

A photograph of an ice cave. The walls and ceiling are made of translucent, blue-tinted ice with various textures and ridges. A person in dark clothing is standing on a ledge in the distance, providing a sense of scale. Light enters from an opening at the top, creating a bright area. The overall atmosphere is cold and majestic.

Northern Science and

Technology in Canada

Federal Activity Report

April 1, 2004 – March 31, 2006

A stylized red maple leaf logo, partially visible in the bottom left corner of the page.

Canada



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Technology in Canada  
Federal Activity Report  
April 1, 2004 – March 31, 2006  
ISBN number: 0-662-37279-4

Cover page: Environment Canada/Roy Neureuther  
Inside cover: Inuit Kanatami/Eric Loring

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April 1, 2004 – March 31, 2006

# Foreword

This report describes the key issues facing the North, and the main federal interdepartmental and interagency scientific research and technology programs and related activities that address these issues.

The overall goal and objective of the *Northern Science and Technology in Canada: Federal Activity Report* is to respond to national and international needs for organized information on federal government activities regarding science and technology in the North. This report will help the federal government maximize the return on federal investment in science and technology, in partnership with other governments, universities and northern peoples, so that activities and results contribute to sustainable development, the advancement of knowledge, and an improved quality of life and environment in the Canadian North.



Source: Inuit Tapiriit Kanatami/Scot Nickels

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# Preamble

The federal government has developed the *Northern Science and Technology in Canada: Federal Activity Report* to help ensure that federally funded science and technology (S&T) contribute to improving quality of life; environmental protection; social and economic well-being; and the advancement of knowledge in northern Canada.

Recent years have seen dramatic changes in the North. The Territory of Nunavut has now existed for five years and is a model for new governance. Indian and Northern Affairs Canada (INAC) has recently devolved responsibility for land and resource management to the Yukon Territorial government. Devolution discussions are underway in the Northwest Territories and are on the horizon for Nunavut. Aboriginal people throughout Canada, including the North, have proceeded with land claim settlements and regional self-government. At the international level, Canada is active with other arctic states in the Arctic Council and new ties have been forged with non-governmental organizations concerned about arctic issues. The International Council for Science (ICSU) and the World Meteorological Organisation (WMO) are working with countries from around the world to develop scientific plans for the next International Polar Year (IPY) in 2007–2008.

Throughout this period of intense northern political and policy evolution, planning, and activity, federal and territorial governments have worked together to develop and carry out S&T activities that reflect northern aspects of the national strategy for S&T, as outlined in *Science and Technology for the New Century* (Minister of Supply and Services, 1996). In the February 2, 2004 Speech from the Throne, there was a commitment to the development of a Northern Strategy which indicates the increasingly important role of the North in federal policy and planning. This strategy will support sustainable development, the advancement of knowledge, socio-economic objectives and improved quality of life. The federal government is the largest single contributor to S&T in Canada and supports these goals throughout Canada, including the Canadian North.

The *Northern Science and Technology in Canada: Federal Activity Report* focuses on northern S&T. Many federal departments support northern S&T and this report will assist in setting priorities on an interdepartmental basis. The report also provides a coordinated federal basis for the promotion and enhancement of Canadian northern S&T cooperation, partnership and international linkages throughout the circumpolar region. The report is divided into two parts – Part I: *Northern Science and Technology in Canada:*

An Overview, and Part II: *Federal Activity Report for Science and Technology.*

The Federal Activity Report will help to encourage investment in northern S&T while also focussing on the scientific resources and expertise as well as capacity building and training that are needed to address issues that are most important to Canada and to the Canadian North, both from a national and a circumpolar focus.



Source: Inuit Tapiriit Kanatami/Eric Loring

**Definition and Boundaries of Northern Canada**

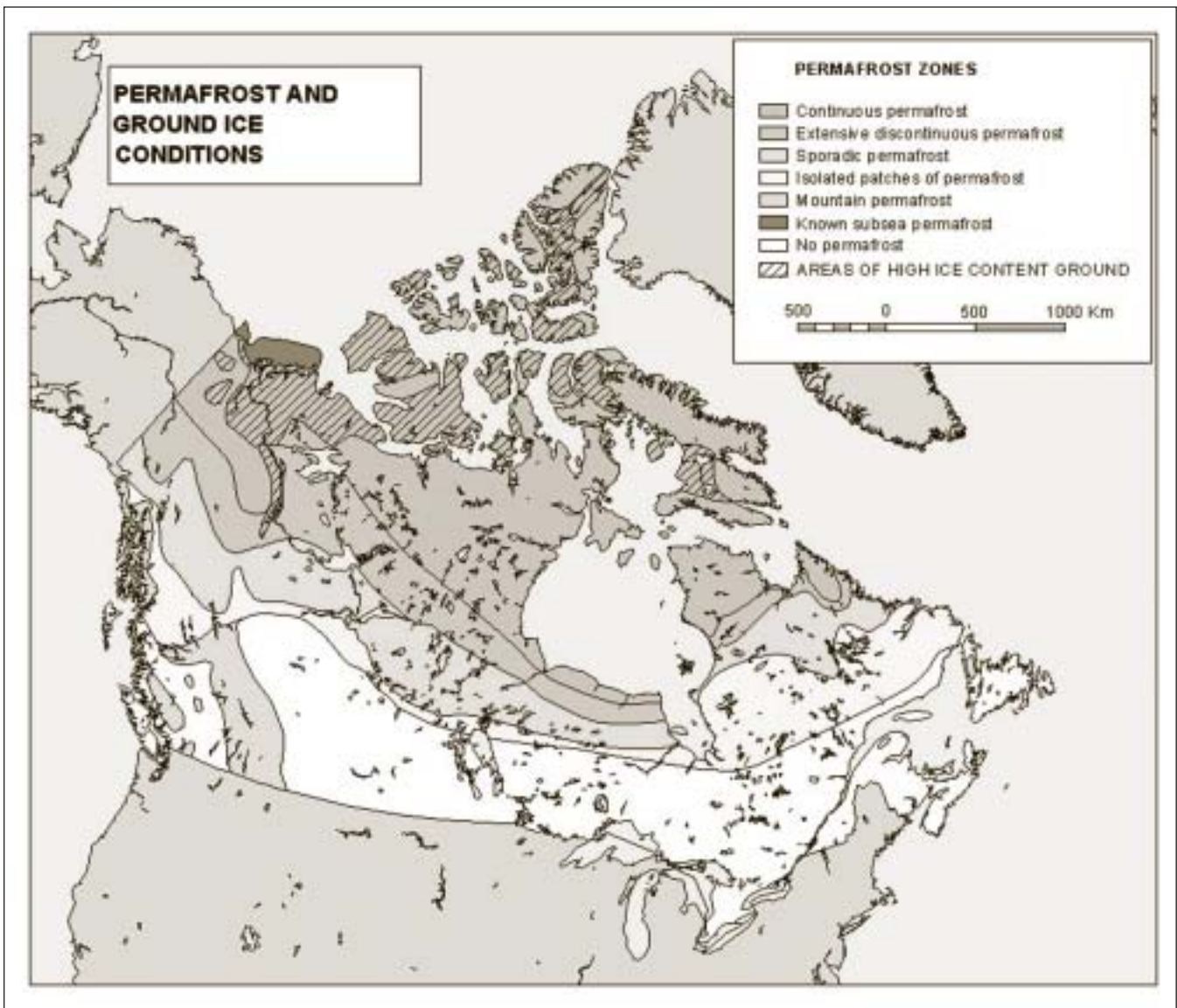
Canadian legislation, institutions, regulations, government programs and Canadians generally define the “North” in a variety of ways. As a result, the interpretation of the geographic location of the “North” or the meaning of “northern” issues may be different depending on the context or its use in different parts of the country.

Most “northern” issues and topics of scientific, research or technology development relate to common high-latitude environmental processes, socio-economic conditions and geographic location. Often, there are no exact geographic boundaries. In other cases, “northern” boundaries have been defined for specific jurisdictional purposes, and distinct policies, regulations or programs may apply within these boundaries.

The Northern Science and Technology in Canada: Federal Activity Report does not recognize a specific “northern” boundary, rather it generally interprets Canada’s northern region as the land- and ocean-based territory that lies above the southern limit of discontinuous permafrost, from northern British Columbia to northern Labrador. See the map below.



Source: Environment Canada/Ray Semkin



# Introduction

In 2000, federal government departments and agencies produced the first Northern Science and Technology: Federal Framework and Research Plan. The current report, which covers 2004–2006, is recognizably similar to and based on its predecessor and has been updated to reflect recent priorities, issues and activities in the North.

Part I outlines the guiding principles and objectives of federally funded northern S&T activities and also briefly discusses consultation, coordination and cooperation among departments and agencies. The report focuses on a number of key selected issues facing the North. Part II illustrates how the federal government is addressing key issues, and highlights the collaborative and horizontal nature that characterizes many federal northern S&T activities. The report concludes by briefly describing some major future interagency opportunities in northern S&T. A List of Acronyms is also provided. Now titled The Federal Activity Report, it continues to provide a foundation for successful northern S&T partnerships, federal coordination and cooperation, and Canadian involvement in international northern S&T initiatives.

## Principles

- Recognize the importance and distinctiveness of northern S&T within Canada.
- Respect northern land claim agreements and political evolution in the North.
- Respect distinctive social, economic, environmental and cultural characteristics of northern regions in Canada.
- Respect, accommodate and promote the advancement of Aboriginal traditional knowledge and universal scientific traditions of inquiry.
- Interpret northern S&T as an interdisciplinary mixture of the social, natural, environmental and health sciences, including Aboriginal traditional knowledge.
- Encourage consultation with and participation of northerners in all federal northern S&T activities.
- Support improving the quality of life and overall advancement of knowledge in Canada's northern regions.
- Support the promotion of Canadian leadership and cooperation in northern S&T internationally.
- Support the protection and conservation of the northern environment, as well as environmentally sustainable northern economic development.
- Support the communication of northern S&T to a wide range of users and the Canadian public.
- Support institutional cooperation in northern S&T among the federal and non-federal institutions within Canada and internationally.

## Objectives

- Provide a federal government-wide perspective on northern S&T for both domestic and international audiences.
- Highlight and promote the collaborative, cooperative and horizontal nature of northern S&T among departments and agencies.
- Enhance northern S&T cooperation among the scientists and institutions who receive federal funding, as well as northern S&T partnerships involving northern communities and institutions.
- Improve the effectiveness and efficiency of federally funded S&T programs, services and activities.
- Promote the involvement of northerners and their knowledge in northern and national issues.
- Promote and facilitate the use of Aboriginal knowledge.
- Promote and enhance the contribution of northern S&T for national goals and programs, and promote the integration of northern knowledge into national knowledge bases.
- Facilitate knowledge-based decision making in the North, as well as knowledge-based connections among community, regional, national and international issues.
- Encourage the development and transfer of technologies that support environmentally sustainable economic development in the North.
- Help build scientific expertise in the North and about the North.



### Consultation

A variety of mechanisms are used for consultation among involved federal departments and agencies, northern governments and institutions, and northern stakeholders. Federal departments and agencies that fund or conduct northern S&T are increasing the focus on the needs and interests of northern residents, including Aboriginal people, northern industries, communities, northern science institutes and land claims institutions. Most northern departments conduct a series of consultations based on responsibilities linked to departmental legislation and mandate. In recent years a number of federally funded organizations, such as the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS), the Natural Sciences and Engineering Research Council (NSERC), the Social Sciences and Humanities Research Council (SSHRC), and the Canadian Institutes of Health Research (CIHR) have initiated workshops to bring scientists and northerners together to discuss important northern themes.

### Coordination and Cooperation

Several departments and agencies share the delivery of federal northern S&T; these activities are carried out to meet specific mandates, missions and policy objectives. Nevertheless, all federal departments and agencies involved in various northern S&T activities share common goals, objectives and principles related to the conduct, impact and coordination of federally funded northern S&T. The Federal Activity Report reflects these common values and objectives.

Development and maintenance of the Federal Activity Report is coordinated by the Assistant Deputy Ministers' Committee on Northern Science and Technology, which includes representatives from Environment Canada (EC), Health Canada (HC), Department of Fisheries and Oceans (DFO), Foreign Affairs Canada (FAC), Indian and Northern Affairs Canada (INAC), Industry Canada (IC), Canadian Museum of Civilization (CMC), Canadian Museum of Nature (CMN), Department of National Defence (DND), Natural Sciences and Engineering Research Council (NSERC), Natural Resources Canada (NRCan), Parks Canada (PC), Social Sciences and Humanities Research Council (SSHRC), Transport Canada (TC) and the Canadian Polar Commission (CPC).



Source: Department of Fisheries and Oceans

## Federal Expenditures on Northern Science and Technology

The following table presents federal expenditures in support of northern S&T in 2003–2004. There is an apparent increase in the total approximate annual federal northern S&T expenditures from \$65.7M in the 2000 Federal Framework and Research Plan report to \$133M in the current 2004 report. This indicates, in part, a strengthening of the commitment of the federal government towards S&T in the North, in particular through the granting councils (NSERC and SSHRC). Most of the increases channelled through granting councils, however, are not available to federal departments. The apparent increase in the federal departmental funding between the two reports is largely the result of substantial changes in how expenditures specific to the North are recorded and presented by departments. Even so, the federal expenditures in support of northern S&T activities in the current report remain difficult to differentiate accurately from S&T activities in other parts of Canada because these expenditures are generally not classified by region. In addition, many activities are sub-components of larger national programs. Many federal program expenditures may not be specifically directed toward the development of research or technology, but have considerable impact in the North.

The following table presents approximate annual federal expenditures in support of northern S&T in 2003–2004.

<b>Federal Department or Agency</b>	<b>Approximate Annual Federal Northern S&amp;T Expenditures (millions of \$)</b>
Canadian Museum of Civilization	1.2
Canadian Museum of Nature	0.5
Canadian Polar Commission	1.0
Environment Canada	28.6
Fisheries and Oceans Canada	11.0
Foreign Affairs Canada	0.4
Health Canada	6.4
Indian and Northern Affairs Canada	6.9
Industry Canada	10.7
Department of National Defence	0.2
Natural Resources Canada	47.4
Natural Sciences and Engineering Research Council	10.6
Parks Canada Agency	5.0
Social Sciences and Humanities Research Council	2.6
Transport Canada	0.5
<b>Total</b>	<b>133</b>

Indian and Northern Affairs Canada – The Grants and Contributions portion of the Northern Scientific Training Program increased from \$ 633 k to \$ 1M for 2004–2005.

Industry Canada – Includes spending by: Canadian Space Agency; Information Highways Application Branch and National Research Council.

The Expenditure Table does not reflect one-time funding infusions such as the Canadian Foundation for Innovation grant for refit of the Canadian Coast Guard Ship Amundsen or Canadian Foundation for Climate and Atmospheric Sciences funding.

# Part I: Northern Science and Technology in Canada: An Overview

## 1.0 Implementation

Building on the first Federal Framework and Research Plan, the Task Force on Northern Research submitted its final report to NSERC and SSHRC in September, 2000. The NSERC-SSHRC Task Force determined that Canadian university northern research was in crisis and indicated that if action was not taken, Canada would be unable to: meet its international science and research obligations; contribute to issues of global importance; or, meet basic national obligations to monitor, manage, and safeguard the northern environment and respond to emerging social issues in the North.

The NSERC-SSHRC Task Force urged Canada to rebuild a vigorous, well-supported, and respected community of researchers able to undertake high-quality research in the North, generate new knowledge for Canada and the international community, and train a new generation of Canadian northern experts.

## 1.1 Logistics Support and Research Infrastructure

Logistics support for research conducted in the North, both on land and at sea, plays a critical role and is often a limiting factor affecting the success of science programs. Logistics support means physical and operational support including transportation, temporary accommodation, fuel and other supplies, which make northern research programs possible. Infrastructure to support northern research includes the existing suite of facilities, federal offices, information and communications networks that are part of the federal presence in the North. The logistics capabilities and capacity of northerners, northern agencies and private sector operators is expanding and evolving in terms of the support and services offered directly from northern communities.

NRCan's Polar Continental Shelf Project (PCSP) has historically been the largest and almost sole logistics and infrastructure support agency for government and researchers working in the Canadian Arctic. Currently, however, fully half of all research is conducted independent of PCSP support. The diversity of researchers has increased, along with the availability and evolution of logistics service delivery from northern communities, to include territorial government agencies, land claims organizations, and community groups involved in traditional knowledge work. It is expected that these trends will continue into the future.

Vessel-based research has increased over the past few years and is often conducted aboard Canadian Coast Guard (CCG) icebreakers. In 2003 the federal government converted a CCG icebreaker for use by the Canadian research community. Available for up to 6 months of the year, the CCGS Amundsen will be deployed to the North for Canadian-led national and international programs.

The current infrastructure for northern research and development is expanding, albeit slowly. After a period of retrenching and withdrawal to core facilities that coincided with financial restrictions, there has recently been more attention paid to northern

research. Historically research infrastructure has been the property and domain of southern-based federal government departments and academic organizations. This is changing, however, as territories, land claim beneficiaries, communities, universities, and the private sector are all looking at the cumulative benefits of establishing science and technology infrastructure in the North.



Source: Department of Fisheries and Oceans

## 1.2 Infrastructure Development

Federal S&T investments to support northern infrastructure and services are extremely important to northern residents. Many northern communities do not have access to highway connections and severe weather is frequent. In addition, community and residential infrastructure are provided under permafrost conditions. Technology and techniques developed by industries in the South for these purposes are often not applicable to northern conditions. Providing roads, ice roads, telecommunications, pipelines, port facilities and cold-weather construction technologies are essential services. Federally funded and conducted research helps meet the challenges of providing services and improving the quality of life for northern residents and communities. TC, DFO and NRCan deliver significant programs to support northern infrastructure development, maintenance, and services.

### 1.3 Northern Knowledge Development and Dissemination

Development and dissemination of northern knowledge do not fall under the purview of a single agency in Canada. It is diffuse and decentralized as compared to most other countries. A great deal of the knowledge in Canada has been generated as a result of research in support of defence and resource development initiatives. Dissemination of research results and knowledge has been somewhat sporadic because they are often derived from specific projects. The federal government has no centralized repository for northern knowledge. Each department and agency makes information available through its own communications branch and outreach programs.

Canada's dispersed and varied polar research community has arisen out of origins in government, academic and private sector research initiatives from across Canada, principally since the late 1940s. The research community requires coordinated institutional support to give it cohesion and focus, and to facilitate information exchange. To respond to this need, Parliament established the CPC in 1991.

### 1.4 Education and Training

Research capacity is a fundamental component of northern science. Canadian capacity declined in the 1990s and there is a need to address this issue by educating and training a new generation of researchers.

In building capacity, there is also the need to educate researchers in alternative knowledge systems (e.g., traditional knowledge) that they can incorporate into research endeavours. Educational approaches also need to be interdisciplinary because most issues in the North are quite broad in scope.

The Canadian research community recognizes the benefits of having more northerners doing research and teaching research. Programs specifically designed to provide opportunities to stimulate youth interest in science in small northern communities are required. The fact that education is a territorial/provincial responsibility, and that there is no university physically located in the North creates challenges. Links between Canadian universities, northern colleges and northern high schools to enable northern students to move on to higher education and research careers require strengthening.

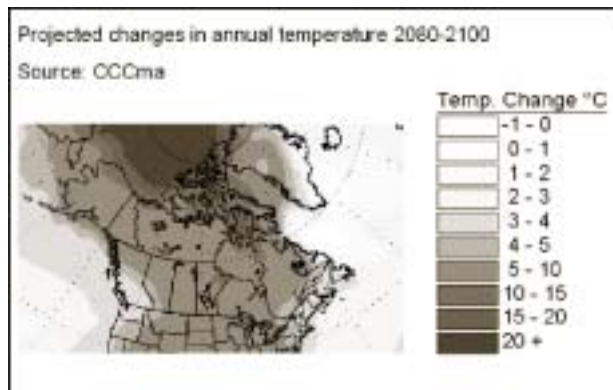


Source: Environment Canada/Ray Semkin

## 2.0 Science and Technology Themes

### 2.1 Natural Environment

There are a number of key issues in the North related to the natural environment. The following sections highlight several of the most critical issues within the themes of climate change, contaminants and toxic substances, ecosystems and biodiversity, and environmental forecasting. The issues are frequently interrelated and are brought up under several themes. For example, climate change affects issues within all four of the selected themes. Such linkages highlight the complex, connected nature of the northern natural environment. They also point to the necessity of using integrated approaches, involving several departments and agencies, in order to address the issues.



Source: Environment Canada

#### 2.1.1 Climate Change

The arctic climate is changing. This has been observed but was also predicted by general circulation models. These computer models have predicted temperatures will increase more than 4 – 5°C in the western Arctic by 2080 and cool slightly in the extreme eastern Arctic.

Other global models also show warming patterns similar to this projection. Model projections are sample images of the future based on current understanding and inherently imply a range of futures. Temperature changes of this magnitude will have a great impact on the North but even small climatic changes will lead to major ecosystem changes and associated changes in human endeavours.

More information can be found at:

[http://www.cccma.ec.gc.ca/eng\\_index.shtml](http://www.cccma.ec.gc.ca/eng_index.shtml)

[http://www.msc-smc.ec.gc.ca/education/scienceofclimatechange/understanding/ccd/ccd\\_0001/CCD\\_00-01.pdf](http://www.msc-smc.ec.gc.ca/education/scienceofclimatechange/understanding/ccd/ccd_0001/CCD_00-01.pdf)

Arctic climate change affects global atmospheric and oceanic processes. Effects of global warming will be both accelerated and amplified in high latitudes. Warming in the lower atmosphere has been associated with atmospheric pressure pattern changes that influence the strength of the westerly wind circulation. Over the past ten years, computer modelling has shown that stratospheric ozone depletion and increases in carbon dioxide throughout the atmosphere have led to a general cooling of the polar stratosphere. A cooler arctic

stratosphere facilitates the formation of polar stratospheric clouds, which act as a catalyst to ozone depletion. Through hemispheric mixing, the depletion of the ozone over the arctic reduces the amount of stratospheric ozone available over mid-latitudes throughout the spring and summer months. The end result is an increase in UV radiation at the Earth's surface, which affects the health of humans and ecosystems.

Over the past forty years, the western Arctic has warmed by an average of 3°C and as much as 5°C in winter over land masses. This had the effect of melting glaciers and permafrost, as well as reducing the amount of ice cover and ice thickness. Precipitation patterns are changing (30% increase since 1968) while the period of snow cover has decreased.

A temperature increase of 4 – 5°C could mean that northern coastal areas would experience more frequent shallow landslides and erosion. Rising temperatures could also lead to the disappearance of over half of the current discontinuous permafrost zone, and shift the boundary between discontinuous and continuous permafrost zones northward by hundreds of kilometers, with both negative and positive effects. Land instability would negatively affect pipelines, pile foundations for buildings, roads, bridges, airport runways and open pit mines. The warming of permafrost could alter carbon sources and sinks in organic terrain and could result in the release of carbon currently stored in methane gas hydrates. A warmer climate and soil could change vegetation and permit the cultivation of new crops and tree species.

Thinning of the sea ice could affect the distribution of ringed seals, walrus and polar bears, thereby affecting Inuit who depend on them. Species of fish not previously indigenous to the arctic are now appearing, as they follow their natural preference for cooler water. Sea level changes, increased wave activity, and coastal erosion are occurring due to changes in storm patterns, atmospheric and ocean circulation, and ice conditions.

The Arctic Ocean has a significant influence on the global climate system. However, it has not been extensively sampled and long-term monitoring initiatives have been sporadic. Improvements in understanding and predicting climate variability and change require long-term, systematic measurement programs. Better understanding of arctic interactions between freshwater and saltwater will help to explain how reactions to global and Arctic Ocean changes may be exported to the North Atlantic and the oceanic conveyor belt. Both winter and summer surveys are required to characterize the seasonal variation in mixing and transport properties within the Arctic Archipelago.

Hudson Bay, Hudson Strait and Foxe Basin represent the largest northern estuaries of the world, exerting a strong influence on the climate of eastern North America. Water mass characteristics and circulation are strongly influenced by freshwater dynamics in the form of riverine input from the large drainage basin, sea ice formation and melting, and the less saline inflows of water from the Pacific Ocean.

The Mackenzie River is the largest North American source of freshwater entering the Arctic Ocean and has an important influence on global ocean circulation and long-term climate. The basin has been experiencing a strong warming trend that can alter regional water resources. Changes in water levels can have dramatic socio-economic implications (e.g., restricting water transport).

Reducing the vulnerability of northern infrastructure and communities to climate change is a key goal of S&T. Scientific research is needed to improve understanding of the climate change sensitivity of northern landscapes, coastal and offshore areas, and oceanic systems. Further research will assist in estimating the extent of such impacts and how best to adapt to address them.

### 2.1.2 Contaminants and Toxic Substances

Contaminants released to the environment from distant parts of the globe where industrial and agricultural enterprises operate are transported to the arctic via the atmosphere, oceans, and north flowing rivers. In the case of long-range atmospheric transport, contaminants may be delivered to the arctic in a matter of days, whereas ocean delivery extends over years. Contaminants transported to the arctic include Persistent Organic Pollutants (POPs), heavy metals, and radionuclides. While the majority of contaminants in the arctic come from regions far to the south, some arctic development has resulted in local sources that include both active and abandoned mines, military sites and other industrial sites.

Although many POPs have been widely banned for the past 20-30 years (e.g., PCBs, DDT), levels of these substances in the arctic environment are just beginning to decrease. In contrast, a new generation of POPs is on the rise. Some of the known POPs substances include the organobromine and organofluorine classes of compounds, which are widely used as fire retardants and stain resisters in synthetic materials. The early detection of these substances, particularly in the arctic, has garnered widespread international attention and resulted in recent industrial phase-outs in both Europe and North America.

The unique characteristics of arctic ecosystems can result in surprisingly high levels of contaminants in biota. The high lipid content and long life spans of arctic organisms result in efficient food chain biomagnification and accumulation of contaminants, particularly in top predators. Higher trophic level species, including some species that have traditionally been important as country food for Inuit, (e.g., beluga whales, walrus) contain levels of contaminants that are up to 109 times greater than their surroundings. This has led to concern over potential effects on the health of people who depend on these species for food (see Section 2.3.1 – Food Safety). The effects of contaminants on the health of arctic ecosystems are relatively unknown. Limited research suggests that contaminant-induced stress is likely causing harmful biological effects in many arctic species. The cumulative effects of contaminants and other environmental stresses (e.g., development in the arctic, climate change) could place arctic ecosystems at even greater risk.

### 2.1.3 Ecosystems and Biodiversity

Ecosystems and biodiversity research is required to ensure that there is a scientific foundation for biodiversity related decision making in the North, according to national mandates and international commitments. This research is needed in order to understand: ecosystem processes; the population status and distribution of identified species; population dynamics and cycles for these species; change processes; and the importance of environmental changes to habitats, populations and biodiversity. Research is particularly important in areas designated as national protected areas, parks and reserves.

Climate, physical and chemical conditions can have important effects on biodiversity and ecosystems. The federal science-based departments and agencies most actively involved in ecosystem and biodiversity research are the CMN, EC, DFO, INAC, and PC. The legal obligations and other commitments that drive much of this work include: *Canada Wildlife Act*; *Migratory Birds Convention Act*; *North American Waterfowl Management Plan*; *Convention on Biological Diversity*; *Oceans Act*; *Species at Risk Act*; *Canada National Polar Bear Agreement*; *Canada National Marine Conservation Areas Act*; and the *Canada National Parks Act*.

This area of research involves collaboration with provincial and territorial government agencies, universities, non-government organizations and First Nations and Inuit land claim organizations. The multidisciplinary nature of this research produces results that are important to Canada and often relevant at a circumpolar level.

### 2.1.4 Environmental Forecasting

#### Meteorological and Ice Science Services

Meteorological and ice forecasting are essential requirements for living in and developing the North. Over the next few years, change in a number of factors including demographics, social structure, the economy, physical characteristics and ecology will result in increasing demand for primary and secondary weather, climate and ice services.

Sea ice plays a central role in arctic life and the economy; however, studies are showing that that ice conditions are changing. The weather, climate and ice data networks contribute and support, at least to some degree, science and research in air quality, climate change, ozone depletion, and hydrologic research. Meteorological Services of Canada (MSC) science and technology in the North contributes to the knowledge base needed to support sustainable development and the management of natural resources. MSC research and monitoring activities contribute to Canadian arctic security and territorial sovereignty.

## 2.2 National Security

The Government of Canada has the mandate and responsibility to conduct surveillance and exert control over its sovereign territory, including the North. The Senate Standing Committee on National Security and Defence has concluded in two reports (“Defence of North America: A Canadian Responsibility” and “Canada’s Coastlines: The longest Under-Defended Borders in the World”) (Senate Standing Committee on National Security and Defence, 2002 and 2003) that, in the past, Canada has not lived up to this responsibility in the North. As a consequence of the events of September 11, 2001, however, it is imperative that Canada participate more fully in the defence of North America by coordinating with the U.S. on intelligence operations related to serious threats to our coastlines. Canada must have systems in place to monitor all potential security threats in the North and have the capability to respond to those threats. These systems would serve the additional purpose of monitoring environmental features on the land and sea surface related to ecosystem function and climate change.

## 2.3 Human Health and Safety

Human health and safety is a critical issue in the North. First Nations and Inuit continue to be among the most disadvantaged groups in Canada and are at high risk of poor health, early death, chronic disease, and socio-economic inequities that influence health practices. For example, in selected First Nations reserve communities, the prevalence of heart disease is 1.5 times higher (First Nations and Inuit Regional Health Survey National Steering Committee, 1997) than overall Canadian rates, diabetes prevalence is almost three times higher (Statistics Canada, 2003), potential years of life lost to injury is four times higher, tuberculosis infection rates are 10 times higher (Health Canada, 2003) and 5.3% of new AIDS cases occur among Aboriginal people who represent just 3.3% of the population (Health Canada, 2002). Remoteness, isolation and cultural uniqueness all add to the complexities of First Nations and Inuit health service delivery.

### 2.3.1 Food Safety

Since 1991, there have been concerns about human exposure to elevated levels of contaminants in fish and wildlife species that are important to the traditional diets of northern First Nations, Métis and Inuit. Early studies indicated that there was a wide spectrum of substances of concern reaching unexpectedly high levels in the arctic ecosystem, including POPs, heavy metals, and radionuclides, many of which had no Arctic or Canadian sources.

Elevated levels of PCBs, various organochlorine pesticides, and metals such as mercury have been found in human tissues and body fluids in certain arctic regions. The main exposure pathway is through the consumption of traditional/country foods, particularly marine mammals. Epidemiological and toxicological studies in Canada and elsewhere have found that at certain levels these contaminants are toxic to humans. The human health volume of the Canadian Arctic Contaminants Assessment Report II (CACAR II) (INAC, 2003) identifies Inuit populations in the Canadian eastern Arctic as those most exposed to a range of POPs and metals. Evidence is now emerging that subtle adverse neurobehavioural and immunological effects in infants and children may be associated with prenatal exposure to contaminants.

### 2.3.2 Service Delivery

Challenges encountered throughout the Canadian health care system such as nursing shortages, escalating drug costs and the cost of new technologies, coupled with growing First Nations and Inuit populations, isolation, and cultural uniqueness, add to the challenges of First Nations and Inuit health care programs and service delivery. These pressures are resulting in significant increases in the cost of Non-Insured Health Benefits and other programs. The provision of effective and accessible health care services to First Nations and Inuit communities requires long-range strategies to address the sustainability of health services and programs that the Government of Canada delivers or funds.

## 2.4 Sustainable Development and Management of Natural Resources

Significant federal northern S&T resources are directed at providing the knowledge base to support the sustainable development and management of both renewable and non-renewable resources. Key areas of interest include geosciences (e.g., geological surveys, infrastructure development and associated environmental protection studies), developing mineral technology, managing wildlife and sustainable harvesting, managing aquatic habitat, developing and conserving fisheries, developing renewable energy technologies, managing forests and oceans, and providing geospatial data infrastructure.

Federal northern S&T programs and activities underpin sustainable resource development, providing much-needed support for future economic and social development. The programs also provide the federal government with the sound science base it requires to fulfill its responsibilities for resource management and for developing the policies, standards, and regulations governing northern development.

### 2.4.1 Renewable Resources

Northern Canada is endowed with one billion cubic meters of timber which is a vital building block serving the government's objective of maintaining a healthy, sustainable renewable resource sector in the Canadian North. Forestry supports six forest-dependent northern communities and provides an important backdrop to transferring northern S&T. Forestry research also fosters First Nation capacity building, including promoting the use of traditional knowledge in renewable resource development. Pursuit of these initiatives rests on the federal objective of improving the knowledge foundation for sustainable northern renewable resource utilization.

The use of northern S&T promotes the application of advanced technologies to support decisions related to sustainable use of the forest resource. Continuing development of tools such as Geographic Information Systems (GIS) and Geographic Positioning Systems (GPS) enable land managers to better understand land mass ecology, change to the vegetation cover, and how to implement best practices for protecting non-timber values in concert with sound forest management. Priorities for research include climate change, forest ecosystem processes, fire and pest management, and socio-economic study.

The effects of some human activities are more severe and persistent in the North than those in southern regions. The knowledge and research into effects of northern climatic conditions, including slower growth rates and reduced productive season lengths, are critical factors in formulating northern resource management decisions. The management of northern renewable resources also needs to be based on specific research and information that takes into account the knowledge and experience of Aboriginal people.

### 2.4.2 Non-renewable Resources

With the objective of maintaining a healthy, sustainable non-renewable resource sector, the goals of northern S&T are to: broaden and improve the natural resource information base and ensure that the information is accurate, unbiased and professional; promote meaningful participation by First Nations and Inuit and the use of traditional and local knowledge in all areas of resource development; and promote research on the environmental effects of resource development and ways to minimize those effects.

The sustainable development of non-renewable resources in the North is a special challenge due to environmentally sensitive terrain, infrastructure constraints, and the existence of a widely dispersed, small population base. Sustainable resource development should aim to integrate economic and social benefits for northerners while safeguarding the environment. Northern S&T provides a crucial basis for new resource exploration, as well as for understanding the ways terrain will respond to potential developments.

Continuing development of databases on geographical, geological and geoscientific information about the Arctic landmass is required to support mapping and resource exploration. This information will also provide baselines for assessing change, risk and landscape sensitivity, and supports the development of policy, regulations and land-use management practices.

Northern S&T supports the application of advanced technologies to recover metals and hydrocarbons, optimize extraction and production mining processes and practices, and to increase efficiency and prolong the operational life of developments that communities depend upon. Priorities for research include acidic mine drainage and effluent management, as well as mine decommissioning and site rehabilitation.

Northern Canada is richly endowed with world-class mineral and energy resources, having proven and potential reserves totalling \$100 billion. The recent opening of Canada's first two diamond mines, coupled with an active exploration industry, is bringing jobs and growth to the North and represents significant revenues for Canada (e.g., projected \$2.8 billion over 20 years for the Ekati and Diavik diamond mines alone). The North contains about 18% of Canada's remaining discovered conventional oil and 25% of remaining discovered gas. Canada's northern basins are estimated to contain approximately 48% of Canada's undiscovered conventional light crude oil potential, and 46% of its undiscovered conventional gas potential. Potential new natural gas pipelines and hydrocarbon exploration are major drivers for northern S&T. Conversion of undiscovered mineral and energy resources into reserves that can be developed economically requires improved geoscience knowledge and enhanced exploration activity.

Application of scientific knowledge and mineral technology innovation in these areas through effective and efficient transfer to the private sector is also vital to economic growth.



Source: CASES project



## 2.5 Social Environment

The most direct challenges facing northern communities relate to the social environment. A rapidly increasing population and living in remote communities is putting pressure on housing and other infrastructure elements, including education and social services. Key aspects of the social environment are below national levels in many communities. The rate of completion of formal education is relatively low and the opportunities to draw on skills and knowledge from a formal education through local employment are few. Cultural and social achievements of significance to many northerners, such as Aboriginal language skills and traditional forms of learning and knowing, are undervalued and difficult to capitalize on.

Low income levels, with relatively few opportunities for secure local formal employment, are coupled with scattered prospects for local economic development. In addition, the demands of formal employment are in conflict with more traditional means of support (e.g., hunting, trapping). The small size and relative isolation of northern communities compounds problems related to poor access to health care and social support services, as demonstrated by the high rates of accidental death, suicide, and addiction across the North.

Northerners have had considerable success in adapting local lifestyles and defining their own identities as full participants in a rapidly globalizing social environment. Individuals and communities, however, face particular challenges. Widespread access to satellite television and the Internet and recent developments in governance (Aboriginal land claims, native self-government programs, and the creation of new territorial government structures) have created expectations and initiated rapid political and social change. Unfortunately, development of the social infrastructure and the economic base has not kept pace.

The study and documentation of the challenges facing northern peoples is a critical requirement in the search for solutions, and contributes to the ability of northerners to be involved in the creation of, and to benefit from, economic, social, cultural and political opportunities.



Source: Department of Fisheries and Oceans

# Part II: Federal Activity Report for Northern Science and Technology

## 3.0 Implementation

In response to the NSERC-SSHRC Task Force Report and other reports, recent federal budgets have taken steps to build on the federal commitment to northern science. These new funding commitments target only a few of the highest priority issues related to northern S&T and more ongoing work, including resources and coordination, will continue to be required in the future.

Activities that are undertaken either individually or in a coordinated fashion by federal departments and agencies are presented in the following text. These descriptions include both the high-priority activities which have received an infusion of funding in recent budgets, as well as the ongoing commitments and priority areas that federal departments and agencies undertake to fulfill their mandates and responsibilities in the North.

## 3.1 Logistics Support and Research Infrastructure

While PCSP was once the largest and almost sole logistics service agency for government and Canadian university researchers in the Canadian arctic, now fully half of all research in the three territories is conducted independent of the PCSP system. Research has become less centred on fixed-base facilities and is now more geographically dispersed. Research programs can be staged directly, at times more cost-effectively, from northern communities.

PCSP continues to coordinate logistics support for approximately 120 groups each year. Its efforts are increasingly focused on delivering services in collaboration with other agencies and community service networks throughout the North in order to contribute to northern economic development and capacity building. Additional information about PCSP is available at the NRCan – PCSP web site which includes links to northern territorial and community-based services and suppliers, along with a list of more than 30 northern field stations and facilities that can be accessed by researchers.

NSERC supports university-based research activities and has a program for assisting university researchers with logistics. NSERC provides funds for the operations and maintenance of field station facilities, including direct support for: Churchill Northern Studies Centre, Kluane Lake Research Station, and Station de recherche du Centre d'études nordiques à Whapmagoostui-Kuujuarapik. NSERC also has a program that will provide supplements to holders of NSERC Discovery Grants, for the additional logistical costs associated with conducting research in the North.

INAC, DFO, EC and NRCan maintain a number of offices and facilities in the Yukon, Northwest Territories and Nunavut. The staff and facilities support a wide range of research, monitoring, resource management and environmental enforcement activities across the Canadian North. INAC, DFO and NRCan have laboratories and facilities that can supplement research programs. EC provides logistics support for atmospheric research with the baseline air chemistry

observatory at Alert and a weather office at Eureka. With over a dozen offices and a network of park facilities in the North, PC provides logistical and other forms of support to researchers.

CCG Arctic Operations deploys vessels (*CCGS Louis S. St.-Laurent*, *CCGS Pierre Radisson*, *CCGS Amundsen*, *CCGS Des Groseilliers*, *CCGS Sir Wilfrid Laurier*, *CCGS Nahidik* and *CCGS Terry Fox*) annually for arctic operations that include icebreaking, re-supply, and science. CCG also tends navigational aids in the North. Joint Rescue Co-ordination Centres in Halifax, NS and Trenton, ON share responsibility for providing marine search and rescue services in the northern waters of Canada, which are re-deployed from other arctic programs as required.



Source: Polar Continental Shelf Project

### 3.2 Infrastructure Development

A number of departments play a role in developing infrastructure to support northern S&T.

NRCan contributes to infrastructure development by:

- Conducting marine and terrestrial geoscience surveys and engineering studies to support facility siting and design (e.g., offshore oil and gas well sites, pipeline development, transportation infrastructure including shipping and transshipment facilities);
- Studying permafrost, active geological processes and hazards, and environmental change (modern and historical) to support infrastructure development in sectors (e.g., transportation and pipeline corridors, ports, mining, communities) experiencing rapid development and change;
- Identifying hazards (e.g., slope failure) in development areas and detection of climate change impacts;
- Improving accessibility of digital geoscience data and information (e.g., comprehensive, user-friendly, digital geoscience knowledge bases, tools and pathways) to facilitate access to geoscience knowledge, improvements in quality and quantity of digital topographic data, student training and internships in geoscience, community-based workshops to demonstrate access and use of geoscience information that support increased participation by northerners in resource-based economic development;
- Developing renewable energy sources (e.g., solar, wind, small hydro) and district heating technologies for remote applications;
- Developing energy-efficient technologies for industry, communities and buildings; and
- Increasing capability to meet management challenges (e.g., forestry inventory, environmental monitoring, boundary delineation for land claim settlements and international dispute resolution with the U.S., topographic mapping at national and regional scales).

Through Geomatics Canada, NRCan provides:

- A reliable system of surveys, maps, remotely sensed data and geographically referenced information on Canada's landmass;
- Maps in computer-accessible format, including development of computerized aeronautical charts and computer-accessible information for aviators to provide more efficient service in the future;
- Leadership and support for GeoConnections, a national Internet window on geospatial data, with the Geological Survey of Canada (GSC); and
- Geodetic surveys to maintain the spatial reference system for Canada with high precision, using radio-telescopes and global positioning satellites, including the provision of the active control positioning system in the arctic.

Through the Canada Centre for Remote Sensing (CCRS), NRCan provides leadership in collecting and analyzing satellite data. CCRS is developing new remote sensing technology for satellites and aircraft, and with private sector partners will use the data for determining forest health and ice conditions, transportation planning and geological mapping in the North.

The DFO Canadian Hydrographic Service (CHS) provides marine navigational charts Canada-wide. The extent of the uncharted areas or areas with dated or incomplete charts is greater in the North than in the South. CHS enters into partnership arrangements with Nunavut and NWT to create some charts. DFO is in the process of creating Electronic Navigation Charts for shipping routes in Hudson Bay and the Canadian arctic. Field surveys are being undertaken to update existing charts and produce new charts, including multi-beam sonar surveys in the Beaufort Sea to support oil and gas development. Hydrographic surveys of Nunavut harbours and approaches in Hudson Strait and Foxe Basin are also being undertaken.

### 3.3 Northern Knowledge Development and Dissemination

Northern knowledge development and dissemination is accomplished in various ways across federal departments and agencies. Each department contributes to the development of new knowledge as it conducts or supports northern research. Research results are disseminated through formal and informal channels.

The CPC has a long-term project that monitors and reports on the state of polar knowledge, using a series of indicators, to identify emerging trends and demonstrate how existing policies affect northern science. Links are maintained with the academic community through the Association of Canadian Universities for Northern Studies (ACUNS) and its related northern and arctic institutes, and the Canadian Climate Impacts and Adaptation Research Network.

In carrying out its mandate, CPC hosts conferences and workshops, publishes information on subjects relevant to polar research, and works closely with other governmental and non-governmental agencies to promote and support Canadian study in polar regions.

CPC maintains the Canadian Polar Information Network (CPIN), which includes a publicly accessible online database of Canadian polar specialists, and the interactive Polar Science Forum. The online forum provides a convenient way for Canada's widely dispersed polar research community to communicate.

CPC publishes the arctic science newsletter *Meridian*, and the *Newsletter of the Canadian Antarctic Research Network*. Both circulate current information on polar research to readers in Canada and abroad. CPC also publishes more detailed information in special research reports, workshop reports, and conference proceedings.

Members of the academic community supported through granting agencies disseminate their results in various scientific journals and at various conferences and symposia for the natural sciences, engineering, health sciences, social sciences and humanities.

### 3.4 Education and Training

Federal support for training related to northern research is provided through the INAC Northern Scientific Training Program (NSTP), the FAC Northern Dimension of Canada's Foreign Policy (NDFP), and various programs of the federal granting agencies (NSERC, SSHRC, CIHR). Specific northern programs aimed at universities (such as the NSTP) provide internships, travel and logistical support directly to students and facilitate interaction with northerners. Students also have access to scholarships and fellowships which can be used in their research studies in the North. By providing funding to university faculty, the next generation of northern researchers can be mentored and trained. Current funding demands, however, far exceed available resources.

To foster youth interest in northern science, NSERC has the PromoScience program which can be accessed by any non-profit organization. This is one of the few ways in which the federal government fosters northern science in education, which is primarily a territorial/provincial responsibility.

INAC provides some support for education among First Nations and Inuit. The Cultural/Educational Centres Program provides assistance to enable First Nations and Inuit to establish and operate cultural/educational centres that include aspects related to research into First Nations and Inuit heritage and culture.

INAC also provides education support to eligible First Nations and Inuit students through the Post-Secondary Student Support Program and the University College Entrance Preparation Program. These programs provide assistance to First Nations and Inuit students for tuition fees, books, travel and living expenses. FAC through the

NDFP supports the University of the Arctic (U Arctic), an international partnership of northern colleges and universities, northern indigenous organizations and governments, designed to address the educational and training needs of northern peoples.

The NRCan Sustainable Communities Initiative (SCI) builds community capacity to support sustainable development. SCI is a component of GeoConnections, a national partnership initiative making geographical data available to Canadians through the Internet. Specifically, SCI builds capacity in First Nations and Inuit communities wanting to take control of their future, by providing them with modern mapping technologies to make informed decisions about their economic, environmental and social development. Geomatics training is provided to community members through pilot projects designed by the community and SCI.

SCI has been a resounding success in promoting sustainable development, having launched twenty-six projects in northern communities during its first four years, representing about 25% of all SCI projects. Fourteen projects have been successfully completed. <http://www.sci.gc.ca/>

NRCan's PCSP has supported thousands of government and university northern research programs involving thousands of students over the years. Many previous students have gone on to become tenured professors and are now mentoring the next generations of polar researchers. As well, through its Traditional Knowledge Program, PCSP has provided logistics support to northern community programs whose aim is to transfer traditional knowledge and skills from aboriginal elders to northern youth.



Source: Department of Fisheries and Oceans

## 4.0 Science and Technology Themes

### 4.1 Natural Environment

#### 4.1.1 Climate Change

Arctic climate change research is carried out collaboratively by EC, NRCan and DFO and involves university, industry and international partners. Other countries that are involved in arctic climate change research include: the United States, Sweden, Finland, Norway, and Japan. Through its membership in the Arctic Council, Canada has contributed to the Arctic Climate Impact Assessment (ACIA), published in the fall of 2004. Research by Canadian scientists has contributed to the international body of knowledge through the understanding gained in relation to climate change, ozone depletion, UV radiation, meteorology, the cryosphere, and the effects of arctic pollution.

EC, through its Canadian Centre for Climate Modelling and Analysis (CCCma), has developed global climate models based on current understanding of the physics of the atmospheric-ocean systems. These models allow for analysis of climate change and make projections of future change. Projections from CCCma are further refined in cooperation with marine modelling at DFO's Institute of Ocean Sciences where recognized biases in climate forecasts are removed and detailed sea ice and ocean conditions are forecast to 2030 for regions that include the Arctic Ocean, Canadian Archipelago, and Hudson and Baffin Bays. Results are developed and evaluated in collaboration with EC's Canadian Ice Service (CIS).



Source: Environment Canada/Ray Semkin

NRCan works in three priority areas: climate system science; impacts and adaptation; and mitigation. The department provides funding for, and conducts, climate change research in the North. Projects currently underway are examining impacts of permafrost degradation on infrastructure and transportation, sustainability of natural resources including forests, and related implications for the health and well-being of northerners. NRCan monitors changes in the northern environment, particularly permafrost, glaciers and terrestrial vegetation in the transitional forests and north of the tree line. The department is engaged in research, development and deployment of new alternative energy technologies (e.g., wind power, photovoltaics, solar wall, small hydro, bioenergy) to reduce energy consumption and greenhouse gas emissions. These technologies support renewable energy and energy efficiency (e.g., wind-diesel technology, diesel

system optimization), and make energy pipelines safer and more reliable (e.g., stronger metals, new monitoring technologies) to prevent pipeline failures and the release of greenhouse gases.

EC scientists, in partnership with universities, conduct research to better understand the meteorology, hydrology and cryosphere of the arctic. Projects being led by EC, or with EC involvement include:

- **Mackenzie GEWEX Study (MAGS)** (1996–2005) aimed at: understanding and modelling high-latitude water and energy cycles that play roles in the climate system; and improving water resource change assessments. MAGS is focused on understanding and modelling climate variability and climate change impacts on meteorology and hydrology in the Mackenzie River Basin.
- **Cryospheric System to Monitor Global Change in Canada (CRYSYS)** is Canada's contribution to NASA's Earth Observing System program with the Canadian Space Agency (CSA) as a major funding partner. The study uses remote sensing, modelling, field studies and data integration to monitor the cryosphere and understand processes, variability and change. Investigators use airborne and satellite measurements to: develop improved satellite-based measurement, monitoring and understanding of cryospheric variables over a range of spatial and temporal scales; develop and validate climate/cryospheric models processes and dynamics to understand the role of the cryosphere in the climate system; and assemble, maintain and analyze historical, operational and research data sets for climate monitoring, model development and validation, and climate change analysis.
- CCCma develops and applies global climate models to understand past climate change and predict future change to support impact and adaptation research. CCCma is also involved in research into dynamic and thermodynamic sea-ice processes and operational sea-ice forecast models. Quantitative projections of future global climate change have been produced for the North, including projections of changes in temperature, precipitation, sea ice and snow cover. These projections have been used extensively in impact assessment studies such as the Intergovernmental Panel on Climate Change (IPCC) and the ACIA.
- Other northern EC modelling activities include: mapping snow cover and snow-water equivalent for flood planning strategies and water resource management; mapping permafrost; and modelling the global climate system (Global Energy and Water Experiment [GEWEX] and Arctic Climate System Study [ACSYS]).

DFO scientists use remote sensing to gather important information about the cryosphere and underlying ocean. Studies of ice cover variability are conducted using a variety of sensors, most of which are in the microwave wavebands (both active and passive), to examine the effects of climate warming and to define future trends. Studies are conducted on the ocean itself to gain an understanding of the phytoplankton biomass cycle and its relation to physical processes. The major initiative in this regard is the participation of DFO scientists in the university-led NSERC funded Research Network,

Canadian Arctic Shelf Exchange Study (CASES), to gain better knowledge of ocean optics processes in arctic coastal regions in order to better use ocean colour images from a wide variety of optical sensors. These studies will continue as part of the developing ArcticNet research network (see Section 5.3) which will expand spatial coverage to most of the Canadian arctic, including Hudson Bay. DFO science efforts are supported by an operational network of remote sensing receiving stations providing access to a complete arctic coverage for both NOAA-AVHRR and SeaWiFS data. Many of these data are available on DFO regional web sites, most in real-time.



Source: CASES

Projects being lead by DFO, or with DFO involvement, include:

- **Climate and Cryosphere (CliC)**, a fundamental component of World Climate Research Programme. DFO projects under CliC include: Beaufort Sea pack ice research and monitoring since 1990; Arctic Ocean to the Labrador Sea transport of freshwater and pack ice since 1998; impact of changing seasonal ice cover on freshwater stocks; the impact of change in freshet timing and volume, on freshwater and marine fish stocks; impact of changing permafrost on freshwater ecosystems and harvestable fish stocks; and impacts of global sea-level change on low-lying coastal areas such as the Mackenzie Delta.
- **Arctic-Subarctic Ocean Fluxes (ASOF)** involves DFO mooring and modelling programs, in collaboration with US partners. These programs, along with European partners, define the boundary conditions used for modelling efforts for ocean and pack ice volume, and heat and freshwater transfer between the Arctic and Atlantic Oceans. ASOF measurements are as precise as possible to understand transfer variability in relation to atmospheric and terrestrial runoff and effects on the overturning circulation in the North Atlantic. ASOF also obtains measurements to understand the steering role of high-latitude oceans in decadal climate variability.

- **Ocean Tracers** determine freshwater sources and show pathways within the Arctic Ocean and to the Atlantic, as part of the return flow of freshwater water from the Pacific Ocean and large river basins draining into the Arctic Ocean. Tracer work has recently revealed a buildup of anthropogenic carbon in the Labrador Sea. Additional tracer research is planned through expeditions in the Labrador Sea and Canadian Arctic Archipelago in 2004 and 2005, and a major expedition in the Arctic Ocean in 2005 (Barrow to Gothenburg via the North Pole).
- **Arctic Ocean Models Inter-comparison Project (AOMIP)** – DFO represents Canada in this international evaluation of leading Arctic Ocean/ice models to identify limitations and guide further development.
- **Études des mers intérieures du Canada (MERICA)** which conducts monitoring and regional ocean modelling programs.
- **ArcticNet** – DFO, in cooperation with other government departments, has significant involvement in ArcticNet programs, including involvement in contributing programs such as CASES. The CIS will also be participating in an ArcticNet theme project “Adapting to Change in the Canadian Arctic: Knowledge Transfer, Policies & Strategies”. Specifically, CIS researchers will assist in the examination of vulnerabilities and adaptation to sea ice-related hazards.
- Other initiatives including: Climate Variability and Predictability Study (CLIVAR); Global Oceans Observing Systems Study (GOOS); and ACSYS.
- DFO develops theory and modelling to understand recent change in the Arctic Ocean and marine cryosphere. Key questions being addressed include: (1) Are observed changes consistent with recognized physical principles? (2) How well do numerical models express these principles? and (3) Where will new observations lead to advances in physics and model representations? Modelling initiatives include: reanalysis of arctic sea ice extent and thickness data extending back to 1950; evaluation of freshwater storage within Arctic Ocean pathways and freshwater exchanges; and analysis of Atlantic water circulation and shifting confluences with Pacific waters.

#### 4.1.2 Contaminants and Toxic Substances

There are several research initiatives that examine the contaminant-related issues described in Section 2.1.2. (Programs and activities related to contaminants and Food Safety can be found in Section 2.3.1.) Among these, the Northern Contaminants Program (NCP) has the widest scope, focusing on: contaminant-related human health issues in the most highly exposed communities; temporal trends of contaminants in the physical and biological environments relevant to human health assessments and international contaminant control conventions; and extensive education and communication work with northerners.

The NCP is led by INAC and jointly managed by HC, EC, DFO, four northern Aboriginal organizations, and the wildlife and health departments of the territorial governments. In addition to conducting targeted science to define the issue, the NCP also supports studies and actions to address the human health and communications issues needed to protect the health of highly exposed northern

Aboriginal populations. The renewed NCP, building on the results of CACAR II, focuses upon human health. The only long-term solution is to control the release of contaminants to the environment. Using mainly NCP information, Canada initiated international action resulting in three international, legally binding agreements, all recently ratified. Our capacity to comply depends on the NCP. The fundamental principles embedded in the management of the NCP include shared funding, horizontal governance, directed research according to strategic blueprints, competitive proposal evaluation with external peer review, a requirement for community consultation, and regular appraisals of results to refocus directions.

The Northern Ecosystem Initiative (NEI), led by EC, supports partnership-based efforts to improve the understanding of how northern ecosystems respond to climate change, contaminants, and resource use activities. The NEI also supports the development of indicators and a network to monitor ecosystem change. Contaminant related research under the NEI focuses on broad ecosystem-level effects with a geographic scope that places a high priority on the historically understudied regions of northern Québec and Labrador, but also includes the three northern territories. The NEI supports projects that address science and capacity building needs throughout the Canadian North. These projects are led by, or involve, partnerships with First Nations and Inuit organizations, communities, universities, colleges and research institutes, non-governmental organizations, as well as foreign government and international agencies.

ArcticNet (see Section 5.3) will continue a number of ongoing activities including: monitoring levels of mercury in ringed seals and beluga whales; assessing the effects of climate change on mercury levels in the Mackenzie delta and Beaufort Sea; carrying out further research on mercury depletion events; measuring mercury levels in lakes and lake sediments; monitoring legacy and new POPs in the arctic marine environment; and examining the processes and vectors associated with carbon and contaminant fluxes in the Hudson Bay system.

Recognizing the need for a collaborative circumpolar approach to protecting the arctic environment, Canada, with funding from the NDFP, participates in the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP). AMAP is a program that integrates both monitoring and assessment activities in order to:

- produce integrated assessment reports on pollution status and trends in arctic ecosystems;
- identify possible causes for changing conditions;
- detect emerging problems, possible causes, and potential risk to arctic ecosystems, including risk to indigenous peoples and other Arctic residents; and
- recommend actions required to reduce risks to arctic ecosystems. ([www.amap.no](http://www.amap.no))

Other Arctic Council initiatives include: Protection of the Arctic Marine Environment (PAME); and the Conservation of Arctic Flora and Fauna (CAFF). Other related international research includes studies of contaminant concentrations in marine mammal and fish tissue to provide information related to traditional diets and Canada's position on POPs.



Source: Inuit Tapiriit Kanatami/Eric Loring

#### 4.1.3 Ecosystems and Biodiversity

The *Species at Risk Act* (SARA) is a major new legislative initiative in Canada. SARA implementation takes advantage of the work of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) which produces species assessments and regularly posts a list of species at risk. The Recovery of Nationally Endangered Wildlife program is developing recovery plans and strategies for 158 species, of which 16 occur in the Yukon, Northwest Territories and Nunavut.

In the marine environment, the *Oceans Act* calls on the Minister of DFO to lead and facilitate the development of plans for the integrated management of activities affecting estuaries, coastal and marine waters. This can include establishment of marine protected areas, including: Marine Protected Areas established by DFO; National Marine Conservation Areas established by PC; and National Wildlife Areas established by the Canadian Wildlife Service (CWS), for reasons that include the protection of areas with high biodiversity or biological productivity or areas that represent a marine region. PC and the CWS have responsibility for habitat conservation in the North focusing on establishing and maintaining protected areas and sanctuaries for nationally and internationally significant wildlife and the perpetuation of natural environments. Habitat conservation is typically accomplished in cooperation with others, often through bilateral agreements between departments, agencies and universities. Activities can involve environmental assessments, the promotion of land use policy and practises, stewardship and public education.

There are 12 national parks and national parks reserves in the North, including Wapusk in northern Manitoba, each with a basic biodiversity inventory and ongoing monitoring programs. Further monitoring is done by the Environmental Monitoring and Assessment Network (EMAN), part of EC. The EMAN Coordinating Office works collaboratively with partners in improving the effectiveness of ecosystem monitoring to support informed decision making and to create environmental awareness among Canadians. The NEI is an example of planning for research, monitoring and delivery of sound management practices for northern sites.

DFO has authority for aquatic species under SARA and will continue to carry out research that directly supports implementation and enforcement of the legislation. SARA requires that DFO increase efforts to assess the status of species at risk; engage in consultations on

species to be considered for listing; develop and implement recovery strategies, action and management plans, and enforcement mechanisms; and identify habitats critical to the survival and recovery of species at risk.

Species of plants, animals, fossils and minerals that are representative of park inventories and obtained through other investigations are kept in the CMN, or one of the many provincial museums. In September 2003, the Alliance of Natural History Museums in Canada was established. Complementary to the Alliance, and formed a year earlier, is the Federal Biodiversity Information Partnership (FBIP) between Agriculture and Agri-Food Canada (AAFC), Canadian Food Inspection Agency (CFIA), CMN, EC, DFO, HC, NRCan and PC. The FBIP is the lead organization coordinating the web-based, freely distributed data and information about biodiversity in Canada. The growing programs of the fledgling FBIP will be an important component of the Canadian Information System for the Environment. The FBIP is also the State representative to the Global Biodiversity Information Facility, and provides the Canadian portal for this information to the rest of the world.

Circumpolar cooperation is essential to the protection of the natural environment and Canada, led by the Ambassador for Circumpolar Affairs, cooperates with circumpolar partners through the Arctic Council. Canada participates in the CAFF working group. CAFF is a distinct forum of arctic professionals, indigenous peoples' representatives, and observer countries and organisations, to discuss and address circumpolar arctic conservation issues. ([www.caff.is](http://www.caff.is))

#### 4.1.4 Environmental Forecasting

EC, through the MSC, provides meteorological services and research throughout the North to ensure safety and productivity. The best known product is the public, aviation and marine advisory and warning forecast service for the Arctic. CIS of MSC produces daily ice hazard bulletins and charts for the Canadian arctic. Regional ice charts are produced for the eastern Arctic, western arctic and Hudson Bay. The CIS also provides forecasts of the freeze-up and break-up of ice on arctic waterways to support marine planning.

The MSC carries out arctic climate and atmospheric research in cooperation with Canadian universities and in support of international programs. Weather forecasting for the arctic is supported through numerical weather models, which are constantly being improved through research and development. Arctic process research and modelling specific to weather, sea ice, climate and air quality is moving toward more regional scales, which are dependent on systematic observations on the same scale. MSC is in the process of opening a hydrology and arctic laboratory in Edmonton to address arctic forecasting issues through research and development.

Climate and atmospheric modelling is also being conducted by MSC in support of the northern research activities of international programs. These include:

- Middle atmospheric modelling for stratospheric ozone research in support of the Vienna Convention and the Montreal Protocol on Substances that deplete the Ozone Layer;

- Long-range transport of air pollutant modelling in support of the UN Economic Commission for Europe Protocols on POPs and Heavy Metals, to determine the country source of contaminants and new chemical threats;
- Climate change modelling and monitoring, in support of the World Meteorological Organisation's Global Atmospheric Watch, and the Framework Convention on Climate Change, to develop models of future climates, determine background greenhouse gas concentrations and stable isotopes to better understand greenhouse gas sources and sinks, and to research adaptation measures to climate change; and
- Cryospheric (ice/snow) modelling and monitoring in support of the World Climate Research Program's new Climate and Cryosphere Project, and in developing new sea ice monitoring and forecast methods.

## 4.2 National Security

Defence Research and Development Canada (DRDC), an agency of DND, presently carries out R&D in support of the Canadian Forces Intelligence, Surveillance, and Reconnaissance (ISR) requirements in general. This includes R&D for space-, air-, land-, and sea-based surveillance. This work includes investigations of both sensor systems and systems to fuse ISR information from these sensors and other information sources. The aim of this work is to determine the performance of various surveillance systems in the North. This requires sufficient understanding of the physical environment to develop realistic models for predicting both electromagnetic wave propagation and background noise in the atmosphere, as well as underwater (under ice) sound propagation and background noise. Current interests include further evaluation of the utility of High Frequency Surface Wave Radar (HFSWR), Unmanned Air Vehicles (UAV) and satellite surveillance in arctic regions, as well as the development of Rapidly Deployable Underwater Acoustic (RDU) Systems for use in arctic waters. Future work will include an operations research study to determine an optimum mix of sensors for surveillance in the North and the development and trials of experimental prototypes of these systems.

## 4.3 Human Health and Safety

Research in human health and safety areas is funded and carried out primarily by HC, often in collaboration with northern governments, INAC, other federal departments, Canadian universities and northern non-governmental research institutions. Primary research areas of HC include: northern food science (e.g., foodborne microbiological contamination); therapeutics; disease surveillance; environmental contaminants (e.g., heavy metals, POPs, and radionuclides) arriving in the Arctic as a result of long-range atmospheric transport; and research into understanding the developmental and immunological effects of exposure to contaminants through the consumption of country or traditional food items.

Canada is a founding partner in the Northern Dimension Partnership for Public Health and Social Wellbeing, established by Health Ministers from 15 countries, the World Health Organization and other groups. The Partnership allows for the promotion of health



services and culturally relevant programs for indigenous peoples in the North, with emphasis on the prevention of major communicable diseases and the enhancement and promotion of healthy and socially rewarding lifestyles.

In 2000, the Government of Canada also created a new national health research agency, CIHR. CIHR is composed of 13 institutes, one of which is the Institute of Aboriginal Peoples' Health which is mandated to focus on research that addresses the health issues that affect the health of Aboriginal peoples in Canada, including Aboriginal people living in northern communities. Research at CIHR is focused on health issues affecting First Nations and Inuit such as mental health, suicide and diabetes, as well as research into traditional health practices and products. The funding includes studies in support of First Nations and Inuit living in Canada's North (e.g., study on food security in Nunavut).

#### 4.3.1 Food Safety

The NCP is a multi-departmental/multi-agency program to address issues related to environmental contaminants in the Canadian arctic. The program works to monitor, reduce and, wherever possible, eliminate contaminants in traditionally harvested foods, while providing information that assists informed food use decision making by individuals and communities.

The human health subprogram of the NCP focuses on levels of environmental contaminants and effects on human health. The program works with territorial, provincial, federal, and Aboriginal partners who deliver health services and advice, to ensure that a balanced message is communicated to northerners.

The NCP human health subprogram supports research on the exposure of northerners to contaminants through the consumption of traditional/country foods. The NCP will continue to support studies and actions to address the human health and communications issues needed to protect the health of highly exposed northern Aboriginal populations. The NCP will focus on human health through the following elements:

- Undertaking studies and assessments to clearly define the human health risks associated with observed levels of contaminants in highly exposed communities;
- Undertaking studies and assessments to identify which traditional/country foods provide the optimum combination of maintaining nutrition and reducing contaminant exposure;
- Formulating alternative contaminant reduction strategies appropriate for specific target groups such as women up to the end of their child-bearing years;
- Supporting health authorities in cooperation with northern Aboriginal organizations in the communication of effective dietary advice; and,
- Verifying, through environmental and human monitoring, whether the new international agreements are being effective in protecting the arctic.



Source: Inuit Tapiriit Kanatami/Eric Loring

#### 4.3.2 Service Delivery

In 2003, HC's e-Health Solutions Unit installed bi-directional satellites in five separate locations in Labrador. This technology provides authorized access to the First Nations and Inuit Health Information System which is a case management and planning tool for use by public health nurses and other health care professionals in rural and remote health facilities. As well, this technology gives access to email and the Internet, web-based health portals and health information sites. One other satellite was installed at Hay River (NWT), giving the Alcohol and Drug Abuse Treatment Centre access to expanded web-based diagnostic, research, and education resources.

### 4.4 Sustainable Development and Management of Natural Resources

Sustainable development and management of both renewable and non-renewable resources involves NRCan, EC, INAC and DFO. Northern S&T partnerships have been established with researchers in other circumpolar nations, Canadian universities, the private sector, NGOs, northern government departments and First Nations and Inuit organizations.

#### 4.4.1 Renewable Resources

NRCan's Canadian Forest Service (CFS), through its national network of science-based establishments, delivers a research program that focuses on the two key aspects of promoting sustainable management of Canada's forests and forest sector competitiveness. It leads and coordinates Canada's national and international forestry S&T activities, and undertakes research in partnership with governments, industry and other stakeholders. In the North, sustainable forest management is facilitated through Memoranda of Understanding between CFS and the Yukon and Northwest Territories. CFS also carries out northern S&T under the First Nations Forestry Program, the Model Forests Program, and Collaborative Research Agreements.

The Western Newfoundland Model Forest (WNMF) and the Canadian Model Forest Network (CMFN) are working with the Innu Nation in District 19 in Labrador through a Forest Management Committee (FMC). A series of projects will help to increase development and adoption of Sustainable Forest Management systems and tools beyond the WNMF boundaries and into central Labrador. The goals, objectives and key needs of the FMC are areas where the WNMF and CMFN have a great deal of experience and much to offer. This initiative in Labrador serves to strengthen sustainable forest management across Newfoundland and Labrador and the CMFN, including the enhancement of cross cultural understanding and traditional knowledge of ecosystems.

CFS delivers programs to the North through the First Nations Forestry Program and S&T activities (e.g., Collaborative Research Agreements, Fire Management Network, Canadian Interagency Forest Fire Center). CFS carries out its national research programs through the five regional Research Centres that address a range of issues, including forest health, climate change, landscape management, forest ecosystem processes, fire and pest management, tree biotechnology and socio-economic research. In addition, Model Forests, such as the Waswanipi Cree Model Forest in northern Québec and the McGregor Model Forest in British Columbia which implement a Wildfire Threat Analysis System, can provide the basis for further assistance and serve as working models for partnerships in the North. CFS plans include programs to:

- Understand the fundamental processes and dynamics of Canada's forest ecosystems;
- Provide leadership in forest ecosystem monitoring and analysis;
- Develop and promote better ways to protect and enhance forest ecosystem health, diversity and productivity;
- Develop integrated knowledge, tools and techniques for sustainable management of forest ecosystems; and
- Contribute to the future viability and competitiveness of Canada's forest-based economies through research and funding support, scientific and technical advice, and assistance in the application and commercialization of environmentally sound systems and technologies.

Plans in relation to First Nations include programs to enhance:

- Capacity of First Nations to sustainably manage forest lands;
- Capacity of First Nations to operate and participate in forest-based development opportunities / benefits;
- First Nations knowledge of sustainable forest management and forest-based development; and
- First Nations institutional capacity to support forest-based economy participation.

Managing fisheries in the North involves 72 fisheries, with over 300 fish stocks and over 50 marine mammal stocks. Management activities include scientific advice, licensing, harvest monitoring, co-management, Fishery Management Plans, and conservation education initiatives. Research is also underway in support of new arctic marine fisheries such as Greenland halibut. Although fisheries and aquaculture in the North are relatively small in terms of economic activity, in comparison to other Canadian coastal areas, fisheries are of

greater importance in the North as a part of traditional diets. DFO has shown leadership in developing community based fisheries monitoring and assessment programs. In Québec, an Aboriginal Fishery Division has been created, in cooperation with the Makivik Corporation and the Kativik Region government, to coordinate fishing permits and plans for Nunavik. DFO Central and Arctic Region is developing an Aboriginal Fisheries Strategy. The Fish and Wildlife Management Board, resulting from the Land Claims Umbrella Final Agreement, is the primary fish and wildlife management instrument in the Yukon. Negotiations are underway (DFO, EC and Inuit) to establish a Multi-tasked Inuit Officer Program. Officers would possess full authority over all wildlife-related legislation.

DFO responsibility for fish habitat management also includes involvement in environmental assessments under the *Canadian Environmental Assessment Act* (CEAA) for projects such as: marine infrastructure, diamond mines, roads, hydroelectric projects, and oil and gas infrastructure (e.g., pipelines).

Scientific studies are a large part of DFO activities, including studies of marine mammal stocks (e.g., support to Northern Beluga Management Plan in Québec, Beaufort Sea Integrated Management Planning Initiative, Hudson Bay Integrated Management Project).

#### 4.4.2 Non-renewable Resources

NRCan's GSC is the major federal contributor to northern geoscience and maintains a national geoscience database. The GSC also conducts geoscientific research and surveys as part of its mandate to provide Canada with a comprehensive geoscience knowledge base that contributes to economic development, public safety and environmental protection. This work is done within the general framework of the 2002 Intergovernmental Geoscience Accord which defines relationships among the GSC, provincial and territorial governments. It also facilitates planning and implementation of government geoscience in Canada. In the Yukon, Northwest Territories and Nunavut, geoscience is delivered cooperatively by the GSC, INAC and territorial agencies. Universities also contribute to geoscience knowledge.

New information about all aspects of northern geology and the landmass is needed by industry and governments for evaluating resource potential, land-use planning, and for avoiding/reducing risk from natural hazards. Knowledge of the landmass and offshore regions plays a critical role in sovereignty and provides scientific underpinning for global policy initiatives such as the UN Convention on the Law of the Sea (UNCLOS).

Geoscience surveys are generally of the following types:

- Regional geological studies of bedrock and surficial materials in areas of known or high potential for mineral deposits, and areas of planned industrial development;
- Geophysical and geochemical surveys to provide regional context and targets for mineral and hydrocarbon exploration;

- Development of mineral deposit models and exploration methods, focused on increasing the probability of exploration success;
- Development of a precise three-dimensional view of sedimentary basins and assessment of hydrocarbon potential to attract exploration investment; and
- Mapping the sea floor to guide hydrocarbon exploration and development and to define Canada's claims under UNCLOS.



Source: BHP Billiton Diamonds Inc.

NRCan also conducts research related to environmental protection, including: studies in support of environmental impact assessment (e.g., cumulative effects from natural resource exploration and production, and hydrocarbon and biomass-based fuel combustion). This work includes:

- Research into earth observation tools for monitoring human-induced interactions and transfer of those tools to northern stakeholders for data gathering;
- Targeted geochemical surveys in areas of existing development, as well as baseline studies where development is possible in the future, to determine the distribution of potentially toxic, naturally occurring elements and potential for future release;
- Research into the bio-geochemical cycle of metals to provide a sound scientific basis for policy and regulatory decisions affecting metal production/use;
- Research into natural hazards, climate change, and permafrost that could affect northern infrastructure; and
- Research into northern pipeline performance/stability.

The Program of Energy Research and Development (PERD) is managed by the NRCan Office of Energy Research and Development to provide funding to and through federal researchers to foster coordinated outcomes. Departments and agencies involved in the PERD northern portfolio are EC, DFO, INAC, NRC and NRCan. Activities provide knowledge to inform oil and gas regulators and industry on the extent, severity and mitigation of geotechnical, environmental and engineering factors related to Beaufort Sea development and pipelines. R&D also supports improved methods to define the extent of northern petroleum resources.

To remain productive and competitive, Canada's resource industry must continue to adopt new technologies to offset high labour costs, enhance efficiency to maximize recoveries, and increase further processing of mineral and metal resources into value-added products. As the national centre for mineral and energy technology, the Canada Centre for Mineral and Energy Technology (CANMET) has a critical role to play in assisting northern industry in meeting these technological challenges and promoting safe, efficient and sustainable operations.

CANMET works in partnership arrangements to develop and deploy energy-efficient, alternative energy and advanced hydrocarbon technologies. Activities focus on energy efficiency, renewable energy resources, alternative transportation fuels and hydrocarbons, including:

- Alternative transportation fuels, including natural gas, propane, ethanol, methanol, hydrogen, electric and hybrid vehicles;
- District heating and cooling, and integrated energy systems;
- Advanced low-emission combustion technologies;
- Processing and environmental catalysis for fuel production and hydrocarbon conversion; and
- Energy-efficient metallurgical fuel products and technologies.

#### 4.5 Social Environment

A people's history, language and culture play a significant role in their socio-economic development and capacity to integrate their society into the national community. This is particularly true of First Nations, Inuit and non-aboriginal northerners who are endeavouring to establish the social environments and cultural identities that will allow them to contribute to the development of Canadian society and culture.

The study of anthropology, archaeology, arts, culture, economics, history, language and literature, political science, psychology, religion, and sociology provides information that is central to the establishment of northern identities. Archaeology and traditional culture are particularly important elements of impact assessment processes related to economic development and the expansion of northern infrastructure.

Northern research in these fields often involves collaboration between academic institutions, First Nations and Inuit organizations, and territorial and federal governments. CMC, PC and INAC lead federal research efforts in these fields, while the SSHRC is the main funding source for academic research on northern themes.

Research at the CMC is presently culminating in the development of several projects designed to increase public knowledge of the North, including:

- An exhibition and accompanying book on the history and traditional culture of the Inuvialuit;
- An exhibition and book on the replication of traditional Gwich'in clothing; and
- Arctic and Subarctic Galleries of the newly-opened First Peoples Hall.

An Internet-based exhibition on the Canadian Arctic Expedition is now accessible on the Internet (<http://www.civilization.ca/hist/cae/>), and another exhibition on Canadian Inuit ivory carving of the past two centuries will soon be available. In 2004, a general-audience history of the arctic regions will be published.

Ongoing CMC research efforts relate to the repatriation of collections associated with the land claims negotiations of several northern First Nation and Inuit groups. Other projects are aimed at tracing the early history of the Inuit and at understanding the art of the Palaeo-Eskimos, who inhabited Arctic Canada before the arrival of the Inuit.

CMC's principal research endeavour in the coming years will be the Helluland Archaeology Project (<http://www.civilization.ca/archeo/helluland/str0101e.html>) aimed at understanding recently discovered evidence relating to early contacts between the Inuit, Palaeo-Eskimo and European occupants of the eastern Arctic in the centuries around AD 1000. Researchers and students from several universities and government agencies participate in the Helluland Archeology Project, which has been developed in cooperation with northern communities and cultural organizations. The anticipated results of this project are potentially significant in terms of knowledge about early European presence in Canada and perceptions of the Inuit as a people whose way of life developed in isolation from the outside world.

PC manages a series of national historic sites in Yukon Territory, most of which relate to the gold rush period. PC manages several national historic sites in the provincial North as well, notably the Chilkoot Trail in northern British Columbia and Prince of Wales Fort and York Factory in northern Manitoba.

There are more than two dozen national historic sites not managed by PC in the three territories, several of which have received financial support through the national historic site cost share program and many of which have had research programs with PC involvement. The National Historic Sites Systems Plan has identified the need for greater recognition of First Nations and Inuit history, and PC is undertaking research to support commemoration of indigenous themes (i.e. collection of oral history, archival work, archaeological surveys).

Some of the recently recognized national historic sites include Tr'ochëk National Historic Site of Canada (Yukon), Grizzly Bear Mountain and Scented Grass Hills National Historic Site of Canada (NWT), Nagwichoonyjik (Mackenzie River) National Historic Site of Canada (NWT), Fall Caribou Crossing National Historic Site of Canada (Nunavut), and Arvia'juaq and Qikiqtaarjuk National Historic Site of Canada (Nunavut).

The protection and commemoration of cultural resources is an important aspect of national parks management. Northern national parks have ongoing archaeological programs and monitor the condition of known cultural resources within the parks. Each field unit has a cultural resource manager, and park staff work with local communities in collecting the local history of each park. The results of this research are used in park management, information provided to visitors, and are published in journals and books. A notable recent publication based on research in Quttinirpaaq National Park is Lyle Dick's "Muskox Land: Ellesmere Island in the Age of Contact".

The INAC Strategic Research and Analysis Directorate is conducting two research projects to measure the socio-economic well-being of northern residents. A series of research papers will be published on various indicators of change in Inuit socio-economic well-being, using Canada Census data from 1981 to 2001. A community well-being index will be developed to measure the relative well-being of First Nations and Inuit communities in relation to each other, and to other similarly situated communities. This is a national study that will include communities in northern regions. A time-series will also be developed to track the relative well-being of communities from 1981 to 2001. The index, which is a composite of various socio-economic indicators, will rely on Canada Census data.

First Nations and Northern Statistics of the INAC Corporate Information Management Directorate publishes a Northern Indicators report that profiles the demographic, social, labour force, economic and public finance characteristics of the Yukon, Northwest Territories, and where possible Nunavut. Updated periodically, the report presents time series statistics in tabular and graphical format. The primary data source for this publication is the Canadian Socio-Economic Information Management System, maintained by Statistics Canada. This report has been recently updated to 2003, and can be found at [http://www.ainc-inac.gc.ca/pr/sts/nia\\_e.pdf](http://www.ainc-inac.gc.ca/pr/sts/nia_e.pdf)

Northern research is a strategic priority for the SSHRC. Research on the Canadian North is supported through a variety of programs (e.g., Standard Research Grants program – SRG) and research training programs such as its doctoral fellowship program. The SSHRC actively seeks partners from government, and the not-for-profit and private sectors, for its Joint Initiatives (<http://www.sshrc.ca>) in support of targeted research on pressing social, economic and cultural issues. SSHRC's Joint Initiatives extend from 1–5 years and normally involve equal partner contributions.

Researchers from post-secondary institutions, not-for-profit organizations and community organizations that have a research mandate and qualified researchers on staff can also apply to SSHRC's new Northern Research Development Initiatives (NRDI) program and to its Community-University Research Alliance (CURA) program. The objectives of the NRDI program are to :

- Support revitalization of existing research;
- Support new research programs in the North;
- Provide opportunities for training future researchers;
- Expand the capacity of individual researchers, research groups and institutions to conduct research in the North; and
- Support research that meets the needs of northern residents by involving them in the research process.

## 5.0 Major Interagency Opportunities in Northern Science and Technology

The Government of Canada catalyses northern S&T through a number of major interagency initiatives that include both the public and private sectors. Three key and emerging initiatives are briefly discussed below.

## 5.1 Canadian Participation in International Polar Year 2007 – 2008: A Strategic Opportunity

The international polar research community is planning an International Polar Year (IPY) for 2007 – 2008. “The IPY is intended to promote intensified investigation of the role of Polar Regions in the earth system” (<http://www.ipy.org>). It represents a unique, once-in-a-lifetime opportunity to engage the world in expanding knowledge on issues of critical importance to Canada. Many of the fundamental issues in polar science, which also have global implications, require the collaboration and cooperation of science and logistical capacities of all countries with polar research interests. The logistical capacities are considered to include icebreakers devoted to science, surveillance satellites with polar orbits, and ground research and monitoring stations.

### Special Opportunity

Canada is a major circumpolar nation. The Canadian Arctic Archipelago is a unique component of the global system and is the homeland of Inuit. Canada also has research interests in the Antarctic. As such, it is vital to Canada to participate in major international scientific programs with national and global implications for society and the economy. According to the IPCC and the ACIA, global change is predicted to have its greatest impacts in polar regions during the 21st century. Unique and severe social challenges face communities in Canada’s North. Additionally, the increased accessibility of the arctic is leading to unprecedented challenges to Canadian sovereignty.

The IPY 2007–2008 draws from the successes of the first IPY in 1882–1883, the second IPY in 1932–1933 and the International Geophysical Year (IGY) in 1957–1958. The IPYs and IGY were major initiatives that resulted in significant new insight into global processes, and led to decades of invaluable polar research.

Organizing an IPY for 2007–2008 will require an intensive international campaign involving several years of detailed planning and coordination. The CPC and federal departments have taken the lead in stimulating interest and discussion on Canada’s role in the IPY. As a result of feedback from northerners and the arctic research community, CPC has promoted inclusion of the human dimension as part of the polar research program for IPY. This has been accepted by the ICSU-IPY planning group. Canada’s representative on this planning group is Dr. Gérard Duhaime from Laval University. Partnerships with territorial governments and the northern research community will be used to fully develop the essential human dimension of Canada’s IPY science program.

International years have proven to be important in setting the international science agenda for decades into the future. Coordinated international research efforts will help to: advance understanding of polar interactions, including their role in global climate; expand our ability to detect changes; and extend knowledge to the public and decision makers. Information gained during an intensive IPY will focus the research agenda and, for Canada, it will provide an opportunity for northern communities to be an integral part of the IPY program.

Full and meaningful participation in an IPY will also position Canada to be a leader and full partner in other international arctic

programs (e.g., European Union plans for a scientific icebreaker deep water drilling platform).

### Program

The planning process for a major international year is well underway and will require ongoing planning and support. To this end, ICSU has established an IPY Planning Group to oversee development of an IPY research program that will include a broad range of activities organized around a select number of scientific themes. The Planning Group has defined the following five main themes (as of June 2004):

- (1) To determine the present environmental status of the polar regions by quantifying their spatial and temporal variability;
- (2) To quantify, and understand, past and present environmental and human change in the polar regions in order to improve predictions;
- (3) To advance our understanding of polar – global teleconnections on all scales, and of the processes controlling these interactions;
- (4) To investigate the unknowns at the frontiers of science in the polar regions; and
- (5) To use the unique vantage point of the polar regions to develop and enhance observatories studying the Earth’s inner core, the Earth’s magnetic field, geospace, the Sun and beyond.

Five emerging observational initiatives serve the scientific themes:

- (1) A synoptic set of multidisciplinary observations to establish the status of the polar environment in 2007-2008;
- (2) The acquisition of key data sets necessary to understand factors controlling change in the polar environment;
- (3) The establishment of a legacy of multidisciplinary observational networks;
- (4) The launch of internationally coordinated, multidisciplinary expeditions into new scientific frontiers; and
- (5) The implementation of polar observatories to study important facets of Planet Earth and beyond.

More information about Canadian participation in IPY can be obtained at <http://www.polarcom.gc.ca> by following the link to “IPY 2007/2008”.

## 5.2 Northern Hydrocarbon Development

### Background

There has been interest in developing Canada’s northern hydrocarbon resources for some time. Development has proceeded from the first oil exploration well at Norman Wells in 1920, to the building of the Canol pipeline during WW II and an oil pipeline from Norman Wells to Alberta in the mid-1980s. Marketable natural gas reserves have been discovered in the Mackenzie Delta, Sverdrup Basin and Liard Valley, with the latter in production since the 1980s. Major projects to bring the Mackenzie Delta and High Arctic reserves to market were proposed in the early 1970s, 1980s and 1990s, and are proposed today.

Proposals to develop and transport hydrocarbons to market resulted in a number of research programs and scientific studies by

industry, government and NGOs to support technical aspects of development, environmental assessment, review and regulation of the projects. These efforts included the: Beaufort Sea Study; eastern Arctic Marine Environmental Studies program; and studies in relation to the Alaska Highway/Dempster Lateral pipeline proposal and the Polar Gas proposals for a high Arctic natural gas pipeline. Development of a Mackenzie Valley pipeline was considered in a public inquiry in the 1970s and delayed pending settlement of Aboriginal Land Claims.

In the Beaufort Sea, exploration included 22 artificial islands with 23 exploration wells, and 15 exploration wells from ships and confirmed marketable reserves. To prepare for oil and gas development in the western Arctic, the federal government, in 1984, launched the seven year, \$68 million Northern Oil and Gas Action Plan (NOGAP). Projects such as the Beaufort Environmental Monitoring Program, the Mackenzie Environmental Monitoring Program and the Beaufort Region Environmental Monitoring Program involved governments, industry and Aboriginal people and co-management organizations.

Two ongoing government programs designed to address environmental and technical issues related to hydrocarbon development are the federal Panel on Energy Research and Development (PERD) and the Environmental Studies Research Funds (ESRF). PERD supports the energy-related research and development activities of twelve federal departments with an annual budget of \$57.6M. ESRF is designed to assist in the decision-making process related to oil and gas exploration and development on Canada's frontier lands. ESRF funding is provided through levies on frontier lands paid by oil and gas exploration companies as permit holders. ESRF is directed by a joint government/industry/public management board.

### Current Energy Potential in the North

The North accounts for 34% of Canada's recoverable gas resources and 37% of the undiscovered potential (Beaufort Sea – 42%, Mackenzie Delta – 22%, Mackenzie Valley – 12%). Most of the remaining undeveloped reserves are found in the Sverdrup Basin.

Approximately 268 million m<sup>3</sup> of northern Canada's estimated 1,433 million m<sup>3</sup> ultimate potential for crude oil have been discovered. The majority is believed to be in the Mackenzie Delta-Beaufort Sea and Arctic Islands regions. In addition, several areas such as the eastern arctic offshore have barely been investigated. By the mid-1990s, 53 significant discoveries had been declared in the Beaufort Sea/Mackenzie Delta region with discovered resources of over 9 trillion ft<sup>3</sup> of natural gas and one billion barrels of crude oil. Recent drilling suggests that this total may have increased.

The focus of northern exploration has been on conventional oil and gas resources but there are also non-conventional hydrocarbon resources that include: heavy oil; oil shales; and coal bed methane that remain largely unquantified. Uniquely, in the Mackenzie Delta there are large onshore deposits of gas hydrates and new research is indicating these may have some production potential.

The current industry focus is on the exploration, development and transportation of the mainland natural gas reserves in the western Arctic. The Mackenzie Gas Project is now under consideration for the development of three anchor fields in the Mackenzie Delta – Taglu,

Niglintgak and Parsons Lake – which contain a total of 5.8 trillion ft<sup>3</sup> of natural gas. On June 18, 2003, proponents of the Mackenzie Gas Project released their Preliminary Information Package. The project includes development of the three fields, construction of gathering lines, processing facilities and a large diameter pipeline along the Mackenzie Valley into northern Alberta.

### Administrative Complexity

Federal science departments and agencies with an interest in oil and gas activities are: NRCan; INAC; DFO; EC; and the NRC. Federal departments with regulatory or administrative authority over such matters include INAC, DFO, EC, TC, and the National Energy Board (NEB). Interests of the territorial governments relate to wildlife and socio-economic issues.

The settled land claims of the Inuvialuit, Gwich'in and Sahtu established a number of resource and environmental management boards. A Land and Water Management Board established under the Gwich'in and Sahtu land claims has responsibilities for land and water management in all of the Mackenzie Valley except in the Inuvialuit Settlement Region where INAC retains these responsibilities. The Deh Cho First Nation land claim in the southern Mackenzie Valley is under negotiation. Large tracts of land in the Mackenzie Delta and Valley are held by Aboriginal organizations that have direct interest and responsibilities for land use and economic benefits from development.

Non-governmental organizations are active in promoting sustainable development, protected areas and wildlife management. The achievement of sustainable development in the North requires a sound science base for informed decision-making.

### Current Activities to Address Northern Science Needs

A wealth of information about the environment and the potential impacts of development has been developed. The technological advances of industry and the potential impact of climate change on the region mean that each new project requires a review and assessment of the existing knowledge base before investing in more scientific studies.

Steps have been taken to prepare the federal government to assess, regulate and monitor current and future hydrocarbon projects. In 2001, a Northern Oil and Gas Science Steering Committee was established, chaired by INAC, with representatives from DFO, EC, and NRCan and links to the National Energy Board, NRC, PC and IC. Two biophysical information "gap" analyses were undertaken, for hydrocarbon development in the Mackenzie Delta and near shore Beaufort Sea Region (2002), and for the Mackenzie Valley including exploration, development and a potential pipeline (2003). Both studies were guided by a Project Advisory Team composed of the federal and territorial governments, industry, and co-management and non-governmental organizations. An Action Plan has been developed to guide studies over the next five years.

Key "gaps" in the scientific knowledge base include: Beaufort Sea sea-bed mapping of ice scour; habitat requirements; beluga whale response to ship and drilling activities; ice ridge dynamics; shoreline/grounded ice stability, erosion and sedimentation processes; frost heave effects on buried pipelines in permafrost; important

spawning, rearing and over wintering habitats for fish and invertebrates along the pipeline route; and climate change impacts on permafrost and hydrology in relation to pipeline integrity.

DFO and NRCan have deployed a vessel with multibeam sonar for seabed mapping and marine habitat analysis, with field work participation of the Inuvialuit. Collaborative efforts are also underway to investigate fisheries issues identified in Travaillant Lake by the community of Tsüighehtchic, adjacent to the pipeline route.

ESRF and PERD are directing resources to northern environmental and technical issues. In 2003-2004, INAC provided interim funding to investigate key science/information issues related to northern gas development by consolidating and updating existing data bases or conducting test sampling. Studies include: the review and assessment of information on frost heave related to the Norman Wells pipeline; methods, tools and data sets to assist communities and contribute to community monitoring; surficial geology mapping; updating granular resource information, and slope instability, land slide occurrence; and the application of sampling protocols for stream and lake crossings.

Approval of the pipeline project will increase the feasibility of other on-shore and offshore gas fields. Drilling in the near shore Beaufort Sea is expected to resume in 2006.

### Future Opportunities

The changing environment, both in terms of the biophysical circumstances, and growth and maturity of the institutions developed by each of the land claim agreements in the western Arctic, offers many challenges and more opportunities than existed in the past. The magnitude of the climate change predictions for the western Arctic raise questions about the reliability of previous science and in some cases re-evaluation may be required. At the same time industry has gained an immense knowledge base from operating in the arctic for over thirty years, enabling it to decrease the potential environmental "footprint". The co-management and Aboriginal institutions are equal contributors to the knowledge needed to sustain a balanced approach to development of hydrocarbon resources.

The new knowledge generated by studies identified by the various planning exercises will contribute to the environmental assessment, regulation and future monitoring of pipeline, exploration, development, operation and ultimate decommissioning activities. The information generated will also contribute to the existing cumulative effects framework and programs, and protected areas proposals.

Budget 2004 announced an investment which provides much needed science funding in support of northern hydrocarbon development. To demonstrate the Government's commitment to responsible energy development in the North, Budget 2004 provides \$75 million over three years to increase federal and regional environmental assessment capacity and streamline the regulatory process. This announcement will also ensure resources are available to conduct scientific research on current and longer-term environmental challenges associated with development in the Mackenzie Valley, Mackenzie Delta and the Beaufort Sea. The resources directed towards the science efforts across the federal government will be in support of the environmental assessment and regulatory review processes for the Mackenzie Gas Project.

### 5.3 ArcticNet

In 2003, the Networks of Centres of Excellence (NCE) announced funding for a Network on northern research known as ArcticNet. This intensive, long-term, multidisciplinary climate variability research program was designed to accelerate scientific investigation into the many natural, social and health science issues and consequences in the North, at the university, private sector and government levels. ArcticNet is the only NCE to date with an arctic focus.

Climate change is predicted to have profound impacts on the Canadian North. ArcticNet is expected to contribute the knowledge needed to formulate climate change impact assessments, national policies and adaptation strategies to help Canada face the environmental and socio-economic consequences of arctic warming. Research teams in Canada, the United States, Japan, Denmark, Poland, Sweden, Norway, the United Kingdom, Spain and Belgium are addressing scientific challenges posed by the warming Arctic. The themes that will be investigated by ArcticNet scientists include:

- Climate change impacts in the Canadian High Arctic;
- Comparative study along the east-west gradient in physical and societal conditions;
- Food, water and resources in the shifting N-S thermal gradient of the terrestrial eastern Canadian arctic;
- Managing the largest Canadian watershed (Mackenzie River) in a new climate;
- Land-ocean interactions in Sub-arctic Hudson Bay; and
- Adapting to change in the Canadian Arctic: knowledge transfer, policies & strategies.

ArcticNet will provide a unique multi-disciplinary cross-sector environment for the next generation of scientists.

Direct funding through the NCE is currently secured to support university-based research relating to ArcticNet for the next four years, at an investment of \$25.7 million. Federal government departments are also providing an equally large investment of in-kind support (e.g., equipment, researcher salaries, analysis, logistics, etc.) to the program.

The long-term scientific program will in part be carried out utilizing Canada's new scientific icebreaker, the *CCGS Amundsen*; an existing CCG vessel now retrofitted with state of the art scientific monitoring equipment. The retrofitting was made possible through an award from the Canada Foundation for Innovation and the contribution of the vessel by DFO-CCG.



Source: Department of Fisheries and Oceans

# Appendices

## Canadian Museum of Civilization

The Canadian Museum of Civilization (CMC) was created by the *Museums Act* (1990), as a corporation with the primary goal of increasing interest, knowledge, understanding and appreciation of Canada's cultural heritage and achievements.

The CMC undertakes research, collects and maintains objects and information of historical and cultural interest, and develops programs of exhibition, education, and information dissemination to Canadians. It is the primary federal organization engaged in archaeological and historical research in northern Canada, and fields archaeological, historical and ethnographic research projects in association with other federal agencies, local communities and other northern organizations. The CMC also maintains, and makes available for research and exhibition, Canada's largest archaeological and historical collections relating to northern Canada. It provides traveling exhibitions to communities in the North and, through its Aboriginal Training Program, provides instruction in museum-related fields to candidates from northern Canada as well as those from other regions.

The CMC represents the Government of Canada with regard to historical and cultural aspects of land claim negotiations relating to northern Canada, and in other matters relevant to northern history and traditional culture.

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## Canadian Museum of Nature

The Canadian Museum of Nature (CMN) is Canada's leading national natural history facility which houses a significant collection of plants, animals, fossils and minerals of which 283,000 are from the North. The mandate of the CMN is to increase, throughout Canada and internationally, interest in, knowledge of and appreciation and respect for the natural world by establishing, maintaining and developing for research and posterity a collection of natural history objects, with special but not exclusive reference to Canada and by demonstrating the natural world, the knowledge derived from it and the understanding it represents.

The CMN is involved in discovery of discovery, using the practises of systematics research. This natural history research in the earth and life sciences is collections-based, providing authoritative scientific nomenclature and new knowledge about the biogeography, evolution and phylogeny of species. Work is done predominantly in multi-disciplinary projects with external partners from universities,

government laboratories and other museums (e.g., CASES, ArcticNet, The Field Guide to Arctic Marine Fishes and the Flora of the Arctic Archipelago).

The CMN was instrumental in establishing the Alliance of Natural History Museums in Canada, which includes the Prince of Wales Museum in Yellowknife and the Beringia Museum in Whitehorse. The CMN also chairs the Management Board of the Federal Biodiversity Information Partnership, which strives to make collections and observation-based data more available via the Internet, including the many tens of thousands of specimens from the North.

The Centre for Traditional Knowledge has always had a close association with the Museum of Nature, and the home office is currently at the Natural Heritage Building in Gatineau, Québec. The Centre and the CMN are partners in the development of an educational traveling exhibit on climate change entitled *Sila: Clue in to Climate Change*, available to the public early in 2004. This program demonstrates how western science and traditional knowledge can be combined to explore climate change in the North, as well as information for individuals and communities to use in reducing their contribution to climate change. Each of the multi-media kiosks will offer interactive materials in English, French and Inuktitut. In association with this resource there will be web-based activities for teachers and students at [www.nature.ca](http://www.nature.ca).

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## Canadian Polar Commission

The Canadian Polar Commission (CPC) was established in 1991 to promote the development and dissemination of polar knowledge. CPC has a mandate to:

- Monitor polar knowledge in Canada and around the world;
- Work with Canadian and international institutions to determine scientific and other priorities;
- Encourage support for Canadian polar research;
- Communicate polar research information to Canadians;
- Foster international co-operation in the advancement of polar knowledge; and
- Position Canada as a leading circumpolar nation.



CPC can:

- Undertake, support, and publish studies;
- Recognize achievement and promote polar research and its application in Canada;
- Report on polar issues and the state of polar knowledge; and
- Initiate and support conferences, seminars, and meetings.

To monitor polar knowledge, CPC has the Indicators Project which uses fifteen indicators developed in consultation with arctic stakeholders to track emerging trends in Canadian polar science. CPC also maintains the Canadian Polar Information Network (CPIN) Website ([www.polarcom.gc.ca](http://www.polarcom.gc.ca)) which provides up-to-date information to the public about polar science in Canada and abroad.

The Polar Science Forum is a CPC web-based community centre where polar researchers can exchange ideas and collaborate online. CPC also maintains a Researcher's Directory which is a searchable database of Canadian polar science specialists. The Canadian Committee for Antarctic Research Website provides information on Canada's Antarctic research activities.

**CPC produces the following publications:**

- *Meridian* – Articles on current Canadian polar science.
- *Canadian Antarctic Research Network Newsletter* – Highlights the work of Canadian Antarctic researchers.

CPC is Canada's link to the circumpolar scientific community. It is Canada's adhering body to the International Arctic Science Committee (IASC) and the Scientific Committee for Antarctic Research (SCAR). The Commission maintains links with research organizations and institutes throughout the circumpolar world, to better inform Canadians and ensure Canada's views are heard internationally.

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**Environment Canada**

The mandate of Environment Canada (EC) is to: preserve and enhance the quality of the natural environment, including water, air and soil quality; conserve Canada's renewable resources, including migratory birds and other non-domestic flora and fauna; conserve and protect Canada's water resources; carry out meteorology; enforce the rules made by the Canada – United States International Joint Commission relating to boundary waters; and coordinate environmental policies and programs for the federal government.

EC, in cooperation with other federal departments, is involved in key areas of northern S&T, including:

- Contaminants and toxic substances;
- Climate change;
- Ozone depletion;
- Human health and safety;
- Northern ecosystems and biodiversity;
- Sustainable development and management of natural resources;
- Infrastructure development, maintenance, and national northern services; and
- Northern sovereignty.

These key areas are addressed through program activities in EC's three business lines: Nature; Clean Environment; and, Weather and Environmental Predictions. Through the Weather and Environmental Predictions business line, EC provides related science activities and research in the North such as climate, air quality, hydrologic, and ice and weather forecast programs that are strongly research based. In addition, MSC supports science research in partnership with universities and other government departments in order to increase knowledge of the northern environment. MSC conducts monitoring and research into air quality and the long-range transport of air pollutants at Alert and Resolute Bay to contribute to the study of contaminants and human health. Scientists at MSC are also carrying out research on climate change and stratospheric ozone depletion as it relates to the arctic. EC monitoring sites and research activities contribute to protecting the security and territorial sovereignty of Canada in the North.

Since Canada has science obligations as signatory to the Montreal Protocol on ozone depleting substances, the Framework Convention on Climate Change, the Kyoto Protocol and the Protocol on Persistent Organic Pollutants, research and monitoring activities in MSC are directed to support these agreements. MSC is an active participant in international northern research collaborations supporting the World Climate Research program, the Arctic Council's Arctic Monitoring and Assessment Programme and the Inter-governmental Panel on Climate Change.

Through the Clean Environment Business Line, Environment Canada uses science to make decisions and take actions in meeting its environmental and human health protection obligations under the *Canadian Environmental Protection Act, 1999* (CEPA 1999), and parts of the *Fisheries Act*. Specifically, the Environmental Protection Service (EPS) uses a science-based decision-making process to identify and assess the environmental risks of new and existing substances, including determining their potential for long-range transport to remote areas like the North; and to design and implement appropriate risk-management instruments such as regulations, guidelines, and performance agreements. Additionally, science supports decisions and actions taken by EPS under a range of programs such as compliance promotion, contaminated sites cleanups, and the work done under the Arctic Council Working Groups, like the Arctic Monitoring and Assessment Programme and the Protection of the Marine Environment program. This latter working group, for example, applies science and knowledge to develop and implement programs

for the protection of the arctic marine environment from both land and sea-based activities. Furthermore, EPS uses science to develop and implement international agreements for managing substances that accumulate in the North, examples of which include the Long Range Transport of Atmospheric Pollutants Protocol on POPs, and the Stockholm Convention on POPs. EPS also directs research and development efforts towards broadening our knowledge of oil spill behaviour and effects, developing oil spill cleanup and soil decontamination technologies, as well as for environmental emergency prevention, preparedness, and response needs.

Through the Nature business line EC conducts scientific research activities to increase knowledge of northern wildlife, aquatic ecosystems, northern hydrology, wildlife habitat, and wildlife response to harvesting, disturbances and contaminants. An example is the NEI, a partnership-based program, which aims to enhance the future health and sustainability of communities and ecosystems in the Canadian North. NEI is guided by the principle of sustainable development, incorporating existing and new scientific knowledge of northern ecosystems, in combination with traditional and local knowledge. The NEI follows an interdisciplinary approach that recognizes that healthy northern ecosystems depend upon a healthy northern social, cultural, and economic fabric.

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**Fisheries and Oceans Canada**

Fisheries and Oceans Canada (DFO) is the lead federal government department responsible for developing and implementing policies and programs in support of Canada's economic, ecological and scientific interests in oceans and inland waters. This mandate includes responsibility for the conservation and sustainable use of Canada's fisheries resources; providing safe, effective and environmentally sound marine services responsive to the needs of Canadians in a global economy; providing leadership on the development and implementation of an Oceans Management Strategy and a national system of marine protected areas, integrated coastal zone management and marine environmental quality programs; providing a sound scientific basis for the conservation and sustainable development of fishery resources, fish habitat management, defence and shipping, as well as studying the influences of climate variations and aquatic ecosystems; safe harbours, waters and waterways, producing reliable navigational charts and maintaining an extensive system of navigational aids and marine communication. The Canadian Coast Guard (CCG) fleet provides icebreaking, aids to navigation, rescue, safety and environmental response services and helps to meet the departmental mandate objectives of managing and protecting fisheries resources and understanding oceans and aquatic resources (marine science).

DFO conducts scientific research in environmental science, fisheries research, hydrography, and oceanography to further our

understanding and the sustainability of the vast oceans, waterways and aquatic resources of our country. This is accomplished through monitoring the aquatic living resources and their environment, maintaining related databases, and providing environmental information for marine freshwater related activities; surveying Canadian navigable waterways and producing nautical publications, including nautical charts, sailing directions, water depth maps and tide and current tables; maintaining scientific capacity to deliver credible advice to assess risk, and to develop resource management practices, regulations and standards, and by transferring the knowledge to the clients, public and media to foster the protection, conservation and sustainable development of living aquatic resources and ecosystems.

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**Foreign Affairs Canada**

Foreign Affairs Canada (FAC) delivers its mandate for northern S&T through: the Aboriginal and Circumpolar Affairs Division.

**Aboriginal and Circumpolar Affairs Division**

FAC participates in Circumpolar S&T initiatives through the Aboriginal and Circumpolar Affairs Division, which is committed to delivering the NDFP to Canadians and their northern partners.

The NDFP is framed by three principles: meeting our commitments and taking a leadership role; establishing partnerships within and beyond government; and engaging in ongoing dialogue with Canadians, northerners in particular. In keeping with this framework, the NDFP has four overarching objectives:

- Enhance the security and prosperity of Canadians, especially northerners and Aboriginal and Inuit people;
- Assert and ensure the preservation of Canada's sovereignty in the North;
- Establish the Circumpolar region as a vibrant geopolitical entity integrated into a rules-based international system; and
- Promote the human security of northerners and the sustainable development of the Arctic.

There are five priority areas for action under the NDFP, setting out a vision for Canada in the circumpolar world, based on cooperation with northerners and our circumpolar neighbours:

- Strengthening and promoting a central place in circumpolar relations and policy coordination for the Arctic Council;
- Helping to establish a University of the Arctic and support a circumpolar policy research network to develop northern research capacity and foster links between arctic researchers;

- Develop and expand opportunities to assist Russia as it addresses its northern challenges;
- Promote sustainable economic opportunities and trade across the Arctic; and
- Cooperation with circumpolar countries and with the EU to implement the Canada-EU Joint Statement on Northern Cooperation.

The northern foreign policy promotes Canadian interests and values as we work to address the issues we have in common with our northern partners. Examples of Circumpolar S&T initiatives include the following:

- Through NDFP, FAC supports the Arctic Council activities which advance circumpolar cooperation by the protecting the arctic environment and promoting the economic, social and cultural well-being of northern peoples. Support is provided to the three Canadian permanent participants of the Arctic Council and its five working groups: Arctic Monitoring and Assessment Programme (AMAP); Conservation of Arctic Flora and Fauna (CAFF); Emergency Prevention, Preparedness and Response (EPPR); Protection of the Arctic Marine Environment (PAME); and, the Sustainable Development Working Group (SWDG). Support is also provided to specific activities conducted by the working groups including the ACIA and Arctic Human Development Report.
- Through NDFP, FAC also contributes to northern Canadian colleges and universities which participate in the University of the Arctic (U Arctic), to ensure that northern stakeholders are developing and benefiting from the new programs being developed. Courses offered by the U Arctic include: Land and Environment; Arctic Environmental Technology; and Polar Oceanography and Meteorology. The courses are designed to address the educational and training needs of northern peoples as they face the challenges of a rapidly globalizing world. The courses can be taken online or in a classroom setting and are part of the signature program – Bachelor of Circumpolar Studies.

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**International Trade Canada**

**Science and Technology Program**

International Trade Canada (ITCan) contributes to strengthening Canada's Science and Technology (S&T) international presence. Through a network abroad, which includes more than 20 S&T Counsellors, S&T Officers and other Trade Officers with S&T responsibilities, ITCan's S&T program:

- Gathers and disseminates international S&T insights and intelligence;

- Facilitates access by Canadian researchers to international R&D opportunities by identifying sources of foreign technology, financing (venture capital), and potential partnerships with counterparts in the host country;
- Contributes to the development of Canada's domestic and foreign S&T policy; and
- Promotes Canada as an innovative, S&T-based country.

Canada has S&T Agreements with the EU, France, Germany and Japan, and an S&T Arrangement with Korea. As the most obvious northern-focussed partner with which Canada has an S&T Agreement, the EU has recently renewed its second Northern Dimension Action Plan, through which it intends to increase participation in northern cooperation. Canada also has very successful bilateral S&T relationships with a number of northern-focussed countries, including the Nordic countries, the United Kingdom, and the United States to name only a few.

The Science and Technology program at ITCan also manages a Going Global contribution program. This program is intended to promote Canada's international science and technology collaboration by assisting Canadian researchers in identifying and establishing new international collaborative R&D initiatives with foreign partners, where a number of successful applications have had a northern research focus.

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**Health Canada**

Health Canada (HC) is the federal department responsible for helping the people of Canada maintain and improve their health. The *Department of Health Act* formally establishes the HC mandate and the Minister of Health is also responsible for the direct administration of another 18 acts, which include the *Canada Health Act*, the *Food and Drugs Act*, the *Pest Control Products Act*, and the *Controlled Drugs and Substances Act*.

HC, together with its partners, delivers public health and health promotion programs and services, such as food safety, environmental health and communicable and non-communicable disease prevention, to northern communities. HC's ongoing work toward the sustainability of health programs and services is critical to improving northern health status. Collaboration with First Nations and Inuit, as well as the provinces and territories and other federal government departments will continue in order to deliver on this commitment. The key initiatives HC undertakes to enhance northern capacity to improve health status and to support health systems include the following:

- Contaminants Health Risk Assessments that undertake health hazard assessments relating to contaminants in food, including participation in the Northern Contaminants Program, methylmercury studies and studies related to endemic foodborne botulism;

- Enhancing First Nations and Inuit Health Promotion and Illness Prevention Programs by working with provinces, territories, First Nations and Inuit;
- Modernizing and Adapting Health Service Systems to First Nations and Inuit by ensuring efficient and effective health services and building capacity to identify, understand and control the impact of exposure to environmental contaminants;
- Health Surveillance Systems, including the International Circumpolar Surveillance Network and National Diabetes Surveillance System;
- Aboriginal Head Start in Urban and Northern Communities (AHSUNC) National Evaluations which collects descriptive, statistical and financial information, including data on program composition and delivery that can be used to provide profiles of remote and/or Inuit participants and sites;
- Canadian Incidence Study of Reported Child Abuse and Neglect (CIS); and
- Centre of Excellence for Children and Adolescents with Special Needs.

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**Indian and Northern Affairs Canada**

Through the *Department of Indian Affairs and Northern Development Act*, the Minister of Indian and Northern Affairs Canada (INAC) is the lead federal Minister in the North. The Minister has responsibility for fostering responsible development through scientific investigation and technology. The NS&T responsibilities of the INAC Minister in the North are delivered primarily through the programs and services of the Northern Affairs Program, in two key areas:

- Supporting northern political and economic development through management of federal interests; and
- Promoting sustainable development of the North's natural resources and northern communities.

INAC is working to support economic and political development in the North by encouraging self-sufficient, prosperous communities where northerners increasingly manage their own affairs. Progress is being made toward transferring provincial-type responsibilities to the territorial governments. In partnership with northerners, INAC is exploring new opportunities to attract investment and supporting key industries including mining, forestry, and oil and gas. INAC is also committed to ensuring an effective regulatory system for northern pipeline development. Mine site reclamation policies have been developed for the Northwest Territories and Nunavut to ensure that industry meets its responsibilities to protect the environment. The INAC Minister also plays a role concerning Canada and international polar science,

including the role of the CPC in promoting development and dissemination of polar region knowledge.

Despite its responsibilities, INAC is not an SBDA. The scientific foundation to discharge its federal mandate (including the formulation of policy and regulations, resource management and environmental stewardship) is obtained through arrangements (often financial) with SBDAs or through contracts with universities and the private sector. The main areas of northern science and technology carried out by the department, either directly or by arrangements with others, include:

- Providing the Secretariat to the Northern Contaminants Program;
- Carrying out geoscience research and related activities in the North;
- Supporting research on northern energy development in the Mackenzie Valley and Delta;
- Supporting research related to local contaminated sites in the North;
- Supporting northern scientific education and training;
- Advancing northern economic development through the Innovation and Knowledge Fund;
- Supporting research into the impacts of and adaptation to climate change in the North;
- Conducting research to support the northern resource management framework including environmental impact assessment, land and water regulation, environmental monitoring and resource development assessment work; and promoting cooperation among the eight circumpolar countries in areas such as sustainable development and science and technology exchanges.

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**Industry Portfolio**

The Industry Portfolio works to leverage resources and exploit synergies in a number of areas including:

- Innovation through science and technology;
- Growth of small and medium-sized enterprises; and
- Economic growth of Canadian communities.

The Industry Portfolio has a broad range of members and partners covering the entire spectrum of the economy including:

- Research and development (National Research Council (NRC), Communications Research Centre (CRC), Canadian Space Agency (CSA));
- University research funding agencies NSERC and SSHRC;
- Technology Development (NRC, CRC, Technology Partnerships Canada [TPC]);
- Data collection and analysis (Statistics Canada);
- Regional development (Atlantic Canada Opportunities Agency [ACOA], Canada Economic Development for Quebec Regions [CED], Western Economic Diversification [WD] – no longer a member of the Industry portfolio as of December 12, 2003 but continues to work in partnership); and
- Financing (Business Development Bank of Canada [BDC]).

The Industry Portfolio is an important contributor to northern S&T, particularly from a technology standpoint. The Industry Portfolio supports new technology demonstration projects for communities in the North, in areas such as information technologies (e.g., Smart Communities, Telehealth) and building and construction technologies (e.g., ventilation, heating, energy efficiency). Specialized expertise, equipment and facilities at Industry Portfolio laboratories (e.g., wind tunnels, wave tanks, ice tanks, research aircraft, icing research, satellites, and climatic engineering facilities) will remain central to research partnerships engaging in northern research. Industry Portfolio departments and agencies have been partners in numerous Northern S&T initiatives in recent years. Specialized S&T development and expertise have contributed to diverse projects including:

- CSA satellites and instrumentation that support Meteorological Services of Canada (MSC) and NRCan research, among others;
- The NRC Canadian Hydraulics Centre (NRC-CHC) computer program is coupling its ice-drift model with DFO oceanographic and EC atmospheric models, into an operational package for the Canadian Ice Service;
- The NRC Institute for Aerospace Research (NRC-IAR) together with EC's Meteorological Service and NASA's Glenn Research Centre, is leading a major North American study aimed at better understanding aircraft icing and hazardous winter weather. The Alliance Icing Research Study (AIRS II) will focus on freezing rain and other severe winter weather hazards to aircraft, and is designed to improve air traffic safety through better forecasting and detection of winter weather hazards to aircraft;
- The NRC Institute for Ocean Technology (NRC-IOT) works on the effects of ships colliding with "bergy bits" – house sized chunks of glacial ice;
- IC's Information Highway Advisory Branch's (IHAB) Broadband for Rural and Northern Development Pilot Program was created to assist those communities that are currently without broadband access. Most often, improved access is necessary in First Nations, northern, rural and remote communities in order to provide services in the area of health and education, as well as to augment economic opportunities;

- The National Satellite Initiative (NSI) was created to complement the Broadband for Rural and Northern Development Pilot Program as well as other provincial, territorial and private sector initiatives. The NSI will expand satellite capacity to far and mid north communities, as well as remote communities, which cannot receive broadband services in any other feasible or economic form than satellite communications. A majority of the approximately 400 communities currently targeted by this initiative are Aboriginal; and
- The CRC and Canarie are exploring the possibility of extending the Canadian Research and Education network, CA\*Net 4, to the North. Such extension would serve as one of the essential infrastructures for northern S&T. A high speed satellite link has been installed and is operational connecting Iqaluit with the CA\*Net 4 via CRC.

The major technology development and support programs of the Industry Portfolio are demand-driven, based on submitted project proposals. For example, IC's TPC program provides funding support to Canadian companies, for strategic research and development, and

demonstration projects, to take new technologies closer to the marketplace. The NRC Industrial Research Assistance Program (NRC-IRAP) provides Canadian Small and Medium-sized Enterprises (SMEs) with value-added technological and business advice, and financial assistance to help them realize their full potential. Programs such as IC's Community Access, that gives thousands of Canadians affordable access to the Internet in places like schools, community centres and libraries, have mandates to ensure that rural and remote regions of Canada, including the North, are able to participate in the Information Highway. IC's Aboriginal Business Canada program encourages entrepreneurship in Canada's Aboriginal communities. Priority areas for Aboriginal Business Canada include innovation and technology development, trade and market expansion, tourism and youth entrepreneurship.

The majority of the programs that are delivered in the North have a national mandate. Several of IC's regional offices have mandates for the North (e.g., British Columbia, Yukon, the Prairies and Northwest Territories), but they mainly deliver national programs in those regions. ACOA, WD and CED have specific regional mandates that include northern regions. In Saskatchewan, WD is leading the Northern Development Agreement (NDA), \$20 million, 50-50 cost shared agreement with the Province, focusing on innovation. The program runs until February 2007.

Typically, Industry Portfolio programs are aimed at strengthening linkages and information flows between S&T users (e.g., businesses, communities, institutions, and individuals) and those that can supply their needs (e.g., other businesses, government laboratories, universities, research institutions, foreign sources).

The bulk of the Industry Portfolio financial contribution to northern S&T is provided by the granting councils. NSERC and SSHRC provide several million dollars per year in research grants, research chairs, fellowships, scholarships and other assistance to university researchers on northern S&T.

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**Natural Sciences and Engineering Research Council**

The Natural Sciences and Engineering Research Council (NSERC) invests in people, discovery, and innovation in natural sciences and engineering to build a strong Canadian economy and to improve the quality of life for all Canadians. It supports research in universities and colleges, research training of scientists and engineers, and research-based innovation. The Council promotes excellence in intellectual creativity in both the generation and use of new knowledge, and it works to provide the largest possible number of Canadians with leading-edge knowledge and skills to help Canada flourish in the 21st century. NSERC fulfils its mission by awarding scholarships and research grants through peer-reviewed competition, and by building partnerships among universities, colleges, governments and the private sector.

A large portion of the research to understand the North and address northern issues is conducted in universities and NSERC programs can be accessed by academics to conduct northern research. Building capacity for conducting northern research is of crucial importance, and NSERC, through its programs, supports the training of highly qualified people. Following the NSERC/SSHRC Task Force on Northern Research, NSERC has recognized the state of northern research and has established a few programs to assist directly in this regard, for example, Northern Research Chairs, Internships and Supplements.

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**Social Sciences and Humanities Research Council**

The Social Sciences and Humanities Research Council (SSHRC) supports research and training on the North in all social sciences and humanities disciplines, through its regular research grants and fellowship programs: *Standard Research Grants* (SRG); *Major Collaborative Research Initiatives* (MCRI); *Community-University Research Alliances* (CURA); *Canada Graduate Scholarships* (CGS) Master's and Doctoral level; *Doctoral Fellowships*; and *Postdoctoral Fellowships*. All of these programs encourage collaboration among researchers and between disciplines. In addition, SSHRC's strategic programs specifically promote partnerships among researchers and stakeholders in government, community and not-for-profit

organizations, and the private sector.

In March 2002, SSHRC adopted four new strategic priority areas, which included one area central to northern research Aboriginal research. In October 2003, SSHRC approved the launching of a strategic program to enhance Aboriginal research on subjects such as urban issues, economic development, environment, education, research ethics, intellectual/cultural property, and Aboriginal languages and cultures.

In response to the related announcement in Budget 2003, SSHRC added "Northern Research" as a further strategic priority theme for the next several years. Specifically, the Board approved development of the *Northern Research Development Initiatives* (NRDI) program, which was launched in November 2003, and is based on SSHRC's *Research Development Initiatives* program. In addition, the SSHRC Board instructed staff to explore new joint initiatives with partners in government, the not-for-profit sector and the private sector to enhance support for research on the economic, social, ecological and political challenges and opportunities facing the Canadian North.

SSHRC has also endorsed the recommendations of the SSHRC-NSERC Task Force on Northern Research in principle.

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**Department of National Defence**

The mission of the Department of National Defence (DND) is to defend Canada and Canadian interests and values while contributing to international peace and security. Within this mission, DND has responsibility to:

- Provide strategic defence and security advice to the Government of Canada;
- Conduct surveillance and control of Canada's territory, airspace and maritime areas of jurisdiction;
- Respond to requests from provincial authorities for Aid of the Civil Power;
- Participate in bilateral and multilateral operations with Canada's allies;
- Assist other government departments and other levels of government in achieving national goals;
- Provide support to broad federal government programs; and
- Provide emergency humanitarian relief.

In addition to these support activities, the Department of National Defence is responsible for the National Search and Rescue (SAR) Program.

National Defence uses NS&T to provide advice to the Canadian Forces on techniques and systems for surveillance of the arctic land mass and adjacent waters of the Arctic Basin, as well as the channels of the Canadian Arctic Archipelago.

### S&T Priorities

Defence R&D Canada (DRDC) presently carries out R&D in support of the Canadian Forces Intelligence, Surveillance, and Reconnaissance (ISR) requirements in general. This includes R&D for space-, air-, land-, and sea-based surveillance. The aim of this work is to determine the potential performance of various surveillance systems in the unique environment of the North. This requires an understanding of the physical environment sufficient to develop realistic models to predict both electromagnetic wave propagation and background noise in the atmosphere, and underwater (under ice) sound propagation and background noise in the waters of the North. Current interests involve further evaluation of the utility of High Frequency Surface Wave Radar (HFSWR), unmanned air vehicles (UAV) and satellite surveillance in arctic regions, as well as the development of Rapidly Deployable Underwater Acoustic (RDUA) Systems for use in arctic waters.

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### Natural Resources Canada

Natural Resources Canada (NRCan) has a legislated mandate to promote the sustainable development and use of natural resources – energy, minerals, metals, and forests. In fulfilling this mandate, NRCan conducts research and implements research support activities, and develops policies and programs to :

- Build and maintain national knowledge infrastructure of Canada's land and offshore-based resources;
- Collect and disseminate knowledge on sustainable resource development and use;
- Conduct research and technical surveys to assess Canada's resources;
- Provide the national geographic framework of reference for spatial positioning, and prepare and publish maps;
- Establish legal boundaries in support of property rights;
- Conduct scientific, technological and economic research related to the energy, forestry, mining and metallurgical industries, and establish and operate scientific laboratories for these purposes; and

- Promote Canada's international natural resource interests and keep access open to global markets for Canadian products, services and technology.

NRCan's Polar Continental Shelf Project (PCSP) coordinates logistics support and provides related assistance to government and university research in the

Arctic as well as to community-based traditional knowledge studies. PCSP also provides services to non-Canadian research groups on a cost-recovery basis.

NRCan conducts scientific research in the energy, forest, minerals and metals sectors. In partnership with others, the department builds the public geoscience knowledge base and provides mapping and geographic information system support. Through these activities, NRCan stimulates resource exploration, supports infrastructure and land-use planning, and strengthens the capacities and decision making of governments and local communities. In addition, the Canada Lands Survey System is enabling Aboriginal people to become economic partners in the development of the North through skills development.

NRCan collaborates with northern agencies to conduct environmental assessments, study land-use related issues, facilitate regional development and achieve regulatory reform. The Department conducts research and development on innovative mineral exploration and processing technologies to enhance industrial productivity, offer cost-effective solutions to environmental problems, generate new knowledge and develop skills needed to conduct environmental assessments. The Ekati and Diavik diamond mines, which opened in the Northwest Territories in 1998 and 2003 respectively, are examples of the benefits of these efforts. Other diamond mines could soon be opened e.g. Snap Lake (Northwest Territories), Jericho (Nunavut), and Victor (Ontario). A nascent diamond cutting/polishing industry is being developed in northern Canada.

Private industry is proposing to develop natural gas reserves in the Mackenzie Delta and construct a pipeline through the Mackenzie Valley linking Inuvik and Norman Wells to southern markets. The project would connect northern gas to the existing pipeline network in northwest Alberta, making it possible to market the reserves and expand gas exploration in the Mackenzie Delta and Beaufort Sea, with benefits for northerners. The undertaking will require a multi-year, phased effort, and may result in gas production starting between 2008 and 2010. In 2001 and 2002, NRCan participated in the identification of geoscience gaps that would compromise informed decision making and has begun to address those gaps. The Department is also responsible for regulating oil and gas exploration activities in the North. Gas hydrates and coal bed methane deposits constitute Canada's largest remaining undeveloped sources of hydrocarbons and are the subject of research by NRCan. Significant emphasis is also being placed on development of renewable energy sources and energy conservation.

As for the Canadian Forest Service, ten research networks have been established and address such issues as forest health, climate change, landscape management, forest ecosystem processes, forest-fire research, pest control, tree biotechnology and socio-economic research. NRCan delivers programs through the First Nations Forestry

Program and through science and technology activities (e.g. Collaborative Research Agreements, Fire Research Network, and Canadian Interagency Forest Fire Centre Inc.). In addition, model forests such as the Waswanipi Cree Model Forest in northern Québec, and the McGregor Model Forest in British Columbia (where a wildfire threat analysis system has been implemented) could provide the basis for further assistance and serve as working models for partnerships in the North.

By promoting the responsible use of our natural resources, NRCan is building upon the Government of Canada's commitment to ensuring the quality of life in our communities, a healthy environment and continued economic prosperity – for the Canada we want, for ourselves and for future generations.

Further details can be found in “A Guide to NRCan's Programs and Activities in Canada's North” (2003) at [http://www.nrcan.gc.ca/sd-dd/pubs/norguide/toc\\_e.htm](http://www.nrcan.gc.ca/sd-dd/pubs/norguide/toc_e.htm)

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**Parks Canada Agency**

The Parks Canada Agency (Parks Canada – PC) administers a system of heritage areas and programs that includes national historic sites, national parks, heritage rivers, heritage railway stations and buildings, historic canals and national marine conservation areas. PC is responsible for implementing the *Canada National Parks Act*, the *Canada National Marine Conservation Areas Act*, the *Parks Canada Agency Act* and several other acts and related regulations. PC is responsible to parliament through the Minister of Environment.

**Parks Canada in the North**

PC manages 12 national parks and national park reserves, one Canadian Landmark and several national historic sites in the three territories and northern parts of the provinces. PC administration in the territorial North is divided into four Field Units: Nunavut, western Arctic (Inuvialuit Settlement Region and Gwich'in Settlement Area), South West Northwest Territories and Yukon.

The Government of Canada's *Action Plan to Protect Canada's Natural Heritage* includes initiatives for several new national parks in the North. Two park proposals are in Labrador, one in Nunavut, one in the Northwest Territories, and one in the southwest Yukon. PC is working to enlarge Nahanni National Park Reserve and Tuktut Nogait National Park.

The first priority for the management of national parks is ecological integrity. Management of national historic sites focuses on commemorative integrity.

**Parks Canada and Northern S&T**

PC engages in research in partnership with other government departments, aboriginal organizations and academic institutions. PC also regulates research within national parks, through a system of park research permits. With over a dozen offices and a network of park facilities in the North, Parks Canada provides logistical and other forms of support to many researchers.

PC uses transportation, communications, environmental observation, and small scale energy technologies in the management of remote parks and historic sites. PC has been an early adopter of satellite telephones, global positioning systems, automated weather stations, photovoltaic and wind power systems for park facilities, geographical information systems, and satellite imagery.

PC research focuses on environmental and ecosystem studies, in addition to a strong cultural resources program that includes archaeological studies, archival research and the collection of oral history. PC conducts research and monitoring programs related to the natural and cultural resources of the parks and historic sites.

**PC research in the North includes:**

- Studies leading to the establishment of national parks, including assessments mineral and energy resource potential in proposed parks;
- Ecological studies of vegetation, wildlife and park ecosystems;
- Natural resource inventories, including species at risk;
- Monitoring of weather, permafrost, climate, water quality and flow, vegetation, wildlife, visitor impacts, cultural resources and others;
- Inventories of cultural resources, including archaeological surveys;
- Cultural research related to aboriginal history and land use, including oral history; and
- Research leading to the commemoration of national historic significance.

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## Transport Canada

The mandate of Transport Canada (TC) in the North, consistent with its national mandate, is to develop up-to-date, relevant transportation policies and legislation that maintain a high level of safety, security and sustainability in a transportation system that meets Canada's economic, societal and environmental needs.

Canadians want and need a transportation system that is the best in the world. One that is safe, efficient, affordable, integrated and environmentally friendly. This is particularly true for northerners, who rely to a great extent on transportation of goods to and from the North.

- TC research and development policy in general, including northern science and technology, is accordingly oriented to provide strategic technological support for the Department's safety, regulatory and security functions, and for the Canadian transportation sector as a whole. This new orientation envisages:
- Greater support of the TC policy function, including technology intelligence, risk assessments and forecasts, economic and productivity analyses of new technologies, and assessment of their safety and environmental impacts;
- Enhanced cooperative approaches to horizontal S&T activities with government, the transportation industry, and other potential partners, responding to broad national priorities such as energy, the environment, accessibility, and sustainability;
- Increased competitive positioning of Canada and promotion of its science culture;

- Greater transparency of research and development activities and results, to Parliament and stakeholders; and
- Enhanced contribution to research capability in the private sector, and acceleration of technology transfer to production, by increasingly contracting-out research.

An example of research into an area with specific northern interest is the measurement and analysis of first and second year ice in support of the Arctic Ice Regime Shipping System (AIRSS). AIRSS has been developed to enhance the safety and efficiency of shipping operations in the Canadian arctic. AIRSS is currently being operated in parallel with the existing system of zone/date controls. Whereas the existing system imposes rigid control based on historical ice patterns, AIRSS provides a more flexible framework for decision-making, making full use of available information on ice conditions.

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**List of Acronyms**

AAFC	Agriculture and Agri-Food Canada	EPS	Environmental Protection Service of Environment Canada
ACIA	Arctic Climate Impact Assessment	ESC	Ecological Science Cooperatives
ACSYS	Arctic Climate System Study	ESRF	Environmental Studies Research Fund
ACOA	Atlantic Canada Opportunities Agency	EU	European Union
ACUNS	Association of Canadian Universities for Northern Studies	FAC	Foreign Affairs Canada
ADM	Assistant Deputy Minister	FBIP	Federal Biodiversity Information Partnership
AES	Atmospheric Environment Service	FMC	Forest Management Committee
AHSUNC	Aboriginal Head Start in Urban and Northern Communities	GEWEX	Global Energy and Water Experiment
AIRSS	Arctic Ice Regime Shipping System	GIS	Geographic Information System
AMAP	Arctic Monitoring and Assessment Programme	GOOS	Global Oceans Observing Systems Study
AOMIP	Arctic Ocean Models Inter-comparison Project	GPS	Geographic Positioning System
ASOF	Arctic-Subarctic Ocean Flux Study	GSC	Geological Survey of Canada
AVHRR	Advanced Very High Resolution Radiometer	HC	Health Canada
BDC	Business Development Bank of Canada	HFSWR	High Frequency Surface Wave Radar
CACAR	Canadian Arctic Contaminants Assessment Report	IASC	International Arctic Science Committee
CAFF	Arctic Council's Conservation of Arctic Flora and Fauna Working Group	IC	Industry Canada
CANMET	Canada Centre for Mineral and Energy Technology	ICSU	International Council for Science
CASES	Canadian Arctic Shelf Exchange Study	IGY	International Geophysical Year
CCCma	Canadian Centre for Climate Modelling and Analysis	INAC	Indian and Northern Affairs Canada
CCG	Canadian Coast Guard	IPCC	Intergovernmental Panel on Climate Change
CCRS	Canada Centre for Remote Sensing	IPY	International Polar Year
CED	Canada Economic Development	ISR	Intelligence, Surveillance and Reconnaissance (Canadian Forces)
CEPA	Canadian Environmental Protection Agency	ISR	Intelligence, Surveillance, and Reconnaissance – Canadian Forces
CFIA	Canada Food Inspection Agency	ITCan	Industry Technology Canada
CFCAS	Canadian Foundation for Climate and Atmospheric Sciences	MAGS	Mackenzie GEWEX Study
CFS	Canadian Forest Service	MERICA	Études des mers intérieures du Canada
CH	Canadian Heritage	MSC	Meteorological Service of Canada
CHS	Canadian Hydrographic Service	NAWMP	North American Waterfowl Management Plan
CIHR	Canadian Institutes of Health Research	NCE	Networks of Centres of Excellence
CIS	Canadian Ice Service	NCP	Northern Contaminants Program
ClC	Climate and Cryosphere	NDFP	Northern Dimension of Canada's Foreign Policy
CLIVAR	Climate Variability and Predictability Study	NDRI	Northern Development Research Initiatives
CMC	Canadian Museum of Civilization	NEB	National Energy Board
CMFN	Canadian Model Forest Network	NEI	Northern Ecosystem Initiative
CMN	Canadian Museum of Nature	NGO	Non-Governmental Organization
COSEWIC	Committee on the Status of Endangered Wildlife in Canada	NOAA	National Oceanic and Atmospheric Administration
CPC	Canadian Polar Commission	NOGAP	Northern Oil and Gas Action Plan
CPIN	Canadian Polar Information Network	NRC	National Research Council
CRC	Communications Research Centre	NRCan	Natural Resources Canada
CRYSYS	Cryosphere System Project	NSERC	Natural Sciences and Engineering Research Council
CSA	Canadian Space Agency	NSTP	Northern Scientific Training Program
CURA	Community-University Research Alliance	NWT	Northwest Territories
CWS	Canadian Wildlife Service	OECD	Organization for Economic Cooperation and Development
DFO	Department of Fisheries and Oceans	PAME	Arctic Council's Protection of the Arctic Marine Environment
DG	Director General	PC	Parks Canada
DND	Department of National Defence	PCB	Polychlorinated Biphenyls
DRDC	Defence Research and Development Canada	PCSP	Polar Continental Shelf Project
EC	Environment Canada	PERD	Program of Energy Research and Development
EMAN	Environmental Monitoring and Assessment Network	POPs	Persistent Organic Pollutants
		R&D	Research and Development
		RDUA	Rapidly Deployable Underwater Acoustic Systems

SARA	<i>Species at Risk Act</i>	<b>Foreign Affairs Canada</b>
SBDA	Science Based Department/Agency	ADM Committee Member – James Wright (ADM, Global and Security Policy)
SCAR	Scientific Committee for Antarctic Research	Working Group Member – Lee-Anne Hermann
SCI	Sustainable Communities Initiative (NRCan)	
SeaWiFS	Sea-viewing Wide Field-of-view Sensor	<b>Health Canada</b>
SSHRC	Social Sciences and Humanities Research Council	ADM Committee Member – Ray Edwards (DG, Policy & Planning Directorate)
S&TCs	Science and Technology Counselors	Working Group Member – Sami Rehman
TC	Transport Canada	
TPC	Technology Partnerships Canada	<b>Indian and Northern Affairs Canada (Co-Chair)</b>
TSRI	Toxic Substances Research Initiative	ADM Committee Member – Liseanne Forand (ADM, Northern Affairs)
UV-B	Ultraviolet-B	Working Group Member – Jill Watkins
U Arctic	University of the Arctic	
UAV	Unmanned Air Vehicles	<b>Industry Canada</b>
UN	United Nations	ADM Committee Member – Andrei Sulzenko (Senior ADM, Policy)
UNCLOS	United Nations Convention on the Law of the Sea	Working Group Member – Karen Johnstone-Hobbs
UN/ECE	United Nations Economic Commission of Europe	
UNESCO	United Nations Education, Scientific and Cultural Organization	<b>National Defence</b>
UNEP	United Nations Environment Programme	ADM Committee Member – John Leggat (ADM, Science and Technology)
WCRP	World Climate Research Program	Working Group Member – Jon Thorleifson
WD	Western Economic Diversification	
WMO	World Meteorological Organization	<b>Natural Resources Canada</b>
WNMF	Western Newfoundland Model Forest	ADM Committee Member – Irwin Itzkovitch (ADM, Earth Sciences Sector)
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<b>Canadian Museum of Civilization</b>		<b>Natural Sciences and Engineering Research Council</b>
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Working Group Member – Robert McGhee		Working Group Member – Norman Marcotte
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ADM Committee Member – Joanne DiCosimo (President and Chief Executive Officer)		ADM Committee Member – Nikita Lopoukhine (DG, National Parks)
Working Group Member – Mark Graham		Working Group Member – David Murray
<b>Canadian Polar Commission</b>		<b>Social Sciences and Humanities Research Council</b>
ADM Committee Member – Peter Johnson (Chair)		ADM Committee Member – Janet Halliwell (Executive Vice-President, Executive Vice-President's Directorate)
Working Group Member – Jean-Marie Beaulieu		Working Group Member – Boris Stipernitz
<b>Environment Canada</b>		<b>Transport Canada</b>
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