capita) • Public knowledge indicators (is the public getting and internalizing information? Do they understand environmental and economic consequences, most significant societal actions and most significant personal actions to reduce emissions?). • Public willingness to act (e.g., track auto purchases / use of public transport) • Transportation First need to establish analytical framework for indicators application (adopt the Dashboard of Sustainability / Barometer of Sustainability); look at index of progress to returning to stabilized climate conditions	
• Wolf Creek Research Basin, http://www.taiga.net/wolfcreek/index.html • Arctic Borderlands Ecological Knowledge Coop, http://www.taiga.net/coop/index.html • Bibliography of climate change studies in the Yukon, http://www.taiga.net/webdata/climatechange /index.html • Database of climate change information sources (under development), http://yukon.taiga.net/climate change/	*Potential Northern (regional) and National Indicators (challenge is that northern indicator data sets are relatively short in duration):* • Snow depth, duration and density -measured in communities through Yukon since 1983; very relevant to Yukoners/Canadians and wildlife; tangible to public; could provide cross-northern perspective; sensitive to year-to-year changes in climate) • Forest fire frequency – 54 year record for Yukon;	• Web sites using searchable databases with map interfaces (i.e., clickable map of Canada with regions); user could click on their region to view relevant indicators organized by human and natural systems • Newspaper inserts have been used effectively by the federal government in the past to speak to the general public • Media segments on national programs (TV/Radio) to highlight climate change and its impacts as determined by

Reference Material[1] / Other Information	Potential Indicators[2]	Communication Approaches[3]
• St. Elias Climate Change Project, http://www.biology.ualberta.ca/hik.hp/steliasproject/ccaf99proposal.htm • Northern Climate ExChange, http://taiga.net/nce/index.html • BC State of Environment Reporting (Effects of Global Climate Change Indicator), http://www.elp.gov.bc.ca/sppl/soerpt/06-1-climate-change.html • EMAN North, http://www.nwtresearch.com/eman/Default.asp *Comments on Indicator Criteria:* • Indicator selection – some of the things considered when identifying indicators for the Coop: • Indicator sensitivity (if tracking climate change - is the indicator sensitive to temperature changes?; can use recent El Nino years to determine whether an indicator registered a response) • Is the indicator understandable and relevant to the public? • Is the indicator easy (level of skill) and cheap to measure? Do the measurements give precise estimates? Are the measurement methods repeatable? Can the indicator be measured over a long time period? Is the data easily accessible? • Is the indicator affected by only a few variables? (This is important because the more variables that could explain why an indicator is trending a certain way, the less certainty you have in identifying the cause of the change) *Other Comments:* • The recently formed Yukon Government Climate Change Committee will be working on developing Yukon wide indicators of climate change involving both emissions indicators and indicators of climate change impacts.	sensitive to summer temperatures, snow levels and overall precipitation; relevant and tangible to Yukoners/rural Canadians; influence on wildlife populations; national data exists • Permafrost monitoring – 10 or more years of data for a couple of sites in the Yukon as well as much monitoring in the Mackenzie Basin; impacts on infrastructure in the North (a uniquely Northern issue); regional coverage is spotty • Early Summer Green Vegetation Index – NDVI Satellite Images are used to show timing of tundra 'green-up' as well as an index of green plant biomass; presently collected for the North Slope of the Yukon and Alaska since 1985; could be used across the North to determine green up dates and relative biomass between years; sensitive to climate changes (showed marked response to El Nino years) • River break-up and freeze up dates and ice conditions – major rivers in Yukon and likely the entire North are monitored by Environment Canada, Water Survey since at least 1987; tangible and relevant to Northeners (transportation)' easy to understand; directly related to temperatures • Storminess – using biometric pressure as an indicator (below 99.5 kilopascals); data exists across North and across Canada; thought to be sensitive to climate change (although no patterns apparent for Inuvik data); varying data record length. • Sea Ice Cover – US Military, NOAA and Geological Survey of Canada have been collecting information on Arctic Sea Ice extent and conditions for at least 50 years; sensitive to climate change; relevant to Northeners and Canadians; relevant to natural (marine ecosystems) and human systems (marine transportation) • Flood frequency – hydrometric measurements in many in many aquatic systems throughout the North and Canada; sensitive to precipitation changes; relevant to ecosystems and human settlements • Glaciers – many glaciers are being monitored for mass balance and areal extent; implications on tourism in some cases; can project backwards in time using creative	the indicators

Reference Material[1] / Other Information	Potential Indicators[2]	Communication Approaches[3]
	techniques; sensitive to long-term changes in precipitation and temperatures; insensitive to non-climatic factors	
Brief summary of public opinion research indicating 2 key themes: • Most relevant link for Canadians is climate change and health • Canadians lack concrete information bout impacts of climate change that would make the issue less abstract and more immediately relevant to them	*Ensure indicators are relevant and meaningful to Canadians; the way the implications of indicators are presented are important.* • Quality and quantity of drinking water • Number of very hot days • Number of smog alert days • Winter recreation days • Lake water levels and impact on cottagers and summer users • Insurance costs • Food costs (due to growing conditions, either higher or lower) • Heating and cooling issues • Cases of insect-borne diseases • Tourism impacts (e.g., freeze over timing of Rideau Canal for Winterlude) • Traffic safety if icy conditions replace snowy conditions	• Government of Can. PEO on climate change includes an information kit which is sent to all people inquiring about climate change • Government of Can. website (being redesigned) is another informational product that reaches a wide range of individuals and would provide a good medium for disseminating the indicators results; the website has an area for teachers. And this may be a good way to bring the indicators to the attention of educators • Many CCAF proponents have websites as part of their projects, and could be asked to link to the indicators • The Weather Channel has expressed interest in producing vignettes on climate change, using information provided by Environment Canada (they would pay the production costs)
• Cramer, W. et al. (Eds.) Climate scenarios for agriculture, forest and ecosystem impacts. Proceedings of the ECLAT-2 Potsdam Workshop, 13-15 October 1999. Climatic Research Unit, UEA, Norwich, UK. [available from, d.viner@uea.ac.uk] • Epstein, P.R. 2000. Is global warming harmful to health? Scientific American, August Issue, 9 pp. [http://www.sciam.com/2000/0800issue/0800epstein.html] • Eyles, J., Cole, D., and Gibson, B. 1996. Human health in ecosystem health. Issues of meaning and measurement. International Joint Commission. 73 pp. • Fisher, A. et al. 2000. Preparing for a Changing Climate. The Potential Consequences of Climate Variability and Change. [US] Mid-Atlantic [Region] Overview. Environmental Resources Research Institute, Pennsylvania State University, University Park, PA. 68 pp. • Hans, S.L. and Adare, K. 1997. Highlights of the Canadian Arctic Contaminants Assessments Report: A	At present there are no readily available specific in indicators of the impacts of Climate Change as such on the health of human populations. This is because few positive or negative health outcomes are uniquely due to changes in climate or weather, and because there has been no health monitoring system using climate- or weather-specific health indicators. *However, the following may be used as specific indicators of trends in health outcomes related to climate or weather:* • Heat or cold stress related illness and deaths, or changed physiologic responses to such stresses • Illness and deaths due to or associated with storms or tornadoes, floods or lightening • Changes in the geographic and temporal distribution of infectious diseases which are directly related linked to regional climatic conditions (e.g., due to northward or altitudinal extension of the range of pathogen vectors	• Posters being prepared by the Geological Survey of Canada, showing possible impacts of climate change on different regions of Canada • "Weather Channel" TV program on climate change ("Hot Planet") shown Oct 10th, 2000 • Illustrated NRCan brochure on "Sensitivities to Climate Change in Canada" published 2000 • "Canada Country Study: Climate Impacts and Adaptation (Paper and CD version) • "Our Changing Planet: The FY 2000 US Global Change Research Program: Implementation Plan and Budget Overview. US National Science and Technology Council.

Reference Material[1] / Other Information	Potential Indicators[2]	Communication Approaches[3]
community reference manual / Synthèse du Rapport de l'évaluation des contaminants dans l'Arctique: Guide de reference des collectives. Indian and Northern Affairs Canada, Ottawa. 83 pp. E / 93 pp. F • Indicators Implementation Task Force. 2000. Final Report. International Joint Commission. ISBN 1-894280-19-9. 34 pp. • Last, J.M. and Logan, H. 1999. CAPITALizing on Science / Du bon usage de la science. Report of a workshop on climate change, Science and Health. Canadian Journal of Public Health, Nov.-Dec. Supplement I. 8 pp. • McMichael, A.J. et al. (Eds.). 1996. Climate Change and Human Health. World Health Organization, Geneva. 297 pp. • Nilsson, A. 1997. Arctic pollution issues: A State of the Arctic Environment Report. Arctic Monitoring and Assessment Programme, Oslo, Norway. 188 pp. • Special Program for Health Analysis. 2000. Health Situation in the Americas. Basic Indicators 2000. Pan American Health Organization / World Health Organization. 12 pp. • Consensus Conference on Environmental Health Surveillance. 2000. Draft discussion documents. Environment Canada, Health Canada, International Joint Commission, National Roundtable on the Environment and the Economy, Pan American Health Organization / World Health Organization, US Agency for Toxic Substances and Disease Registry.	such as ticks, mosquitoes, or biting flies; or of animal hosts of viruses transmissible to humans, such as deer mine carrying hantavirus) • Changes in the geographic and temporal distribution of bio-allergens (e.g., pollen, mold spores) • Changes in the distribution and number of "weather sensitive" individuals which suffer from chronic pain, or from mood changes responding e.g. to hot and humid weather, Chinooks, or other sudden weather changes; or of people involved in violent acts • Changes in the geographical and temporal distribution of UV-related diseases such as cancer, cataracts (as some greenhouse gases attack stratospheric ozone)	
Relevant climate change indicator work: • As part of the Great Lakes Large Ecosystem Initiative, the Meteorological Service of Canada -Ontario Region has planned to expend some effort developing methodologies to monitor and detect atmospheric change, with particular emphasis on climatic extremes; literature review of approaches to detect changes in climate and in particular potential parameters undertaken (further assessment of the potential parameters and selection of a set for analysis is next stage)	*The literature review revealed a broad set of potential climate change indicators:* • Precipitation – approximately 20 different measures have been suggested including total precipitation, daily extremes, and a variety of methodologies to compare the fraction of precipitation falling within various regions; there are also measures of drought severity and length • Temperature – more than a dozen methods of evaluating temperature change proposed including trends in max, min, and means, number of days exceeding	

Reference Material[1] / Other Information	Potential Indicators[2]	Communication Approaches[3]
Approaches to organizing indicators: • Sectoral approach – would need additional emphasis on "human health" sector that encompasses many of the most compelling indicators such as heat stress and severe weather frequency • Regional indicators	various thresholds, frequency of heat or cold waves, and indices such as heating degree days and growing degree days • Other fields such as: freezing rain indices; severe wind chill, tornadoes, strong winds etc. *Hydrological indicators specific to Great Lakes Region:* • Trends in Great Lakes water supplies • Trends in Great Lakes water temperatures (average annual and seasonal) • Trends in winter ice conditions • Trends in Great Lakes aquifer levels in southwestern Ontario (Grand River Watershed)	
Important to monitor and develop indicators to detect initial impacts of subtle warming on ecosystems and built environment: • Integrated Mapping and Assessment Project (IMAP) – shown that several of southern Ontario ecosystems are highly sensitive to subtle climate warming (two papers published at two American Meteorological Society Conferences, Summer 1999)	• Fish biodiversity • Loss of woodlots, wetlands, and agricultural intensification • Biodiversity impacts of large ecosystem disturbance events (e.g., Ice Storm '98)	
• Climate Change Environmental Indicator Bulletin. National Environmental Indicator Series, Environment Canada. • The State of Canada's Environment. 1996. Chapter 15 Atmospheric Change. • Climate Change and Forests. Natural Resources Canada, Canadian Forest Service. • Climate Change Media Kit (Federal Government) • PowerPoint presentation by T. Prowse, "Climate Change in the Arctic: Ecosystem Effects of Climate Change", Environment Canada. • UK Department of Environment, Transport and the Regions. Indicators of Climate Change in the UK.	*Attached list is included in Appendix E*	• Environment Canada's Climate Change media kit • Supplement on Climate Change from London Observer, April 8th, 1990, "Planet in Peril". Observer Special Weather Report No. 1.

Appendix B
Workshop Agenda and Backgrounder

CCME Indicators Workshop
November 6 and 7, 2000

Agenda

Delta Airport Hotel, 801 Dixon Road, Toronto, Ontario.
(416) 675-6100

Background: *CCME has formed a working group to develop a set of indicators and a communications strategy which will enable ministers to provide Canadians with a national snapshot of trends of climate change and associated implications. (Please review the Backgrounder attached to this material for further information.)*

Workshop Purpose:

In delivering its mandate the Working Group is convening a national workshop to engage all jurisdictions in the project. The workshop will focus on:

- *Determining an indicator framework including objectives;*
- *Identifying a set of useful indicators based on scientific accuracy and validity; and,*
- *Discussing the creative package by which the indicators can be communicated to Canadians.*

Workshop Results:

The Working Group will consider the insight, knowledge and advice obtained at the workshop. Discussions will form the basis for national climate change indicators, and communications mechanisms to be used.

Hotel Information:

A block of rooms has been reserved under CCME. Participants are asked to make their own reservations.

Day 1: Monday, November 6, 2000
Developing an indicator framework and identifying candidate indicators

8:00 **Continental breakfast and workshop registration**

8:30 **Welcome, Introductions and Opening Remarks –**
Background to the Project and purpose of workshop
Roger Street, Co-Chair, CCME Working Group
Ron Zukowsky, Co-Chair, CCME Working Group

8:45 **Context Setting Presentations**
Fred Wrona – NWRI – Climate change in the north
Roger Street – CMC – Canada Country Study

9:15 **Participants' Round Table – Sharing Knowledge on Climate Change Indicators**
International Context: Anne Kerr, Environment Canada
What we know, what we don't and discussion of emerging trends in other jurisdictions.

10:00 **Break**

10:30 **Vision: A "made-in-Canada" Indicator Framework**
Brainstorming session on the type of indicator framework and content and creative methods of communicating climate change to Canadians
Demonstration on Communicating Indicators: Ron Zukowsky

11:15 **SESSION 1: Developing the Indicator Framework**

In this plenary session, participants will brainstorm key components for an indicator framework from a "user" perspective. This session may include:

- *Goal(s) for climate change indicators*
- *Objectives for identifying indicators (selection criteria)*
- *Potential categories or groupings for indicators*
- *Issues of scale, and geographic/regional needs*
- *Audience needs - Potential differences between indicators which communicate to Canadians and indicators which are based in sound science.*

12:15 **Luncheon (provided)**

1:15 p.m. **Fine-tuning the Framework – Participant Discussion on Session 1**

1:30 **Reviewing Climate Change Indicators**
Co-Chairs present charge to participants.
Facilitated Small breakout sessions will discuss a candidate set of indicators.

3:30 **Break**

3:45 **PLENARY SESSION: REPORTS AND DISCUSSION**
Small groups will report results to plenary. A synthesis of areas of agreement and disagreement will be presented by participants.

4:30 **Review Day 2 Work and Adjourn Day 1**
❖ *Co-Chairs provide perspectives and Review Day 2 work*

Day 2: Fine Tuning Indicators
and Developing the Communications Strategy

8:30 **Welcome and Purpose of Day 2**
Co-Chairs review results of Day 1 and charge participants for Day 2.

8:45 **Breakout Sessions on Indicators**
Facilitated Small groups further discuss indicators –
- *Which indicators can we agree on?*
- *Reasons to consider indicators we disagree on*
- *Emerging indicators/issues to watch*

10:15 **Break**

10:30 **PLENARY SESSION : Reports and Discussion**
- *Results of the breakout sessions are reported. A set of indicators is discussed for potential consensus.*
- *Emerging issues, data needs, etc. are identified.*

11:30 **PLENARY SESSION: Communicating Indicators**

- *Brainstorm discussion on communicating indicators*
- *Identifying elements of a communications plan*

12:00 **Luncheon (provided)**

1:00 **Detailing the Communications Plan**
Small group sessions work up the details of each element – e.g., tactics, audiences, tools, messages.

2:30 **Break**

2:45 **PLENARY SESSION: Reports and Discussion on the Communications Plan**
- *development of elements and advice for communicating indicators*

3:00 **Summation of Workshop Results**
- *facilitator summation of results*

3:30 **Next Steps and Closing Remarks**
- *Co-Chairs closing remarks*

Backgrounder
CCME Climate Change Indicators for Canada

Goal: To provide Canadians with a national snapshot of trends of climate change in Canada and associated implications for those things that Canadians value

The Job: A Project Working Group[4] has been established to identify, assemble, and ensure that a set of indicators is prepared that has technical merit. This set of indicators will be made available through a number of communications products, which are suitably accessible for the target audience.

Audiences: The PWG is preparing this work for the Ministers, who in turn will communicate it to the General Canadian public. Information will also be used by educational institutions, the media, policy and decision-makers in the public and private sectors.

The Process:

The Working Group will have the indicators available for communication purposes by September 31, 2001. In conducting this task, it is:

- Consulting with experts from across the country at a workshop;
- Relying on the contribution of member jurisdictions for data and related information which comprise the preliminary set of indicators;
- Developing selection criteria (see below) which ensures a sound and engaging communications package is prepared for the ministers
- Ensuring that presentation media is accessible, innovative and relevant to Canadians including use of multi-media and multi-level formats (e.g., CD-Rom, colour posters, newspaper supplements, internet access – clickable maps by region, sector or other category)

Approaches to Organizing Indicators

The Working Group has identified at least three approaches that could be used to organize indicators. These are described below:

- Quality of Life factors include: Personal Health and Safety (e.g., thermal stress, air quality); Jobs and the Economic Well-being (e.g., tourism industry); Social and Communities Well-being (e.g., water quality/quantity); Physical Environmental (e.g., sea and lake ice, river freshet, frost free period);

[4] The Project Working Group consists of Co-Chairs Ron Zukowsky, Saskatchewan Environment and Resource Management and Roger Street, Environment Canada; Randy Angle, Alberta; Risa Smith, British Columbia; Dick Stephens, Manitoba; Aynslie Ogden, Yukon; Anne Kerr, Canada; Rob Cross, Canada; Rolande Laveau, Quebec; Gwen Goodier, Quebec; Raymond Wong, Alberta; Mike Gill, Yukon; Heather Blumenthal, Quebec; Krista Nakrieko, Manitoba; Dave Besner, New Brunswick; and Creighton Briscoe, Nova Scotia.

Ecosystem Health (e.g., change in the range of species, fire frequency, flood frequency, etc.)

- By Sectors: Agriculture and Food; Forestry and forest products; Energy; Wildlife and Landscapes; Manufacturing; Transportation; Communities; Health; Parks, Recreation and Tourism;
- By Regions: provincial/territorial jurisdiction and other major ecozones; both climatological and sectoral indicators relevant to the region are available (e.g., BC – climate, forestry, coastal ecosystem, etc.)

Indicator Selection Criteria

Indicators to be selected include those which:

- identify **state of climate** and observed trends (e.g., temperature, precipitation, sea-level, freshwater and marine ice, hydrology). State indicators should show significant regional extremes and gradients or areas particularly sensitive to climate change and/or the changes have been or are projected to be significant; and,
- provide an understanding of **impacts** on health and safety, water, socio-economic development/sustainability, food supply, communities, infrastructure, natural ecosystems and landscapes, etc.

The following criteria for selecting indicators are proposed. Indicators should:

- focus on climate change and its impacts on things Canadians value;
- address specific policy concerns (UNFCCC Article 2, Canada Country Study)
- be understandable and resonate to the intelligent lay person
- provide a national perspective on what climate change and its impacts mean to Canada and Canadians (include regional variations where relevant)
- have a long and accurate record of observations;
- have data which is easily available and expected to be so for the foreseeable future; meta data should be available regarding data collection methods and archiving
- be sensitive to year-to-year variations in climate (using long-term historical information),
- be expected to change in response to projected changes in climate, and,
- as much as possible, be relatively insensitive to non-climatic factors.

Adaptation strategies could be built into a brief discussion of the implications of observed trends under each indicator.

Appendix C List of Participants

Name	Affiliation
Heather Blumenthal *	Environment Canada, Climate Change Bureau
Rob Cross *	Environment Canada, Meteorological Service of Canada
Everett Dorma	Saskatchewan Environment and Resource Management
Joanne Frappier	Natural Resources Canada
Mike Gill *#	Canadian Wildlife Service, Yukon Territory
Doug Haines	Statistics Canada
Anne Kerr *	Environment Canada, Indicators and Assessment Office
Rolande Laveau *	Environnment Québec
Joe Muldoon	Saskatchewan Environment and Resource Management
Krista Nakrieko *	Manitoba Conservation
Dieter Riedel	Health Canada
Risa Smith *	BC Ministry of Environment, Lands and Parks
Roger Street *	Environment Canada, Meteorological Service of Canada
Stephen Wolfe	Natural Resources Canada, Geological Survey of Canada
Raymond Wong *	Alberta Environment
Aining Zhang	Natural Resources Canada, National Atlas of Canada
Ron Zukowsky *	Saskatchewan Environment and Resource Management
David Dilks	Facilitator, Lura Consulting
Joanna Kidd	Co-Lead Facilitator, Lura Consulting
Sally Leppard	Co-Lead Facilitator, Lura Consulting

* Members or alternate members of CCME's Project Working Group
# Mr. Gill participated in the plenary sessions by telephone from the Yukon

Appendix D
Presentation Slides
Canada Country Study

The Canada Country Study

What do we know about impacts and about adaptation?

- The Canada Country Study: Climate Impacts and Adaptation
  - first national assessment of the state-of-knowledge
  - a capacity building exercise
  - a review of existing literature - based on existing research
  - identified impacts for regions, sectors and Canada as a whole
  - identified knowledge gaps

Canada Country Study - Highlights

Identified the current state of knowledge with respect to impacts and adaptation under the following categories:

- international;
- domestic (costs and security);
- protecting infrastructure (building and construction, insurance);
- maintaining vibrant industry (energy, transportation);
- ensuring social well-being (human health, recreation and tourism);
- sustaining food and fibre production (agriculture, fisheries, forestry); and
- foundation blocks (water, natural ecosystems).

Canada Country Study - International

As member of global community, Canada is sensitive to impacts and responses in other countries - trade, foreign policy, international relations, security, environmental refugees, and international finance

trade - part of the global market - forestry and agriculture
security and increased diplomatic turmoil
transboundary water management
sovereignty in the North
international common property - fish stocks; and
role in regional conflicts - peacekeeping
environmental refugees - implications for health and social infrastructure

Canada Country Study - Domestic

Impacts of climate change will cost Canadians economically, socially, culturally and environmentally
Adaptation to climate change (positive and negative) is not without costs
technical adaptation - engineering solutions
environmental adaptation - ecosystem changes
social adaptation - changes in lifestyle and employment
Domestic security
regional and national disasters
increased surveillance and search and rescue (Arctic)

Canada Country Study - Infrastructure

Building and Construction

increased length of construction season, decreased winter season - implications for access via ice/snow roads in North

- increase in frost heave, thaw settlement and slope instability - implications for foundations, utility lines, pipelines and mining operations

building security and integrity - implications for snow, wind and rain loading along with changes in freeze/thaw cycles

flooding and other extreme events - implications for vulnerable structures, docks and port facilities as well as storm sewers

Insurance

- property and casualty insurance most vulnerable - increased social vulnerability - implications for increased public and personal responsibility

Canada Country Study - Industry

Energy

- demands of residential sector expected to decrease in relative terms - decreased heating degree days and increased cooling degree days
- supply
- decreased river and reservoir levels could decrease hydro generation potential
- decreased ice cover in Arctic both positive and negative implications (longer open-water season)
- coal mining operations - increased erosion and landslides

Transportation

- decreased snow-removal costs in some areas
- reduced length of snow/ice roads
- increased costs of road repair due to permafrost and freeze/thaw cycle changes
- lengthened shipping season
- lowered freshwater levels - decreased carrying capacity

Canada Country Study - Social Well-Being

Human Health (young, elderly, frail and the ill especially in urban areas)

increase in frequency and severity of heat waves

increased exposure to extreme events - infectious diseases, social disruption and environmentally enforced migration

increased potential for exposure to infectious diseases encephalitis, lyme disease and hantavirus

increased exposure to exacerbate air pollution - respiratory disorders

environmental contamination - cryptosporidium, sea-food toxins, and reduced water quality

Recreation and Tourism

extended summer outdoor recreation - increase demand

increased beach maintenance costs - SLR and freshwater losses

recreational fishing, hunting and bird-watching - fish and wildlife displaced due to habitat loss or increased competition

shorter winter outdoor recreation season - implications for ice-fishing, skiing, and snowmobile seasons

Traditional Lifestyles

- subsistence patterns and the sustainability of subsistence lifestyles are vulnerable - availability and distribution of wildlife and access to fishing and hunting areas - ice

Canada Country Study - Food & Fibre

Agriculture

rate of crop development is projected to increase - reduced timing between seeding and harvesting

yields are projected to increase in some areas and decrease in others - temperature increases and water shortfalls

some expansion of land are suitable for commercial crop production

increased summer stress on livestock while reduced cold stress in winter

longer and warmer frost-free periods

Fisheries

decreased and more variable sustainable harvest for Pacific southern salmon

overall sustainable harvests could decrease in the Atlantic

increases in Arctic sustainable harvests for most fish populations

decreases in sustainable harvest in southern freshwater - declining water levels, flow rates and increased water temperatures

- increases in sustainable harvest in northern freshwater - longer warmer growing season and relatively smaller changes in water levels

Forestry

- changes in the growth and regeneration capacity of forests in many regions - altering function and composition of forested areas
- increased drought stress, increased in frequency and severity of fires, increased vegetation growth rates, and potentially more frequent storm and wind damage in coastal area

shift northward and to higher altitudes - limited by soil

grassland and temperate species are projected to invade from the south

Canada Country Study - Foundations

Water - foundation for species existence and distribution

conflicting demands and limited supply

- changes in flow regime due to changes in precipitation (snow and rain), evaporation, and changes in glacial melt water availability

more vigorous hydrological cycle - too much water, too little water, wrong place, wrong time

Canadians spend over a billion dollars per year in water resources sector adapting to current climate conditions

Natural Ecosystems

plant growth increase on average

boundaries of existing vegetation and wildlife species could shift to higher latitudes and elevations - invasions

High Arctic Peary caribou and musk oxen may become extinct, while mainland caribou would come under significant stress

- semi-permanent wetlands may change from open-water dominated basins to vegetated areas and wetland salinity could increase significantly

summer and winter habitats and migratory routes, including coastal staging grounds (SLR and drying of wetlands)

Canada Country Study

Suggested priorities for future impacts and adaptation research:

water, ecosystem sensitivities, urban issues, human health, integrated air issues, costing, TEK, adaptation

Results of the Study have been made available to Canadians:

scientific and technical documents and summaries

hard copy, Internet, and CD-ROM versions

National Symposium (November 1997)

Appendix E: Climate Change Indicators: Existing and/or Proposed

COUNTRY/REGION	HUMAN ACTIVITY/ STRESS INDICATORS	STATE/CONDITION INDICATORS	EFFECTS/ IMPACTS INDICATORS	RESPONSE INDICATORS
Canada (*National Environmental Series*. 1998. Environment Canada)	• CO_2 emissions from fossil fuel use • Global atmospheric concentrations of GHGs	• Global and Canadian temperature variations		
Denmark (*The Environment in Danmark 1999. Selected Indicators.* 2000. Ministry of Environment and Energy.)	• Global emissions of CO_2 • CO_2 emissions per person • CO_2 emissions in Denmark • CO_2 emissions per unit of energy	• Global and Danish temperature trends		
European Environment Agency (*Environmental Signals 2000. European Environment Agency regular indicator report*. 2000. European Environment Agency)	• Total EU emissions of GHGs (CO_2, CH_4, N_2O) • Total EU GHG emissions by sector	• Global and European annual mean temperature deviations		
Finland (*Signs of Sustainability. Finland's Indicators for Sustainable De velopment 2000*. 2000. Finnish Environment Institute)	• GHG emissions	• Finland's mean temperatures • Ice break-up date of the river Tornio		

COUNTRY/REGION	HUMAN ACTIVITY/ STRESS INDICATORS	STATE/CONDITION INDICATORS	EFFECTS/ IMPACTS INDICATORS	RESPONSE INDICATORS
France (*Environmental Performance Indicators in France*. 1996-1997. Institut français de l'environnement)	• National aggregate emissions of GHGs • Quantity of CO_2 emissions per inhabitant in France and selected EC member states			
Great Lakes Basin Ecosystem (*Selection of Indicators for Great Lakes Basin Ecosystem Health. Version 4*. 2000. P. Bertram and N. Stadler-Salt.		• First emergence of water lilies in coastal wetlands • Ice duration on the Great Lakes	• Number of extreme storms	
Mexico (*Report on the Development of Environmental Performance Indicators in Mexico.* 1997.General Directorate of Environmental Management and Information)	• Global emissions of CO_2 • National CO_2 emissions • GHG emissions by type of activity • GHG emissions from energy consumption • Global concentrations of GHGs	• Variations in global temperature		
New Zealand (*Environmental Performance Indicators: Proposals for stratospheric ozone and climate change indicators.* 1998. Ministry for the Environment)	• Levels of GHGs (CO_2, CH_4,N_2O) • CO_2 emissions by sector • Net CO_2 emissions (gross CO_2 emissions less net CO_2 removal by forests)	• Average NZ temperature • Rainfall indices • Detailed temperature indices • Changes in windiness • Average sea surface temperature	• High country snow cover • Sea level • Storm damage • Spread of subtropical grasses	

COUNTRY/REGION	HUMAN ACTIVITY/ STRESS INDICATORS	STATE/CONDITION INDICATORS	EFFECTS/ IMPACTS INDICATORS	RESPONSE INDICATORS
Norway (*Natural Resources and the Environment 2000, Norway*. 2000. Statistics Norway)	• Emissions of CO_2 by source • Norwegian emissions of GHGs • Emissions of CO_2 in relation to energy use in transport sector (Norway, Canada, New Zealand, Sweden)	• Changes in global mean temperature compared with the normal value		
OECD (*Towards Sustainable Development. Environmental Indicators*. 1998.)	• CO_2 emission intensities • GHG concentrations			
United Kingdom (*Indicators of Climate Change in the UK*. 1999. Department of Environment, Transport and the Regions.		• Air temperature in central England • Seasonality of precipitation • Precipitation gradient across the UK • Predominance of westerly weather • Dry and wet soil conditions in southern England • Appearance of ice on Lake Windermere	• River flows in NW and SE Britain • Frequency of low and high river flows in NW and SE Britain • Groundwater storage in the Chalk in SE Britain • Sea level rise • Risk of tidal flooding in London • Domestic property insurance claims related to damaging weather events • Supply of gas to households • Domestic holiday tourism • Scottish skiing industry • Number of outdoor fires	

COUNTRY/REGION	HUMAN ACTIVITY/ STRESS INDICATORS	STATE/CONDITION INDICATORS	EFFECTS/ IMPACTS INDICATORS	RESPONSE INDICATORS
			• Incidence of Lyme disease in humans • Seasonal pattern of human mortality • Use of irrigation water for agriculture • Proportion of potato crop that is irrigated • Potato yields • Warm-weather crops: grapes, forage maize • Late summer grass production • Date of leaf emergence of trees in Spring • Health of Beech trees in Britain • Dates of insect appearance and activity • Insect abundance • Arrival date of the swallow • Egg-laying dates of birds • Small bird population changes • Marine plankton • Upstream migration of salmon	
United Nations Commission on Sustainable Development (UNCSD) (*Core selected indicators for*	• Emissions of GHGs • Level of compliance with national reduction targets for GHGs		• Sea level rise	• Expenditures

COUNTRY/REGION	HUMAN ACTIVITY/ STRESS INDICATORS	STATE/CONDITION INDICATORS	EFFECTS/ IMPACTS INDICATORS	RESPONSE INDICATORS
sustainable development. 2000.)				

Appendix F
Presentation Slides
Communicating Indicators

Communicating Indicators

CCME Climate Change Indicators Project
Delta Hotel, Toronto
November 6-7, 2000

Presentation Overview

Background to Climate change Indicators Project
Audiences

- Issues in assessing audiences
- Who are they?
- What do they already know?
- What are they like and what do they value?

Communication Formats

- Print, Broadcasting, E-media

Implications for Indicator selection

Terms of Reference

Background
Goal:

- To provide the general Canadian Public with a national snapshot of trends of climate change in Canada and associated implications for those things that Canadians value

Objectives:

- A set of Canadian indicators of climate change suitable for communications purposes
- Use media/formats to facilitate broad communications
- By September 30, 2001

Who are the Audiences?

Audiences

- Listed in Terms of Reference
- Primarily the general Canadian public
- Secondary audiences:
    - Educational institutions
    - The media
    - Public sector policy and decision-makers
    - Private sector policy and decision-makers

Why?

CCME wants to engage Canadians on climate change implications:

- Projected impacts concern things Canadians value
- Projected impacts will vary across Canada
- Canadians should be informed about climate change
- Need sound, unbiased information on impacts, both positive and negative

Issues to consider?

Audiences

Effective communications requires an analysis of the audience

- What do they know - a question of fact
- What would they like to know - a question of values and utility
- How would they like to be informed - convenience

New information valued over already known

Values and utility engage audience most strongly

Select indicators strongly linked to values and utility

What does the audience already know?

The public is aware of climate change

- 70% have a clear recall; 25% have a vague

Sask Omnibus poll

- Believes climate is changing
- Believes humans are inducing the change
- Mixed views on whether or not change has been or will be positive or negative

Implications for indicators

- Profile information new to the audience on direction of change
- Challenge existing views where incorrect
- Spin out implications: drill out vs. drill down

What is the audience like?

Audience profile influences values and utility

Citizens: Country, province, region, community

Gender, age and family status

Producers

- Hold jobs, make goods, provide services

Consumers

- Incomes, travel and spending patterns

Cultures and nationalities

Lifestyles and quality of life goals

Implications for indicators

Indicators which touch Canadians on a number of these dimensions will be more powerful and engaging

Indicators which have value and utility only for specific audiences will be less powerful.

Impacts on specific audiences can evoke a sympathetic response if they are considerable, e.g., ice storm, Red River flood

Examples of Audience Profiles

Recreation

- Survey on Importance of Nature to Canadians, 1996
    - Relaxing in outdoor setting (32.4%)
    - Sightseeing in natural areas (31.1%)
    - Swimming or beach activity (23.7%)
    - Camping (18.8%)
    - Downhill Skiing (4.7%)
    - Cross country skiing(3.5%)
    - Snowmobiling (2.5%)

What do Canadians Value?

What are the "hot buttons" around values and utility?

Priorities next 5 years	*Immediate*
Health Care	Health care
Education	Education
Children's Issues	Economy
The environment	Unemployment
Crime and Justice	Taxes

Linking Values to Climate change

Readiness to make personal lifestyle changes if:

- Quality of life of children is at risk
- Improves air quality
- My health is being affected
- Business and Industry take concrete action
- Negative impact on animals and nature
- Linked to Extreme weather events
- Government takes action
- Increases personal disposable income
- The science behind climate change

Implications for Indicators

Possibility to use indicators to influence actions

More powerful indicators

- Touch Canadians and their families directly and personally
- Emphasis on children, personal health, family security
- What business and industry are doing
- Linked to what individuals can do

Less powerful indicators

- Impacts on natural environment
- What government is doing
- Science of climate change

Media Formats

Print, Broadcasting, E-media

Print and Broadcasting

- Brochures, publications, mail-outs, advertising

E-media: E-mails; CD-ROMs; Internet sites

Issues

- Accessibility
- Navigability
- Targetability
- Extendability
- Interactivity
- Associated Processes: meetings, displays, conferences

Implications for Indicators

Technology permits a large number of indicators to be stored, accessed and displayed

Issues really are:

- Which indicators are profiled for a general audience
- Which indicators are targeted for specific audiences or for reference purposes
- What data have we and what needs collection?
- How best to present implications of changes in indicators vividly

English Flooding Example

One picture is worth a thousand words

- York Town Crier John Redpath reports that floodwaters still rising. No improvement for 48 hours
- Or...

Summary

Profile information new to the audience

- Challenge existing views
- Spin out implications: drill out vs. drill down

Profile more powerful indicators:

- Have a high number of linkages to audience characteristics and their values and utility
  Touch Canadians and their families directly and personally; link to action

Technology permits assembly of a wide variety of indicators and accessibility to a wide variety of audiences

Appendix G: Notes from Small Group Discussions

Notes from Group #1: Facilitator, Dave Dilks

1.0 PARTICIPANTS

Participants included: Rolande Laveau, Joe Muldoon, Krista Nakrieko, Dieter Riedel, Risa Smith, Stephen Wolfe and Aining Zhang.

POTENTIAL CLIMATE CHANGE INDICATORS

During breakout sessions on the first and second day of the workshop, the group discussed a list of potential indicators of impacts of climate change. The key result of this discussion – a "long list" of potential indicators -- is provided in a tabular summary of the following pages.

The tabular summary provides the group's perspectives on:

- Potential indicators for each of the five indicator framework categories – physical environment; personal health and safety; jobs and economic well-being; social and community well-being; ecosystem health – identified during the plenary sessions.

- Audience – whether the potential indicator would be of interest to the general Canadian audience or to a more specific audience.

- Interest, Utility and Value – whether the potential indicator is of high interest, utility or value.

- Likelihood of Encouraging Action – whether the potential indicator is likely to encourage personal action on climate change to either mitigate or adapt to the impact.

- Data Availability – whether data are available to facilitate use of the potential indicator.

Due to time constraints, the group was not able to fully complete their review of proposed indicators for physical environment and ecosystem health.

"LONG LIST" OF POTENTIAL INDICATORS OF IMPACTS, GROUP ONE

Category of Impact	Potential Indicator	Audience?	High interest, utility or value?	Likely to encourage action or adaptation?	Data available?
Physical Environment	Frequency & intensity of snow avalanches				
	Shrinkage of polar ice caps / glacial hydrology	General			Yes (from "ice center")
	Frequency / intensity of extreme events (flooding, hail, tornadoes, thunderstorms, droughts, etc.)				
	Change in permafrost				
	Change in sea level	General	Yes (especially in coastal areas)	Yes	Yes
	Number of frost-free days	General (easy to communicate)	Yes		Yes
	Ice in, ice out dates				
	First flowers, birds and bees			Yes (a good way to get community involvement)	
	Change in flow rates (hydrology)				

Category of Impact	Potential Indicator	Audience?	High interest, utility or value?	Likely to encourage action or adaptation?	Data available?
	Salinity of Arctic marine environment				
	Groundwater levels (e.g., rise of depletion of aquifers)	General (but would show regional differences also)	Yes	Yes	May not have good data in all parts of the country
	Number of days above / below 30 degrees				
	Frequency / changes in winds (westerlies, chinooks)				
Personal Health and Safety (or "Human Health and Well-Being")	Change in range of disease vectors (e.g., malaria, Lymes disease, hantavirus)	General	Yes (national interest)	Yes	Yes (for Lymes, ticks)
	Illness / death due to extreme weather (e.g., heat stroke	General	Yes (national interest)	Yes	Yes (good data available)
	Stratospheric ozone depletion	General	Yes (national interest)	Yes	Yes (UV Index)
	Sunburn (this could be linked to ozone depletion)				
	Incidence of skin cancer (this could be linked to ozone depletion)				

Category of Impact	Potential Indicator	Audience?	High interest, utility or value?	Likely to encourage action or adaptation?	Data available?
	Number of sunshine days / hours				
	Number of snow and ice days				
Jobs and Economic Well Being	Sustainability of resource-based jobs	General	Yes - Very High (national & regional interest)	Yes (retraining)	Yes (e.g., CFS data for 1991 and 2000)
	Weather impacts on major transportation (e.g., winter roads, water-based, pipelines, etc.)	General	Yes	Yes (especially governments)	Yes (for winter roads)
	Impacts on power generation (could use hydrologic flow as a measure)	Specific (B.C. & Great Lakes area)	Yes	May cause industry to act	Yes (hydro industries)
	Water supply	General	Yes (national interest)	Yes	Yes (drinking water, wells, beach quality)
	Crop damage	General	Yes	Yes (especially farmers)	Yes (crop insurance data)
	Production capacity of resource-based industries (agriculture, forestry, fishing, mining)	General	Yes	Likely (more for adaptation)	Some (for agriculture and forestry)

Category of Impact	Potential Indicator	Audience?	High interest, utility or value?	Likely to encourage action or adaptation?	Data available?
	Weather-related losses (could link this to insurance rates; this could be a measure for crop damage)	General	Yes	Maybe (depends on type of loss)	Yes (insurance industry)
	Length of growing and harvesting season (this could be a measure of agricultural capacity)				
	Factors affecting the construction season	General	Yes	Likely not (but could lead to use of different methods)	Likely (home-builders' associations)
Social and Community Well Being	Recreational opportunities (e.g., ice fishing, use of snow-making equipment, etc.)	General	High to Moderate	Maybe?	Yes
	Social connectivity (e.g., no. of potential BBQ or outdoor party days, etc.)				
	Duration of winter roads (this could be linked to the transportation indicator under "economic well-being")				
	Availability of subsistence foods and vegetables ("country food", "food from the wild")	Specific	Yes (but regional interest)	Not likely	Very little (have some for recreational fishing)

Category of Impact	Potential Indicator	Audience?	High interest, utility or value?	Likely to encourage action or adaptation?	Data available?
	Expenditure on infrastructure for adapting to change (need to choose example communities, e.g., GVRD	General	Yes (national and local interest)	Yes	Yes (at the municipal level)
	Number of beach days (could be linked to a "primary impact" indicator)	General	Yes	Questionable	Yes
	Crime and violence (as they relate to weather)	General	Questionable		Recent Quebec study could provide model
	Disruption due to extreme events (e.g., flooding, ice storms)	General	Yes (national and regional interest)	Yes (especially at municipal level)	Yes
Ecosystem Health	Water quality	General	Yes (national and regional)	Yes	Some (but not consistent across Canada; need to confirm WQ index)
	Change in range of species / migration patterns (e.g., salmon, polar bear, migratory birds, caribou, monarch butterflies)	General and Specific	Yes	Likely – for some species	Some (e.g., migratory birds)

Category of Impact	Potential Indicator	Audience?	High interest, utility or value?	Likely to encourage action or adaptation?	Data available?
	Surface water quantity (need to identify regional water bodies: e.g., Great Lakes, St. Lawrence R., Fraser R., Mackenzie R., Red R., Sask. R., Bow R., etc.)	General	Yes	Yes (e.g., water conservation)	
	Reproductive cycle of indicator species (including birds, fish, etc.; each region would need to have a representative species selected)	General and Specific	Moderate	Maybe	Some (but not easy to get)
	Intensity and frequency of major disturbance events	General	Moderate	Maybe	Very good (especially for insects and fires)
	Net primary productivity	Specific			Questionable (1994)
	Change in vegetation composition (e.g., shift in forest composition)	General	Moderate	No	Some (satellite data but not trend data)
	Air quality (could use the Humidex; this may also fit under personal health and well-being; this may also be a "primary impact" indicator)	General	High	Yes (but maybe not for all people)	Yes (but hard to make the link to climate change)
	Introduction of non-indigenous or exotic species	General	Low	No	Some (for plants, bird counts; difficult & expensive to get)

Category of Impact	Potential Indicator	Audience?	High interest, utility or value?	Likely to encourage action or adaptation?	Data available?
	Change in area of major ecosystem types (e.g., wetlands, forest, etc.)	General	High	No	Some (but very old and will be hard to link to climate change)
	Moisture of soil	General	High	Not likely	Yes (good data for agricultural land; link to climate change will be difficult to make)

3.2 "Most Promising" Indicators of Impacts

In reviewing their "long list" of potential indicators of impacts, the group identified the following indicators as "most promising" for inclusion as part of a set of national climate change indicators. Where provided, supporting rationale is included in brackets.

Physical Environment

- Shrinkage of polar ice caps / glacial hydrology (this indicator would be a symbolic "icon")
- Change in permafrost
- Change in sea level (plenty of data available; would be of very high interest in coastal areas)
- Number of frost-free days (plenty of data available; easy to communicate)
- Ice in, ice out dates (this would be an indicator that would "integrate" impacts from all or most categories of the framework)
- Salinity of Arctic marine environment
- Ground water levels, e.g., rise of depletion of aquifers (would show regional differences; would link nicely to changes in precipitation – an indicator of "primary impacts")

Personal Health and Safety ("Human Health and Well-Being")

- Change in range of disease vectors, e.g., malaria, Lymes disease, hantavirus, etc.
- Illness / death due to extreme weather, e.g., heat stroke
- Stratospheric ozone depletion (would provide a direct relationship to climate change)
- Number of sunshine days / hours (would provide a strong link to indicators of social and community well-being)
- Number of snow and ice days (would provide a strong link to indicators of social and community well-being)

Jobs and Economic Well-Being

- Water supply
- Crop damage (could link this indicator to crime and violence; plenty of good data from insurance statistics)
- Weather-related losses (this could be a measure for crop damage)

Social and Community Well-Being

- Recreational opportunities (this indicator could be directly linked to "primary impact" indicators, such as snowfall, to make this relevant for people)
- Disruption due to extreme events (e.g., flooding, ice storms)

Ecosystem Health

- Water quality
- Surface water quantity

- Reproductive cycles for indicator species
- Intensity and frequency of major disturbance events, e.g., fires, insect/disease outbreaks, etc.
- Moisture of soil (but will be difficult to link this to climate change)

3.3 "Emerging" Indicators for Consideration

The group also felt that the following indicators should be considered further for inclusion in the set of indicators, in spite of data gaps or other shortcomings. Where provided, supporting rationale is included in brackets.

Physical Environment

- First flowers, birds and bees (this indicator could provide a good vehicle for getting communities involved in data collection and/or monitoring)

Social and Community Well-Being

- Expenditure on infrastructure for adapting to change (would need to choose some example communities, e.g., GVRD; this could provide a tangible impact that can be communicated easily to the public)

Ecosystem Health

- Introduction of non-indigenous or exotic species

3.4 "Gaps" that Should be Filled

The group identified several "gaps" and indicators that could fill these:

Jobs and Economic Well-Being

- Factors affecting the construction season (the group felt that it is important to start illustrating the impacts of climate change on different sectors of the economy)

Social and Community Well-Being

- Crime and violence, as they relate to weather (it will be difficult to make a direct link between this indicator and climate change, but this indicator should be considered as it is a key indicator of social health; there is also a question of what an appropriate measure would be, e.g., family violence)

Ecosystem Health

- Net primary productivity (important as this was chosen by the U.S. Academy of Science as an "integrating indicator", but will be very difficult to communicate)

3.5 Potential Indicators of "Primary Impacts"

In addition to identifying potential indicators of impacts, the group also considered indicators that could address the "drivers" of climate change. The group suggested that the following indicators should be considered, and noted that these should be referred to as indicators of "primary impacts" rather than "drivers":

- Air quality
- Snowfall
- Temperature
- Rainfall
- Humidity
- Barometric Pressure

3 COMMUNICATING INDICATORS

In discussing communication needs for climate change indicators, the group considered:

3 Why? - the rationale for indicator communication efforts.
4 Who? – the key target audiences for communications.
5 What? – the key messages that need to be communicated.
6 How? – methods, products and tactics.

3.1 Rationale for Indicator Communication Efforts

In view of the working group's mandate, the group reviewed the rationale for communicating with the Canadian public about climate change indicators. It was noted that the purpose of the communication effort is to:

- educate the public about and achieve support for government policy initiatives and actions concerning climate change;
- communicate the issue of climate change (including impacts) to the public and make it real and relevant;
- take a phased approach to encourage action and adaptation by Canadians through informing people about the risks, and motivating them to take action.

3.2 Target Audiences

The group identified the following primary and secondary audiences:

Primary

- The Canadian adult public ("Mrs. Murphy", "Joe Blow") as…

- parents;
- business people (will need a special targeted approach for the business community);
- consumers;
- teachers.

Secondary

- students (as a channel for influencing parents and their communities);
- Aboriginal / Northern peoples (a key challenge will be how to engage these groups as part of the climate change indicator work); and
- other ethnic audiences.

3.3 Key Messages

The group identified the following key messages:

- Climate change is happening and will affect you.
- Although climate change is a global issue, it will affect you locally.
- Climate change will touch many aspects of your life (i.e., it is a very complex issue).
- Climate change is linked to human activities.
- The impacts of climate change are both positive and negative, but more likely negative (the indicators should tell us this).
- Some effects of impacts can be modified by adaptive strategies (e.g., changing the size of sewers).
- These adaptations will cost money.
- Mitigative measures can be taken to reduce impacts.
- Local action is part of the solution.

3.4 Communication Methods and Tactics

A wide range of approaches were suggested to reach the target audiences identified by the group:

The Canadian adult public

- Mass media: advertising; community newspapers (particularly op / ed pages)
- Environment Canada should arrange for a special climate change indicator to be reported along with weather bulletins (e.g., on the Weather Network, Meta Media, etc.)
- Case studies / vignettes
- Access and use existing national networks (e.g., SOE reporting; national atlas, etc.)
- Recruit opinion leaders and supply them with material to use

- Tap into existing community-based networks (e.g., community service groups; clergy / religious groups; artists; environmental groups) and provide them with visual and verbal tools for them to use
- Provide information on the internet, and advertise its availability
- Provide information to libraries
- Partner with organizations to reach their audiences (e.g., utilities; insurance policy holders through the Insurance Bureau of Canada)

Business

- Provide information to the business media
- Partner with key groups that reach out to businesses (e.g., Insurance Bureau of Canada; unions, etc.)

Aboriginal Communities

- Engage the Aboriginal media
- Need to access "verbal channels" – provide information to community groups, Band Councils, etc.
- Important: There is a need to communicate with these audiences during the "product development" process (ideally Aboriginal communities would be involved in the indicator selection process)
- Need to tap into existing northern resources (jurisdictional, indicator processes, etc.)

Students

- Tap into student unions, associations and newspapers
- Internet is a good way to reach students

Ethnic Groups

- Need to reach out to and engage the ethnic media

Notes from Group #2: Facilitator, Joanna Kidd

1.0 PARTICIPANTS

Participants in Group #2 included: Heather Blumenthal, Rob Cross, Everett Dorma, Joanne Frappier, Doug Haines, Anne Kerr and Raymond Wong.

2.0 POTENTIAL CLIMATE CHANGE INDICATORS

During breakout sessions on the first and second day of the workshop, the group brainstormed and then analyzed a list of potential indicators of impacts of climate change. The key results of the discussion – a "long list" of potential indicators -- is provided in the table on the following pages.

The table summarizes the group's perspectives on:

- Potential indicators for the impacts of climate change, based on the framework categories identified during the plenary sessions (physical environment; personal health and safety; jobs and economic well-being; social and community well-being; and ecosystem health).

- Audience: whether the potential indicator would be of interest to the general Canadian audience, a more specific audience (a sector or region), or for reference or research purposes.

- Interest, Utility and Value: whether the potential indicator is of high interest, utility or value.

- Likelihood of Encouraging Action: whether the potential indicator is likely to encourage personal action on climate change to either mitigate or adapt to the impact.

- Data Availability: whether data are available to facilitate use of the potential indicator.

"LONG LIST" OF POTENTIAL INDICATORS OF IMPACTS, GROUP TWO

Category of Impact	Potential Indicator	Audience?	High interest, utility or value?	Likely to encourage action or adaptation?	Data available?
Physical Environment	Water table levels	Specific	Yes	Yes	Some
	Water quality and quantity	General	Yes	Yes	Variable
	River, lake and sea levels	General	Yes	Yes (those affected)	Yes
	Glacier mass	General	Yes, Symbolic	No	Yes
	Smog days	General	Yes	Yes (in large urban areas)	Yes
	Date of ice in / ice out	Specific	Yes (in regions affected)	No	Some
	Extent of ice in arctic and other areas	Specific	Yes	No	Some
	Severe weather events (i.e., storms, lightning strikes, hailstorms, droughts, floods, tornadoes, ice storms, heat waves and freezing rain)	General plus Reference	Yes	Yes	Yes
	Growing season	General	Yes	Yes (farmers)	Yes
	Number of heating / cooling days	General	Yes	Yes	Yes
	Soil quality	Specific (farmers)	No	No	Site Specific
	Frequency of forest fires due to lightning strikes	Specific plus Reference	No	No	Yes
	Changes in windiness	Specific	No	No	Yes
	Permafrost	Specific (north)	Yes (north)	Yes (north)	Yes
Personal Health and Safety	Heat related morbidity and mortality	General	Yes	Yes	Some
	Changes in vector-borne disease	General	No	No	Yes (CDC tracks)
	Smog advisories	General	Yes	Yes	Yes

Category of Impact	Potential Indicator	Audience?	High interest, utility or value?	Likely to encourage action or adaptation?	Data available?
	Recreational pursuits (e.g., snow cover for cross-country skiing)	General	Yes	No	Some
	Health costs	Reference	N/A	N/A	Weak data, could model
	Perceptions of risk and real risk	Reference	N/A	N/A	Study needed (universities?)
	Flood and hail insurance costs/availability	General	Yes	Yes	Yes
	Length of season for local produce	General	No	No	No
Jobs and Economic Well-Being	UVB advisories	General (if link can be made to climate change)	Yes	Yes	Yes
	Tourism impacts (e.g., ski industry, length campgrounds open, Rideau Canal skating days)	General	Yes	Yes	Yes
	Forest productivity and susceptibility to disease and pests	Specific	Yes	Yes	Yes
	Agricultural productivity and susceptibility to disease and pests	Specific	Yes	Yes	Yes
	Fisheries productivity and susceptibility to disease and pests	Specific	Yes	Yes	Yes
	Hail damage insurance	Specific	Yes	Yes	Yes
	Costs of storm damage, fighting forest fires, rescue missions, clean up, etc.	General plus Reference	No	No	Yes
	Transportation (ice roads, water levels for shipping, dredging for navigation, length of shipping season, arctic shipping)	Specific	Yes	Yes	Some
	Erosion and mudslides	Reference	N/A	N/A	No
	Traditional industries (trapping, fishing, etc.)	General	Yes, Symbolic	Yes	Yes (TEK, IISD, Yukon Climate Change, Hudson's Bay Co.)

Category of Impact	Potential Indicator	Audience?	High interest, utility or value?	Likely to encourage action or adaptation?	Data available?
	Irrigation days / amount of water used	Specific	Yes	Yes	Some
	Length of season for oil and gas development in arctic	Specific	Yes	Yes	Yes
	Hydroelectric impacts	Specific plus Reference	No	Yes	Yes
Social and Community Well-Being	Traditional lifestyles (loss of hunting grounds, length of hunting season, species changes)	Specific	Yes, Symbolic	Yes	Yes (TEK)
	Recreation (e.g., no. of swimming days, no. of days for outdoor rinks, etc.)	General	Yes	Yes	Refine, then look for data
	Municipal planning and delivery of services	General	Yes	Yes	Yes
	Number of sewer overflows, basements flooded	General	Yes	Yes	Yes
	Water usage (per capita water use or number of water restrictions)	General	Yes	Yes	Yes
	Infrastructure costs (e.g., replacement of bridges)	Reference	N / A	N / A	Refine, then look for data
Ecosystem Health	Shifts in ecosystems (boreal forest, prairies, tundra, plant species)	Specific (regional)	Yes	No	Some (satellite imagery?)
	Phenology (flowering dates, migration of birds, salmon and groundfish migration, insect appearance, leaf emergence)	General	Yes	No	Some (e.g., EMAN, universities)
	Changes in diversity of animal species	Specific plus Reference	No	No	Yes (birds) Some (mammals)
	Impacts on animal species already at risk	Reference	N / A	N / A	Some
	New insects and diseases (or increased populations and frequency)	Specific	High	Yes	Yes (forest diseases)
	Primary productivity (e.g., plankton)	Reference	N / A	N / A	Some site specific (e.g., satellite imagery)

2.1 "Most Promising" Indicators of Climate Change Impact

After analyzing the "long list" of potential indicators of impacts, the group identified the following indicators as being the "most useful" or "most promising" for inclusion as part of a set of national climate change indicators.

Physical Environment

- Water quality and quantity
- River, lake and sea levels
- Glacier mass
- Severe weather events
- Heating and cooling days

Personal Health and Safety

- Heat-related morbidity and mortality
- Smog days and smog advisories

Jobs and Economic Well-Being

- Insurance costs for weather-related disasters (e.g., flood and hail)
- Tourism impacts
- Water restrictions
- Impacts on forestry, agriculture, fisheries and hydroelectric power generation

Social and Community Well-Being

- Traditional lifestyles
- Recreational days

Ecosystem Health

- An indicator of impacts on nature or wildlife (such as changes in bird populations)

2.2 Gaps in Indicators

The group identified the following as a indicator gap that should be filled:

- Emerging issues and future threats (such as changes in populations of insects, changes in frequency of diseases, or demand for bulk exports of fresh water)

2.3 Potential Indicators of Climate Change Trends ("Drivers")

The group identified the following indicators as useful indicators of climate change trends. Participants felt that it would be essential to communicate these indicators of climate change trends, along with the indicators of impacts.

- Air temperature
- Sea temperature
- Precipitation (amount and seasonality)
- Concentration of greenhouse gases in the atmosphere
- Changes in the jet stream
- Solar radiation (number of hours of sunshine)

It was recognized that, to be meaningful, some of the above indicators would have to be reported on a sub-national or regional basis.

3.0 COMMUNICATING INDICATORS OF CLIMATE CHANGE

Participants discussed communicating indicators by focusing on three questions:

- Who are we trying to reach? (i.e., audiences)
- What's the story we are trying to tell? (i.e., key messages)
- How will we tell the story? (i.e., type of product and media used)

3.1 Key Audiences

The group identified the following key audiences:

Primary Audiences

- "Joe and Joanna Canadian" who need to be reached based on their characteristics as:
  - Consumers
  - Householders
  - Earners
  - Users of recreational resources
  - Youth
  - Media
  - Rural or urban dwellers in a particular region

Secondary Audiences

- Educators
- Decision-makers

Participants stressed that we have to remember another important audience – the client (CCME).

3.2 Key Messages

Participants developed the following "story line" for communicating indicators on climate change:

- Climate change is happening now (it's not just about the future).
- Climate change is affecting many aspects of our lives and things that we value.
- It is affecting our: health, food, recreational activities, methods of travel, cost of living, economy, biodiversity and the natural environment.
- Climate change poses both opportunities and challenges.
- (We then need to explicitly make the linkages with other initiatives including adaptation and mitigation efforts).

3.3 Communication Methods and Products

Participants made the following key points about how the indicators should be communicated.

Organize the indicators of climate change impacts by theme such as:

- Water
- Seasons
- Recreation and tourism
- Householder (urban)
- Rural dwellers and farmers
- Natural resources
- Traditional lifestyles
- Health
- Nature / ecosystem health / wildlife

Use the following communication tools:

- Produce periodic print reports
- Create a series of PSAs for radio and TV
- Encourage celebrity endorsements or champions
- Develop posters (on particular themes)
- Prepare power point presentations (for ministers and others)
- Post material on a web site (such as the proposed "national hub" with regional and theme displays)
- Produce editorial content (backgrounders and stories) for news agencies and community papers
- Prepare features for the Weather Channel, @ Discovery Canada and provincial TV networks
- Provide material for the PEO Toolkit being developed for other organizations
- Provide material to the Canadian Atlas (potential cost-sharing for preparation of content and maintenance)

It was stressed that focus groups and other appropriate methods should be used in the development of the above materials to ensure that communication materials are effective.