Scan of Current and Emerging Environmental, Social, Cultural and Economic Issues Across Canada's North:

Final Report

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EXECUTIVE SUMMARY

The Northern Ecosystem Initiative (NEI) is an initiative of Environment Canada. Working to support Environment Canada's mandate in the north, the NEI expressed a need to reaffirm and revise as needed its strategic priorities in order to focus on key results and outcomes. The purpose of this report is to document the results of a scan of current and emerging environmental, social and economic issues that overlap with Environment Canada's mandate, the mandate of NEI and common/shared priorities in Canada's North.

The scan is to help inform program priorities and approaches, including program governance, as the program prepares for Phase III of its existence. Under Phase II, NEI established Partner-Issue Tables to identify gaps in current knowledge and focus project decisions. Partner-Issue Tables were established for each of the following program priorities:

- Climate Change
- Contaminants
- Monitoring
- Northern Quebec Steering Committee
- Resource Use Activities

Building on evidence and opinions gathered through interview, the scan adopted an approach that examined causal relationships in issues to examine trends, knowledge, current capacity and program influence. Using this approach, the scan reaffirmed the broad issues being addressed by the program, though it demonstrated that priorities within this framework made need to be adjusted. For example, the ecological impacts of climate change are becoming increasingly likely and are poorly understood in the north. The scan describes links among these issues, for example, the mobilization of contaminants through ecosystems as a result of global climate change. The scan argues there is a difference between issues like climate change, contaminants and resource use activities, and strategies to address these issues, like monitoring and capacity building. Finally the scan identified two key cultural issues likely to face the north, associated with issues of concern to NEI – potential impacts of the strategic environmental issues on traditional lifestyles, and on the role of traditional knowledge.

To enhance program influence, improve governance, and to adopt more integrated approaches, the scan recommends working with northerners to develop a focus in key ecological areas of the north, and to focus on monitoring, and on capacity building in support of monitoring. The program needs to make clear ties to decision making. NEI needs stronger ties internal programs like Ecological Monitoring and Assessment Network and EcoAction to support implementation. Using the ecological framework as a basis, the program may consider integrated reporting on changes in the north, perhaps by developing a consistent scorecard to reflect monitoring results and to inform decisions on a pan-Northern basis.

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1 INTRODUCTION

The Northern Ecosystem Initiative (NEI) is an initiative of Environment Canada. NEI began in 1998 with the vision "to enhance the future health and sustainability of northern communities and the ecosystems on which they depend." The program works in partnership to support projects that address science and capacity-building needs throughout the Canadian North, including the Yukon, Northwest Territories, Nunavut, northern Ontario, northern Quebec and Labrador. These projects are led by or involve partnerships with Aboriginal organizations, communities, universities, northern colleges and research institutes, non-governmental organizations, as well as government and international agencies. As NEI continues to evolve, it is committed to further strengthening its partnerships.

The program is in alignment with Environment Canada's mandate, which 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.

Currently under Phase II, the program's annual budget is approximately $2 million per year. In order to achieve its vision, NEI supports projects that address science and capacity building needs throughout the Canadian North (Labrador to Yukon, including northern Quebec and Ontario). This northern "national" approach to science and capacity building addresses an important gap in Canada's North, while supporting efforts at the broader circumpolar level as well as the regional and local level.

With its northern partners, NEI has identified climate change, contaminants, resource use activities and monitoring as key program priorities. The fifth program priority, capacity building, represents a cross-cutting element in all NEI supported projects and activities. Capacity building can take many forms including helping Canadians and Canadian organizations in the North acquire the knowledge, tools, and skills needed to sustain healthy northern ecosystems and communities.

Recognizing the importance of Aboriginal Peoples in the North, NEI has developed active and evolving partnerships with national level First Nation and Inuit organizations including Inuit Tapiriit Kanatami, Dene Nation, Council of Yukon First Nations and more recently the Innu Nation. These partnerships help build the program's shared capacity to identify and address ecosystem priorities across the Canadian North. They have also helped to strengthen the collective body of knowledge through efforts to combine local and traditional knowledge and methodologies with scientific knowledge and methodologies. Collectively, NEI, its program partners, and NEI-supported project managers are helping Canada and Canadian organizations from the community level up to the national and international levels in several ways. These include helping to test,

develop and implement innovative research methodologies, generate new knowledge, identify adaptation measures and better manage resources across Canada's North.

Under Phase II, NEI established Partner-Issue Tables to identify gaps in current knowledge, as well activities being conducted to address northern ecosystem concerns. Each Table is mandated to recommend priorities to be addressed and resource commitments to make within its particular issue area. Partner-Issue Tables have been established for each of the following program priorities:

- Climate Change
- Contaminants
- Monitoring
- Northern Quebec Steering Committee
- Resource Use Activities

2 PURPOSE

The NEI needs to reaffirm and, where needed, revise its strategic priorities in order to focus on key results and outcomes. The purpose of this report is to document the results of a scan of current and any emerging environmental, social and economic issues that overlap with Environment Canada's mandate, the mandate of NEI and the common/shared priorities of residents and organizations in Canada's North. The scan will be used to examine program priorities and approaches, including program governance, as the program prepares for Phase III of its existence.

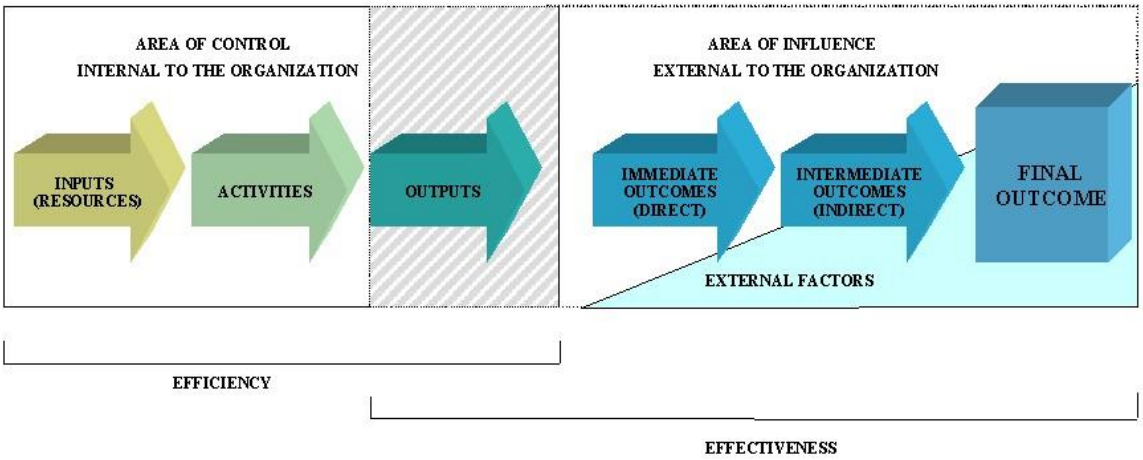
3 KEY RESULTS

Understanding exactly what results the NEI is to contribute to, and how it will contribute, greatly affects the nature and scope of issues that the program works to address. As such, a brief discussion of the program in a results context is important in considering the types of issues the program is to address.

Results are defined by the Treasury Board of Canada as "the consequence attributed to the activities of an organization, policy, program or initiative. Results is a general term that often includes both outputs produced and outcomes achieved by a given organization, policy, program or initiative. In the government's agenda for results-based management and in *Results for Canadians*, the term *result* refers exclusively to *outcomes*." An overview of the results chain as presented by Treasury Board appears in Figure 1. All federal departments and programs must manage for results; an output would be a project report, or a statement of priorities; an outcome is the impact the program has had, for example, the identification of thresholds, or the remediation of contamination sites. In general, a program like NEI can have stronger influence over immediate results, and less over long-term results or final outcomes because immediate outcomes can be directly targeted, whereas

long term results generally require a broader set of partner engagement or other changes need to affect the issue.

FIGURE 1: A results chain as set out by the Treasury Board of Canada

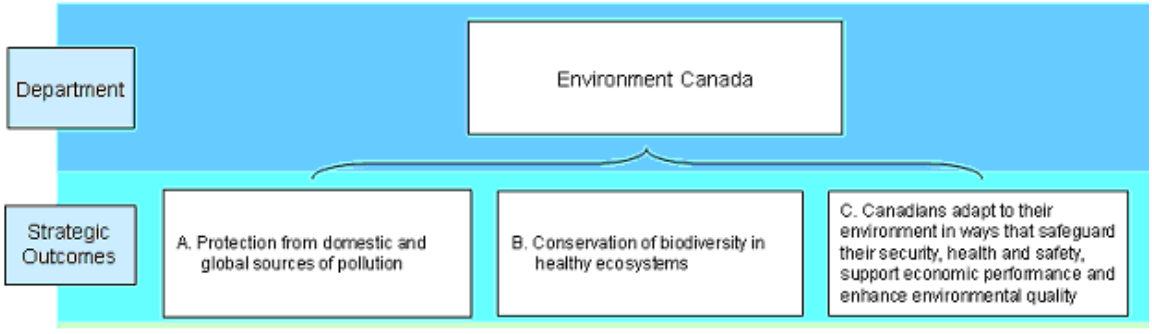


In response to new results structures being developed by Treasury Board, Environment Canada has completely re-aligned its program structure around results and outcomes (see Figure 2 below). Through a Board structure, a governance framework is now in place that strives for:

- Integration across activities to support results;
- Setting and supporting priorities; and,
- Planning and budgeting in alignment with key results and outcomes.

The department has identified key strategic outcomes or key result areas that it will contribute to through its mandate (see Figure 2).

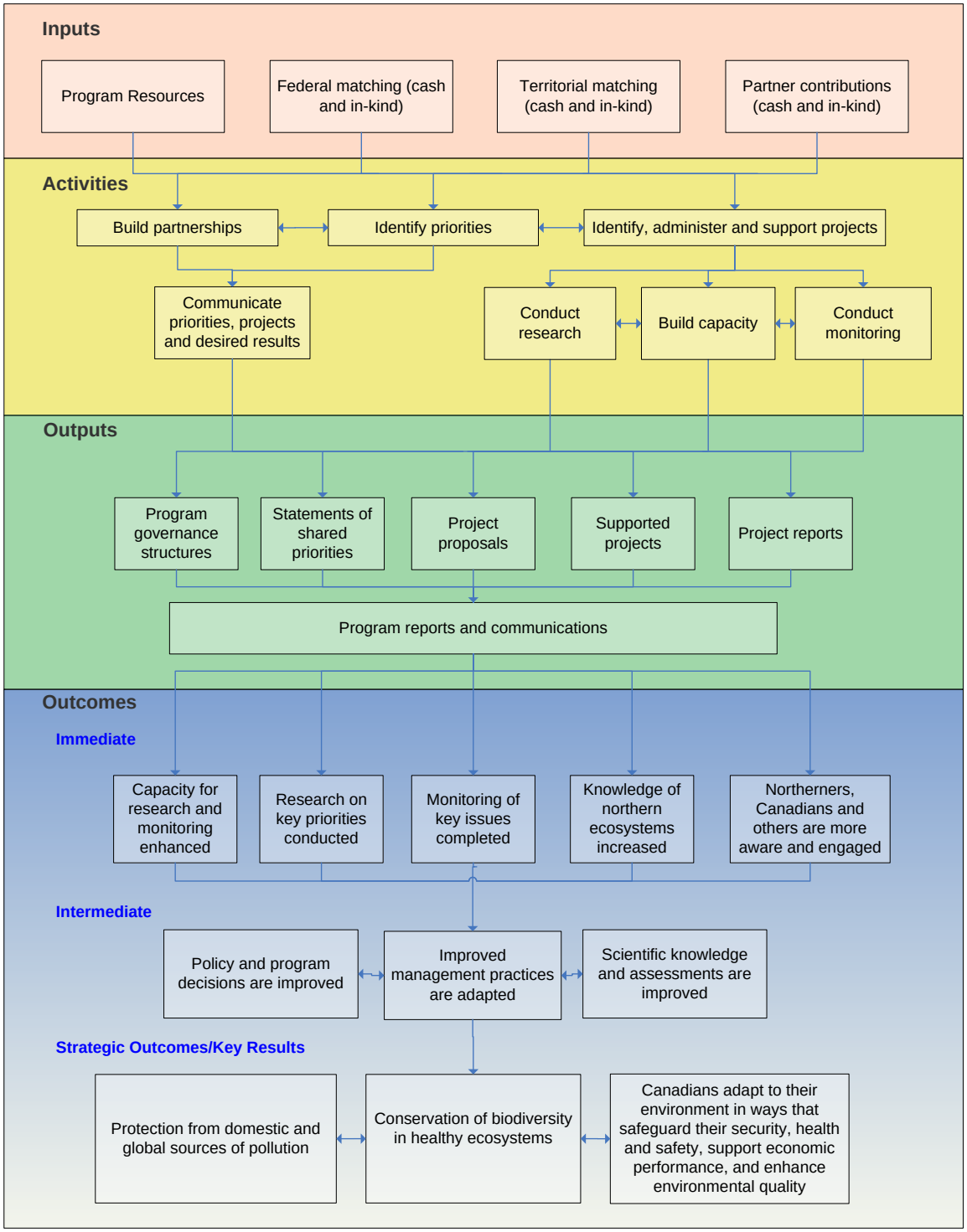
FIGURE 2: Strategic outcomes for Environment Canada



The current priorities and activities of the NEI clearly fit into these strategic outcomes, and extensive internal work is underway by program staff to ensure that the program is appropriately "mapped" against the results structure of the department. All program activities supported by the department must now contribute to these strategic outcome areas, through a hierarchy of *outcome*

project groupings and *outcome project plans*. Project plans are in turn broken into *components* and *subcomponents*, which make up the core activities of the

Figure 3: NEI Suggested Program Logic Model



department that contribute to results. Within the department, funding allocations are compared against aggregate reports of spending within outcome groupings and project plans to ensure the department is on track. For the NEI, having a clear sense of what results the program is contributing to is critical to its long term success in attracting funding at one end of the results chain, and to its success in generating results at the other end.

As a consequence of new program structures inside Environment Canada, the NEI now must report to several *outcome project groupings*, complicating the process of understanding exactly what results the program should be generating. Exactly how the NEI contributes to these outcomes is also of primary interest – exactly what activities should it support. In effect, 70% of the budget of Environment Canada goes towards science and technology, and the work of the NEI since its inception in 1998 has focused on research and monitoring, with an expanded focus on partners in this effort since Phase II began in 2003; as a result of this expanded focus, it has adopted capacity building as a core activity, in relation to research and monitoring.

To try to set out a clear results structure for the program, and based on current statements of intended results for the program, we suggest a program logic model as set out in Figure 3. It should be noted that the suggested logic model is a synthesis of various results-related documents prepared by the NEI, including an earlier logic model, performance indicators, and information to support a range of outcome project plan subcomponents. The logic model shown here does not necessarily represent the views of the program at this stage. However, what is consistent in this proposed model with program documentation is the notion of affecting decisions, either about policy, about management or about how science is conducted, at the intermediate stage.

4 METHODOLOGY

Given the diverse information that must considered, and the NEI's focus on capacity building and knowledge development, the following framework was applied to complete the scan (see Figure 4 below) – light blue elements were based primarily on a review of documentation, though they were also informed by interviews, green elements were informed by interviews, and dark blue was in part analysis and recommendations. More details on the method follow below:

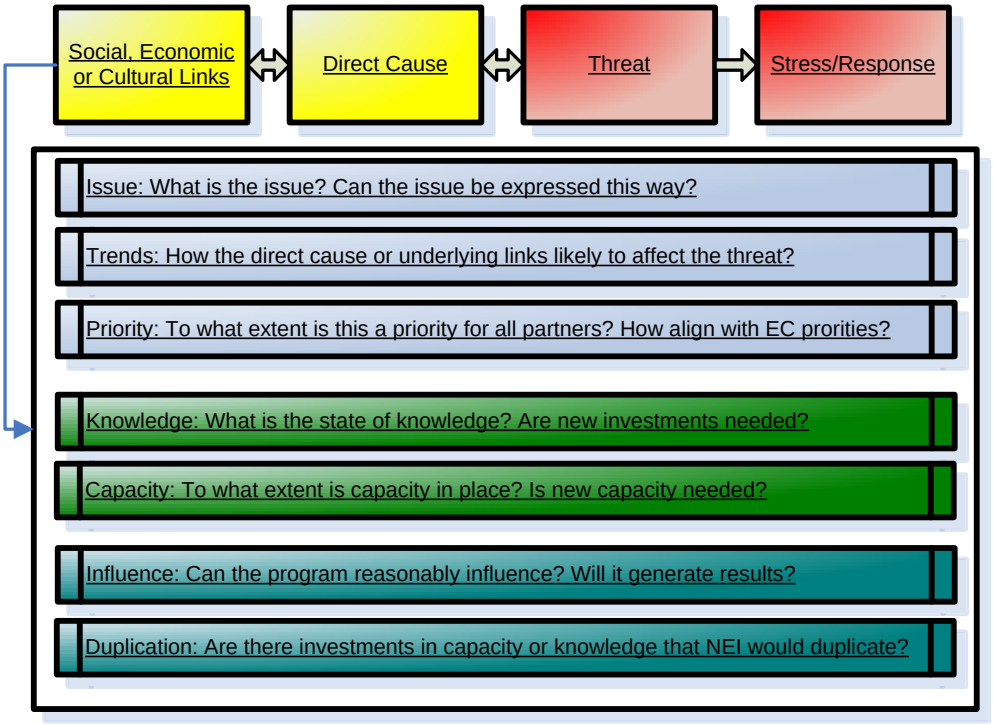
1. Issue statement: we tested whether the issue could be expressed along a cause-effect continuum, to assist with assessing trends and where knowledge gaps exist. The issues were identified through a high level literature review, and through projects supported by the program to date. They were also informed by select personal interviews;

2. Trends: We then examined trends in the issue, for each of its components, to develop a sense of its importance over the results time horizon of the NEI with respect to long term results. For example, while a threat may not have seemed important, the threat may have been increasing because trends that indicate the activities underlying the threat are increasing. The

report develops a single statement of the relative importance of the issue given these trends. The trends were later validated through personal interviews;

3. Priorities: We mapped partner and Environment Canada priorities against the issue to examine to what extent the issue is currently a priority and developed an overall statement of priority, by developing weightings for key partner priorities;

FIGURE 4: Summary of approach to collating and reviewing issues that were scanned[1]



4. Knowledge: We identified a statement on the state of knowledge of the issue. In some cases, the gaps may not be an appropriate target of the NEI, though this was tested. The report assigns a qualitative score of knowledge of the issue, based on the causal continuum;

5. Capacity: We examined existing capacities as a basis to inform where capacities exist and where they need to be developed across issues; we have associated a qualitative score of the need to develop capacity with each issue;

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1 This method is set out in a document entitled "Forecasting Threats to Ecosystems" a report done for Environment Canada by the Rawson Academy of Aquatic Science. It is supported by work internationally related to pressure-state-response models.

6. Influence: Given the program's limited funding and broad geographic scope, we analyzed whether the program can reasonably be expected to have an influence over each issue, and considered how the program could have influence.

7. Duplication: We assessed whether there are existing efforts that address the issue, documenting these to ensure NEI does not duplicate investments. We also have made a statement as to whether other initiatives are adequate to address the issue as clarifying the niche role of NEI.

To conduct the scan, we (1) reviewed program documentation, (2) searched through existing web sites and organizations for documentation related to the issues, and (3) conducted interviews. The interviews helped to focus further research, where we tried to gather evidence to support either issues or statements of trends. A copy of our interview guide appears in Appendix 1.

It should be noted that during the course of the project, we discovered that the interview process was very informative to the identification of issues, and we conducted a greater number of interviews than initially planned, and identified numerous other potential interviewees that would be helpful to the NEI. A brief list of these names were provided to the program coordinator.

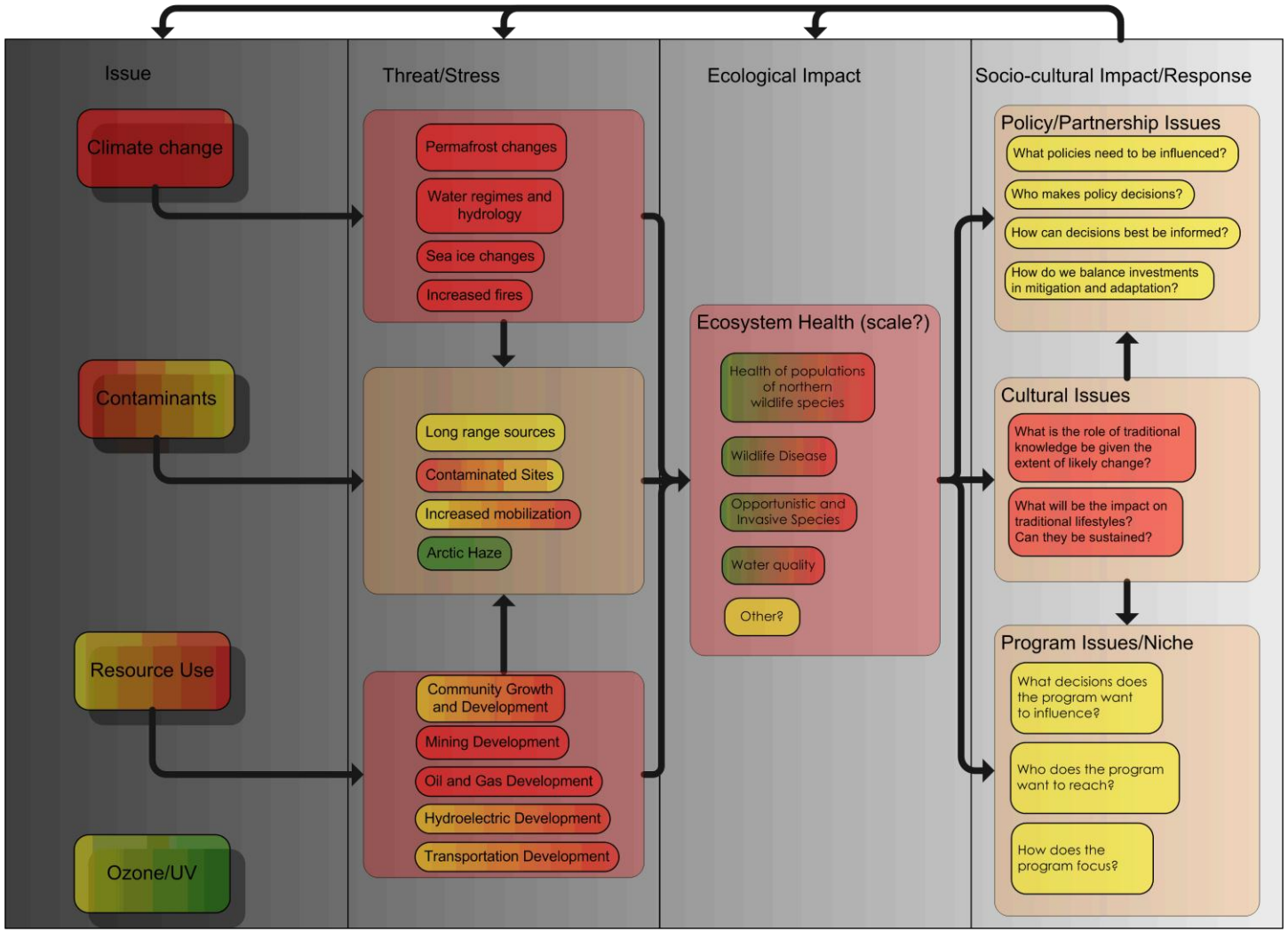
5 OVERVIEW OF ISSUES

The focus of the scan was on issues tied directly to Environment Canada's mandate. The identification of issues was determined on the basis of causality, and differed somewhat than past approaches by NEI. For example, monitoring and capacity-building, labeled as priority issues for program, would have been identified in the scan as responses to strategic issues rather than issues *per se*.

The scan identified issues similar to those addressed by the NEI (climate change, contaminants and resource use) and it briefly explored other issues (for example, ozone layer depletion and ultraviolet B radiation). It also placed some issues considered to be strategic issues (like exotic species) as effects of causes. It should be noted that in our view, the labeling of many issues mixes cause and effect, for example, climate change is an effect of greenhouse gas emissions and global fossil fuel consumption activities, and sea ice change are an effect of climate change. Likewise, contaminants are associated with releases from consumptive and industrial uses, and sources can be long range or localized (for example, from mining activities). Teasing out the semantics of these issues and looking for trends, knowledge and capacities across elements of the causal chain was the substance of the scan.

In Figure 5, we present an overview of the issues and the links among them, as identified through the scan. The color indicates the current intensity of the issue (red representing most intense, followed by yellow and green representing the least intense), and the extent to which is should be a concern; varied shading indicates a trend towards improvement or an issue that is of growing concern.

Figure 5: Overview of Scan Results



The table below provides further details on issues identified in the scan, and presents a summary of key variables that the program identified and considered with respect to these issues. Please note that causal links are presented in the trend

and intensity column, and the knowledge columns, but are better represented in Figure 5. Below Table 1, we provide details of evidence we were able to collect on each issue.

Table 1: A Detailed Overview of Issues Identified

Issue	Links	Location	Priority	Trend and intensity (large, small arrows)		Knowledge of the issue			Current Capacity	Influence, Role of NEI[2]	Comments
				Cause	Threat/ Stress	Cause	Threat/ Stress	Biological Impacts			
Climate change		Pan-Northern	High	▲		High			Low	Low	Need to define program niche
Permafrost changes	Climate change	Impacts mainly in southern arctic and taiga sheild	High (see map)		▲		Med	Low	Low, higher in commun-ities	Low	Lots of existing work on physical changes
Water regimes and northern hydrology	Climate change	Impacts in w and sw; taiga plains, taiga shield, Hudson plains	High (W, SW)		▲		Med	Low	Low, higher in commun-ities	Low	Some mapping work, some monitoring work, need to focus on biological impacts
Sea ice	Climate change	Northern Arctic,	High		▲		Med	Low	Low, higher in	Low	Focus on biological and ecosystemic impacts

[2] Note, the influence of NEI has been assumed to be limited to the mandate of Environment Canada as stated in its strategic outcomes, and to program statements of priorities and results

Issue	Links	Location	Priority	Trend and intensity (large, small arrows)		Knowledge of the issue			Current Capacity	Influence, Role of NEI[2]	Comments
				Cause	Threat/ Stress	Cause	Threat/ Stress	Biological Impacts			
changes		Arctic Cordillera, Hudson Bay	(N)						commun-ities		
Fires	Climate change	Impacts in w and sw; taiga plains, taiga shield, Hudson plains	Med (S, SW)		▲		Med	Low	Med	Low	Not a lot of data collection north of 60, but intensity increasing. Niche limited to understanding biophysical impacts.
Contaminants			Medium	►		Med-High			Med	Low	Growing levels of some contaminants (flame retardants, teflon compounds)
Long range sources		Pan-northern; southern and northern arctic	Medium		▼		Med	Med	Low	Low	Trend is downwards for many metals, POCs. Need to niche: NCP doing extensive work. Niche to focus on pathways and mobility
Contaminated sites	Links to mining; an historical issue	Pan-northern; see high level maps	Medium(high locally)		►		Med	Med	Med	Low	Effort link to asthetics, not to real priority; local concern important, but bigger issues? Leadership?
Mobilization through climate	Links to climate change	Impacts mainly in southern arctic and	High		▲		Low	Low	Low	High	No one studying mobilization issues extensively as they relate to climate change; NEI

Issue	Links	Location	Priority	Trend and intensity (large, small arrows)		Knowledge of the issue			Current Capacity	Influence, Role of NEI[2]	Comments
				Cause	Threat/ Stress	Cause	Threat/ Stress	Biological Impacts			
change		taiga shield; uncertain									has a niche here
Artic Haze		Southern and northern arctic	Low		▶		Med	Low	Low	Low	The issue does not have strong environmental concerns at this stage.
Resource Use Activities	Focused in key areas of the north			▲		High					Intensity of impacts growing, and more study underway through CEAM in NWT. CEAM needs to be coordinated across ecosystems.
Exploration impacts	Ties to mining and oil and gas development	Pan-northern	Low		▲		High	Med, NEI specific, com-munities	High (communit y)	High	Need to work with governance mechanisms (boards, land claims, territorial governments).
Mining Development	Diamond mining key focus; contributing to wage economy	Taiga shield, southern arctic	High		▲		High	Med, EA links, com-munities	Med	Med	Need to work with governance mechanisms (boards, land claims, territorial governments) and programs to study cumulative impacts; avoid monitoring every site/project
Oil and gas development	Cumulative effects	Taiga plains	High		▲		High	Med, EA links, com-	Med	Med	See above

Issue	Links	Location	Priority	Trend and intensity (large, small arrows)		Knowledge of the issue			Current Capacity	Influence, Role of NEI[2]	Comments
				Cause	Threat/ Stress	Cause	Threat/ Stress	Biological Impacts			
								munities			
Hydroelectric energy development	Links to resource development generally	Labrador, Quebec, NWT	Med		▲		Med	Med			Projects emerging to support mining development (NWT) and to build on existing infrastructure in Labrador.
Community Growth and Development	Solid waste, water and wastewater, energy	Pan-northern	Med		▲		Med	Med, com-munity-based	High	Med	Need to work with territorial government, DIAND. There are large issues with sewage treatment, and also with water quality
Transportation corridors	Depends largely on oil, gas, energy and mining development	Pan northern; shipping, rail and road developm ent	Med		▲						There are large issues emerging in Yukon associated with Beaufort Sea.
ecotourism		Pan-northern	Low		▲		Med	Low	Low	Low	A growing issue in the North, but impacts are not as significant; opportunity to inform

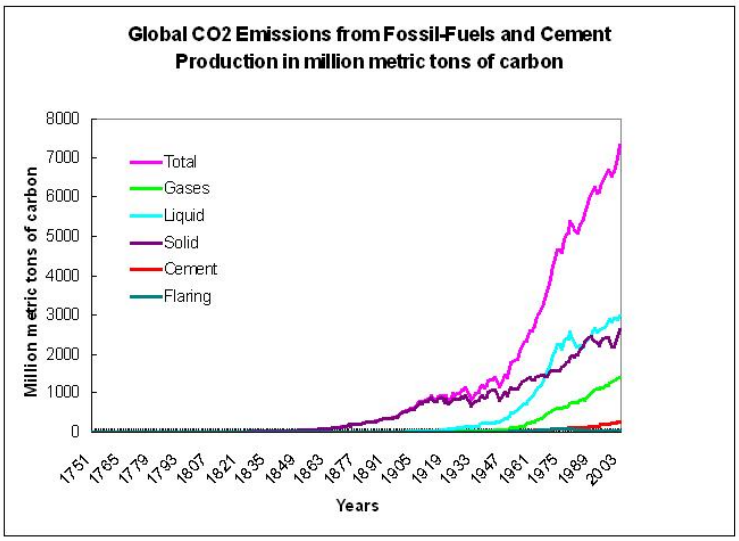
6 ISSUES

6.1 Climate Change

6.1.1 Cause

Global emissions of greenhouse gases like carbon dioxide have continued to grow despite international commitments to reduce emissions (see Figures 6 through 8 below).[3] The primary source of these emissions is from fossil-fuel consumption.

Figure 6: Trends in global CO_2 emissions from fossil-fuels and cement production in millions of metric tons of carbon



3 Source: Marland, G., T.A. Boden, and R. J. Andres. 2006. Global, Regional, and National CO2 Emissions. In Trends: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A.

Figure 7: Global per capita CO_2 emissions (not factoring in global population growth rates)

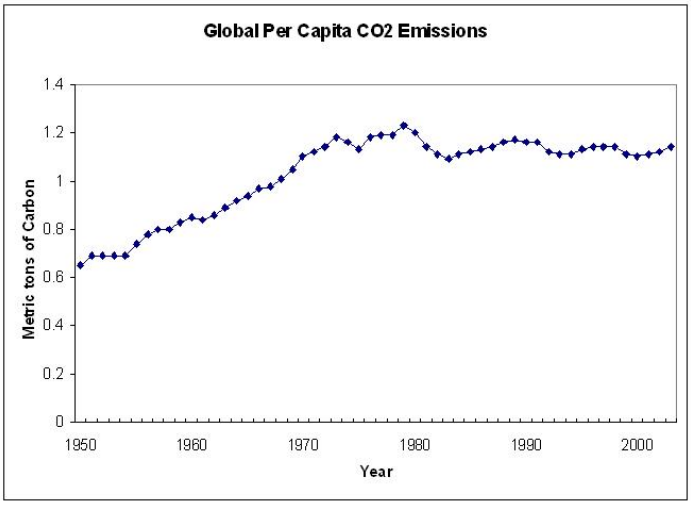
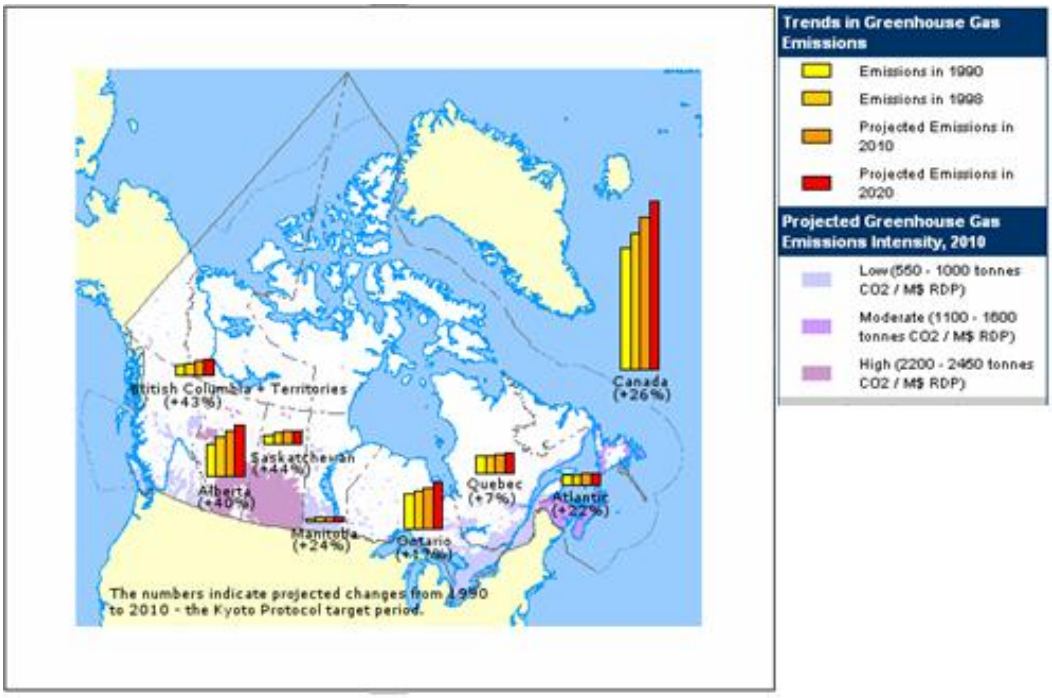


Figure 8: Trends ingreenhouse gas emissions in Canada to the year 2020

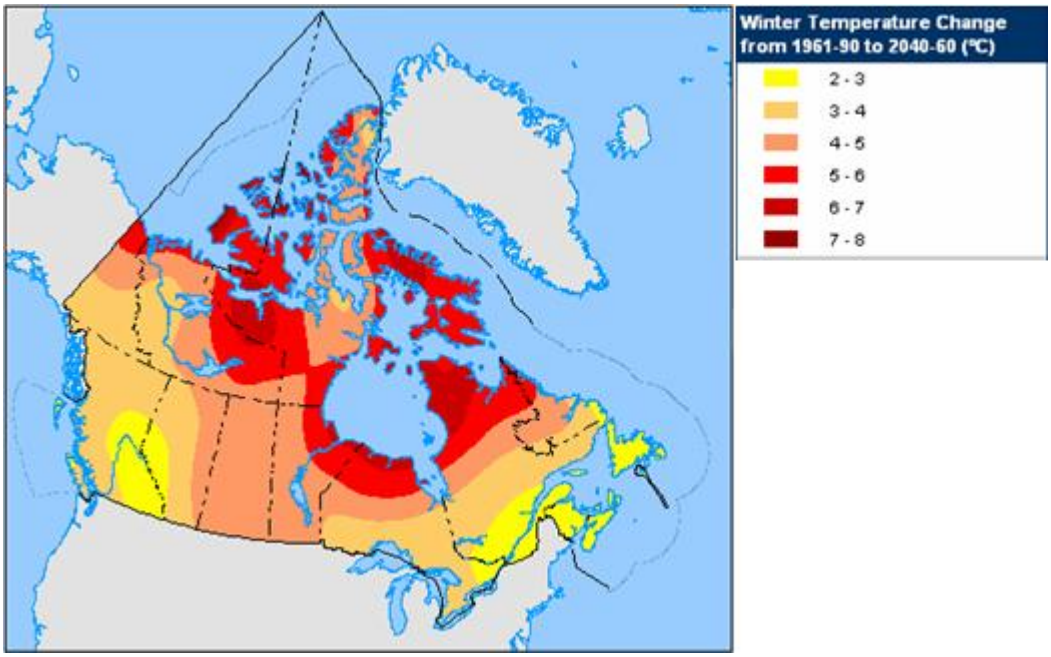


Current climate models predict a large increase in average annual temperatures within the next 50 years. In Canada alone, emissions are likely to increase by 26% from 1990 levels (see Figure 8) and current forecasts indicate that the challenge of addressing climate change is likely to grow. In some cases, the effects of these changes are already being felt in the north.

Though it is international emissions that determine the trend, and there appears to be a global concern and commitment to GHG emission reductions, this trend may be exacerbated slightly by Canada's recent policy position on climate change, where Canada is re-examining its approach to meeting international commitments with respect to climate change and greenhouse gas emissions.

Current climate change trend models indicate key areas where temperatures are likely to change. In particular, the Hudson plain, Taiga Shield, Southern Arctic and Northern Arctic ecozones are likely to be susceptible to climate change (see Figure 9).

Figure 9: Projected winter the greatest increases in temperature changes in Canada to the year 2050



While knowledge is growing, further knowledge needs to be developed on the precise impacts of climate change in the North. Areas where climate change could impact include: (1) changes to sea ice; (2) permafrost reduction; (3) forest fires and pest outbreaks in areas where boreal forests occur (southern and south-western parts of the north); and (4) hydrological changes.

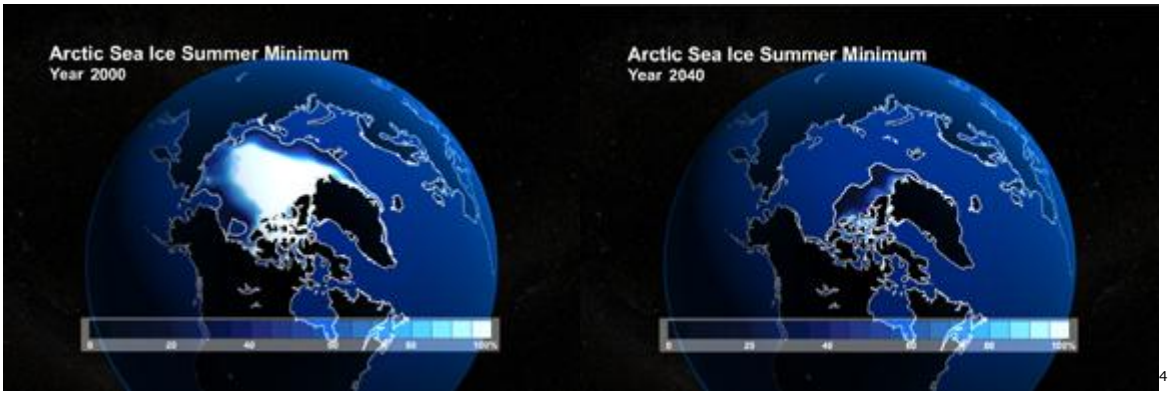
6.1.2 Threats/Stresses

Changes to sea ice

Sea ice strongly influences coastal climate, ecosystems, and human activities. The area of Arctic sea ice varies up to 50% seasonally, and also shows strong year-to-year variation. Significant reductions in summer sea ice, which have been proposed as an early signal of global climate change, are evident in recent decades. Recent reports show sea ice area declines of about 3% per decade since the late 1970s. Comparison of satellite records suggests that the rate of area loss increased from 2.8% per decade in the 1980s to 4.5% per decade in the 1990s. Record low values of summer ice extent have been set repeatedly since 1980. A recent article published by the National Center

for Atmospheric Research has indicated that the Northwest Passage could be clear of ice in 2040 (see Figure 10).

Figure 10: Current projections indicate the extent to which sea ice will melt in northern Canada by the year 2040



[4]

Arctic sea ice has also grown thinner over the past few decades. Local observations of sea ice thinning by 1 to 2 m have been reported for several years. A recent analysis of submarine ice data, however, has provided the first persuasive evidence of large-scale thinning over the entire Arctic basin. A loss of about 1.2 m was found when ice depth from six trans-Arctic submarine cruises from 1958 to 1976 was compared with three similar cruises between 1993 and 1997. In addition to this average thinning between the two sets of cruises, the recent cruises also found continued thinning at a rate of around 10 cm per year from 1993 to 1997. Evidence of widespread sea-ice melting is corroborated by recent substantial increase (three to four times) in freshwater content of the Arctic Ocean. Under further climate change, further large reductions in sea ice are projected, although there is substantial variation in estimates of the amount and timing. Most models suggest large reductions (to complete losses) in Arctic summer sea ice area accompanied by an increase in the duration of the open-water season by 2100.[5]

The precise impact of sea ice changes on the north need to be further studied. With respect to human activities, there is likely to be increased transportation on northern sea routes, and increased exploration and development of oil and gas deposits (see below) such as in the Beaufort Sea. With respect to biophysical changes, sea-ice retreat allows larger storm surges to develop in the increased open-water areas, increasing erosion from increased waves, sedimentation, and the risk of inundation in coastal areas. Moreover, areas of coastline where permafrost has thawed are made more vulnerable, which in combination with increased wave action, can cause severe erosion. It also has the potential to affect wild populations of marine life dependent on

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4 UCAR article, December 12, 2006 at http://www.ucar.edu/news/releases/2006/arctic.shtml

5 US National Assessment of the Potential Consequences of Climate Variability and Change Educational Resources, at December 2006. http://www.usgcrp.gov/usgcrp/nacc/education/alaska/ak-edu-3.htm#Environmental%20Impacts:%20Melting%20Sea%20Ice

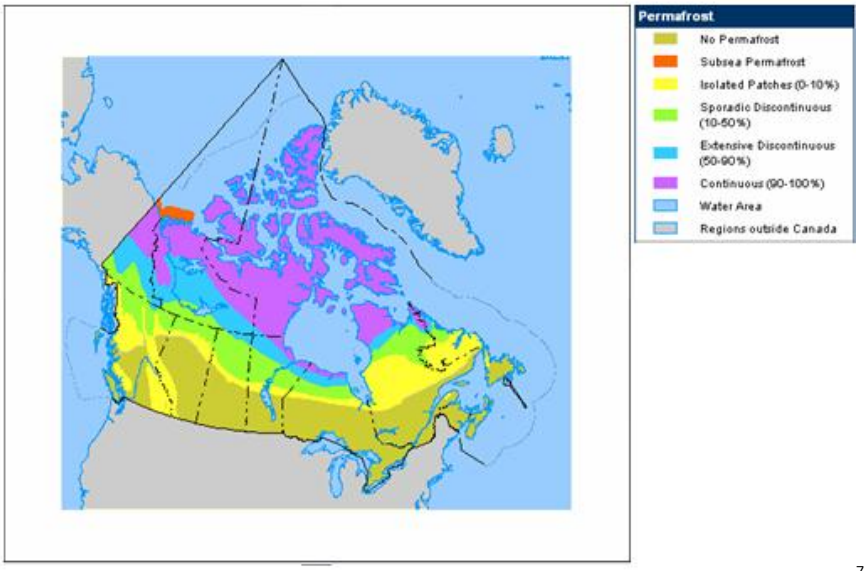
sea ice (e.g., for reproduction or during feeding cycles). These impacts are not well studied.

Permafrost loss

Permafrost has profound effects on hydrology (the land-based water cycle), erosion, vegetation, and human activities. It limits movement of ground water and the rooting depth of plants. On slopes, it allows fluid-like movement of surface soil and deposits. Seasonal thawing over continuous permafrost creates a saturated surface layer in which pools of meltwater accumulate, conducive to marsh and tundra ecosystems and peat formation. Thawing permafrost can create thermokarst terrain -- uneven surface topography that includes pits, troughs, mounds, and depressions. These can fill with water and can be dangerous for wildlife and people. Thermokarst damages agricultural fields and ecosystems such as forests by drying in mounded areas and flooding low-lying zones. Further, it can contribute to erosion and increased sedimentation and siltation of rivers, which poses additional environmental concerns.[6] It can have impacts on the movement of wildlife populations, and on ecosystems where permafrost is a key part of the physical environment.

Figure 11 identifies current permafrost distribution in Canada while Figure 12 indicates permafrost areas susceptible to climate change.

Figure 11: Permafrost distribution in Canada (2006)

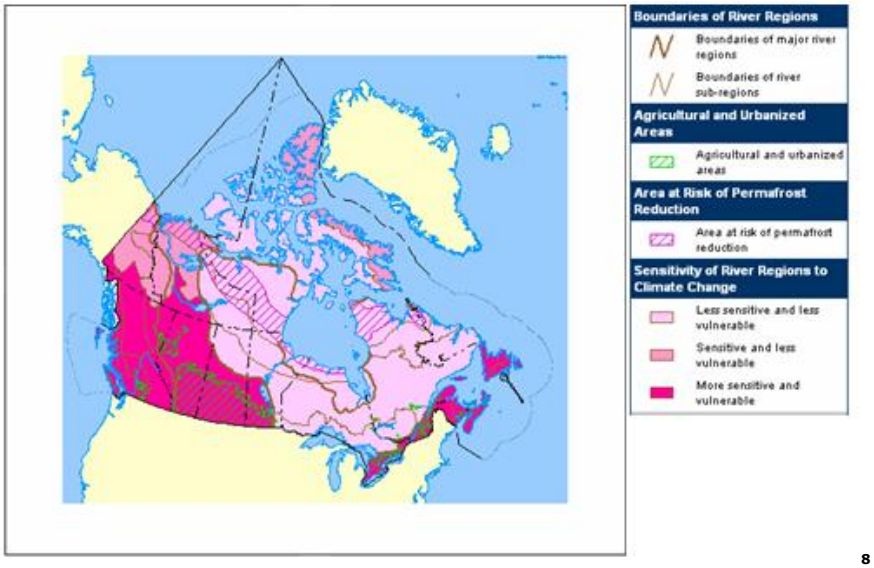


[7]

6 http://www.usgcrp.gov/usgcrp/nacc/education/alaska/ak-edu-3.htm#Environmental%20Impacts:%20Thawing%20Permafrost

[7] Source: National Atlas of Canada

Figure 12: Areas of permafrost thought to be susceptible to climate change



[8]

Increased Fire

Extensive fire data is not being collected in the north, though it is felt that the number of fires and their ecological impact is growing and likely to grow in the north. Exactly the nature of the impact of fires is not clearly understood, nor is the direction that policy and action need to take in response. Fire is likely isolated to areas where boreal forests occur, in pockets in the north, or along the south and western edges of the area covered by the NEI.

Drying climate expected from climate change is expected to threaten the world's boreal forests with increased fire risk. Doubled carbon dioxide levels could result in a northward shift of the Taiga and Boreal forest belts by about 500 km. However, this would be a Taiga or Boreal forest different than the one known today, because it would be modified by the more fast-moving flexible species such as those with wider seed dispersal, faster growth, and early maturation.

The boreal forest itself is expected to undergo an extensive reduction in size, as grasslands and temperate deciduous species may invade from the south, and northern expansion is limited by poor soils and insufficient levels of sunshine. The frequency, area, and intensity of forest fires and pest infestations are expected to increase due to warmer and drier conditions. Increased fire incidence will lead to loss of habitat for species that inhabit mature forests. This may be eased by changes in fire management policy in order to facilitate species migration and forest adaptation, but this would require significant investment. In 1994, Canada lost four million hectares of forest to fires.

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8 Source: National Atlas of Canada[8] Source: National Atlas of Canada

Since 1980, Canada has lost an average of 2.4 million hectares of forest to fires each year, a 140 per cent increase over the previous 30 years.

Hydrological changes

The exact nature of hydrological changes is not known for certain. Projections of water availability and flows suggest differentiated impacts on hydroelectric generation potential, with possible increases in Labrador and northern Quebec, and decreases in other parts of the North. In the Old Crow Flats region of the Yukon, the local population suspects that water levels in thaw lakes are dropping. They fear that a trend towards warmer temperatures and earlier springs will ultimately dry up the wetlands and threaten fishing, hunting and trapping. The lake shown in black on the 1990 satellite image (Figure 13) is drying up and contained almost no water in 1994 (shown by decrease in black area on image). Figure 14 depicts sensitivity of Canadian river regions to climate change.

Figure13: Examples of the impacts of hydrological changes in Old Crow Flat, Yukon Territories

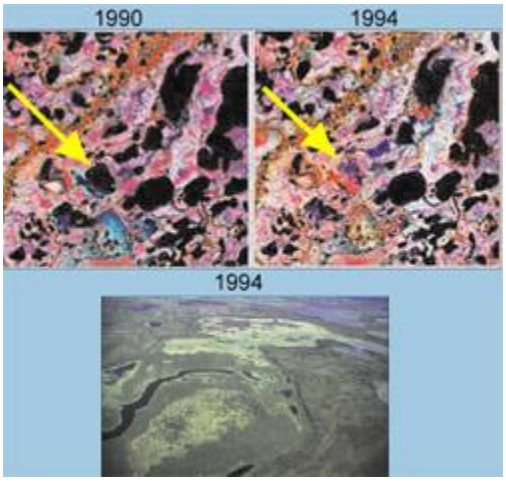
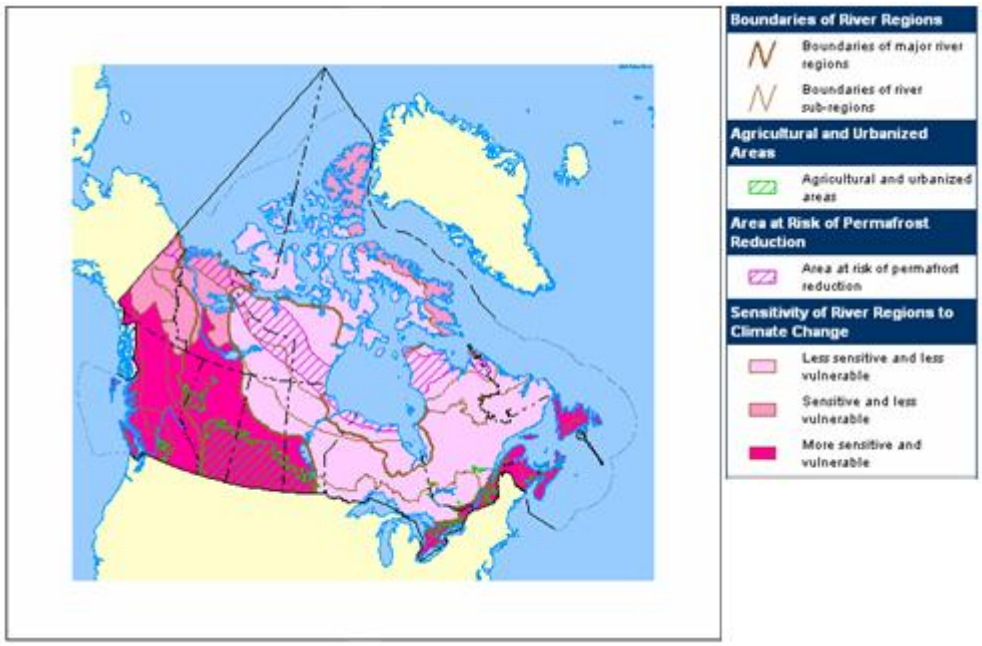


Figure 14: Sensitivity of river regions to climate change



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6.2 Contaminants

6.2.1 Cause

The overall trend for contaminants in the north is stabilized, though this is not unequivocal, as set out below. The exception is for some metals, fire retardants and Teflon-derived compounds that are globally transported. Perhaps a more important issue is the mobility of existing contaminants in the north which is likely to be affected by climate change, and which may exacerbate the impacts of even downward trends in the long range transmission of atmospheric pollutants. With the exception of mining, oil and gas developments in the north and the use of fossil fuels to drive electricity generation in many communities, point sources of contaminants in the north are minimal.

The trend has been driven in part by global policy initiatives, such as the Convention on Persistent Organic Pollutants, signed by more than 90 industrial countries in 1991, and by voluntary industry programs, such as the Responsible Care Global Charter, a program which originated in Canada, which is run in 52 countries whose combined chemical industries account for nearly 90% of global chemicals production. In addition, domestic regulation, such as the *Canadian Environmental Protection Act*, and disclosure of emissions, such as those through the National Pollutant Release Inventory, have curtailed global emissions.

9 **Source: National Atlas of Canada**

The results from a few long-term studies of temporal trends in Arctic biota indicate that PCB and DDT levels in the Arctic environment have declined in the past 20 to 25 years, since the first controls began on DDT and on the use of PCBs in open systems. Evidence from dated lake sediment cores also shows input declines in sub-arctic latitudes have low levels of POPs. Sharp declines in PCB and DDT levels were seen in the 1970s and 1980s, and some time trends indicate continued declines during the late 1980s and 1990s, whereas others are unclear. There are no long-term standardized data sets for the High Arctic.

6.2.2 Treats/Stresses

Long range transmission

Levels in biota are extremely variable, and observed levels are still near the thresholds for biological effects. These uncertainties and variabilities make it difficult to speculate about the future, and reinforce the importance of careful sampling programs and the need to archive samples for future analysis. Less is known about time trends for hexachlorocyclohexane, hexachlorobenzene, chlordane, toxaphene, dieldrin, and dioxins and furans. Of these, hexachlorocyclohexane has been followed most closely. In air, there was a nine-fold decrease from 1979 to 1993 in measurements from the Bering and Chukchi Seas and from several locations in the Canadian Arctic Archipelago.

In the Canadian High Arctic, PCB and DDT levels in eggs of migratory seabirds declined from 1975 to 1993, mostly in the late 1970s and early 1980s. This decline may reflect an overall reduction in organochlorine levels in the North Atlantic. The decline is not uniform, however. In one of the birds, the ivory gull, PCB and chlordane levels in the eggs have increased. Declines in POPs in seals and whales from the western Canadian Arctic are not as steep as those observed in seabirds and whales from eastern Canada. From 1972 to 1991, PCB concentrations declined five-fold and DDT concentrations three-fold in marine mammals from the western Canadian Arctic. Over the past 10 to 12 years, seals and walrus from Eastern Canada and Greenland have shown no declines in contaminant levels, nor have there been any declines in DDT, PCBs, chlordane, or toxaphene in female ringed seal or in male narwhal from Lancaster Sound from the mid 1980s to the early 1990s.

Contaminant Pathways and Climate Change

One key trend researchers have been following under the Arctic Monitoring and Assessment Program is the interaction between contaminant pathways and climate change. Researchers are beginning to demonstrate that the availability of contaminants is affected by climate change, either by changing deposition rates, changing degradation rates, changing cycling patterns within ecosystems, or altering exchange among media (air to water). Under this research, a range of contaminants are being examined, including heavy metals and organochlorine compounds.[10]

10 Macdonald, R.W., T. Harner, J. Fyfe, H. Loeng and T. Weingartner, 2003. AMAP Assessment 2002: The Influence of Global Change on Contaminant Pathways to, within, and from the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. xii+65 pp.

Contaminated Sites

Figures 15 and 16 identify some contaminated sites in northern Canada. Table 2 also notes a number of abandoned mines and status of remediation action required. However, the precise number and location of contaminated sites in northern Canada is unclear. However, what is clear is that (1) the number of such sites is unlikely to increase in the future, given the strength of new policy and regulatory initiatives to control and prevent the creation of such sites, and (2) there are programs in place federally to begin to assess, set priorities and to remediate these sites.

Figure 15: Known contaminated sites in northern Canada

Table 2: Abandoned Mines in the North[11]

Mine	Location	Action	Status
Arctic Gold and Silver	Yukon	Required	Under remediation (monitoring*)
Clinton Creek Mine site	Yukon	Required	Under risk management
Colomac Mine	Northwest Territories	Required	Under assessment
Contact Lake	Northwest Territories	Required	Under assessment

11 **Government of Canada. 2002. 2002 "Appendix to Chapter 3 Abandoned Mines in the North" in Report of the Commissioner of the Environment and Sustainable Development. Minister of Public Works and Government Services Canada.**

Discovery	Northwest Territories	Required	Under remediation
Faro	Yukon	Required	Under assessment
Giant Mine	Northwest Territories	Required	Under remediation
Ketza River	Yukon	Required	Under assessment
Mount Nansen	Yukon	Required	Under risk management
North Rankin Inlet	Nunavut	Required	Remediated and under risk management (monitoring*)
Port Radium and Eldorado Mine	Northwest Territories	Required	Under assessment
Rayrock	Northwest Territories	Required	Under remediation (monitoring*)
Terra No. 1 (North Mine)	Northwest Territories	Required	Under assessment
Terra No. 2 (Northrim Mine)	Northwest Territories	Required	Under assessment
Terra No. 3 (Norex Mine)	Northwest Territories	Required	Under assessment
Terra No. 4 (Smallwood Mine)	Northwest Territories	Required	Under assessment
Tundra-Taurcanis	Northwest Territories	Required	Under assessment
Crestaurum	Northwest Territories	Likely required	Under assessment
Hidden Lake Mine	Northwest Territories	Likely required	Under assessment
Hope Bay	Nunavut	Likely required	Under remediation
Indore Gold and Hottah Lake	Northwest Territories	Likely required	Under assessment
North Inca Mine	Northwest Territories	Likely required	Under assessment
Outpost Island	Northwest Territories	Likely required	Under remediation
Venus Tailings and Mill Site	Yukon	Likely required	Remediated and under risk management (monitoring*)
West Bay and Black Ridge Gold Mine	Northwest Territories	Likely required	Under assessment
Liten Mine and Old Parr No. 2	Northwest Territories	May be required	Under assessment
Old Parr No. 1	Northwest Territories	May be required	Under assessment
Pensive Mine	Northwest Territories	May be required	Remediated and under risk management
Ruth Gold Mine	Northwest Territories	May be required	Under assessment
Sun Rose Claim Group	Northwest Territories	May be required	Under assessment

Abandoned Direct Early Warning (DEW) Line sites are sources of PCBs, and these contributed 1% of total PCBS to the north. There is a program in place to remediate them. In addition, the Inuit Tapiriit Kanatami (ITK) identified a number of other contaminated sites, though precisely what the contaminant issue is remains to be assessed for all sites.

Figure 16: DEW line and waste sites identified by the ITK needing further assessment

Artic Haze

Arctic Haze is a persistent winter diffuse layer in the Arctic atmosphere whose origin may be related to long-range transport of mid-latitude continental anthropogenic pollutants. Sulfates are primary haze pollutants. According to the Arctic Monitoring and Assessment Program, sulfate concentrations in air at measured at monitoring stations in the High Arctic (Alert, Canada) and in other countries at Arctic and subarctic locations indicates that arctic haze is on a decreasing trend since the 1990s (see Figure 17).[12]

Long-term monitoring at Alert in northern Canada showed little change in the spring levels of sulfate and several other haze pollutants during the 1980s, but a decrease of almost 60% in spring sulfate levels between 1990 and 2000.

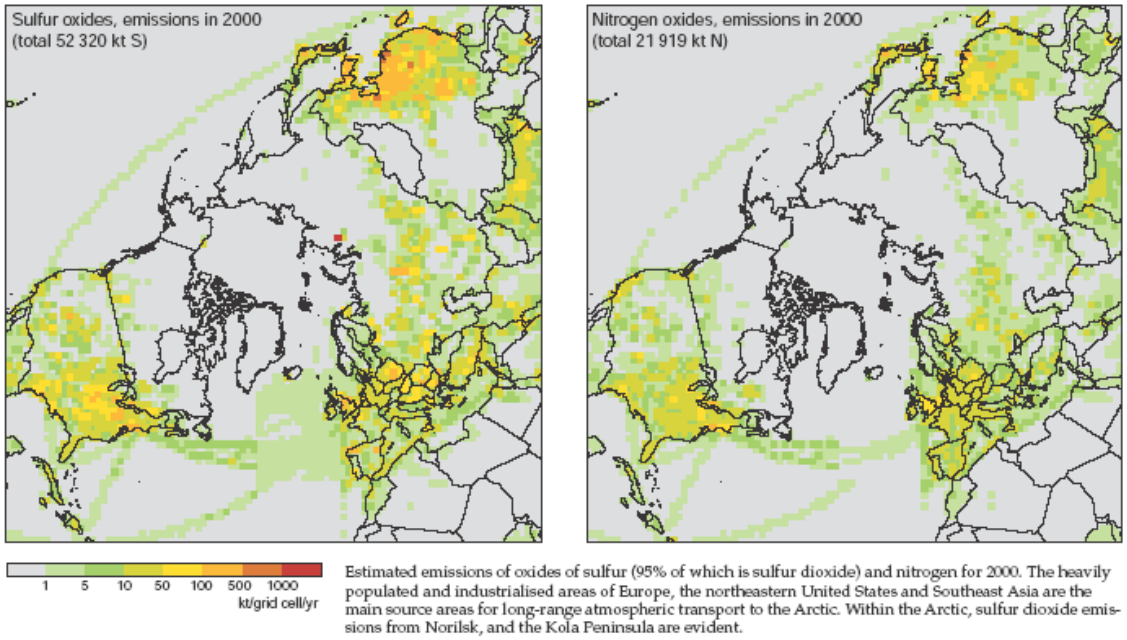
Recent indications are that spring sulfate levels are still decreasing. In contrast, spring concentrations of particulate nitrate at Alert increased by about 40% between 1990 and 2000 though there are some suggestions that soot deposited onto the land surface may be contributing to earlier snowmelt on tundra in Siberia, Alaska, Canada, and Scandinavia.

Generally in the Arctic, further improvement in the acidification status of the terrestrial and freshwater ecosystems is expected through to 2020 but dependent on the implementation of existing international agreements to reduce acidifying substance emissions (e.g., the Gothenburg Protocol to the UN ECE LRTAP Convention). Even with

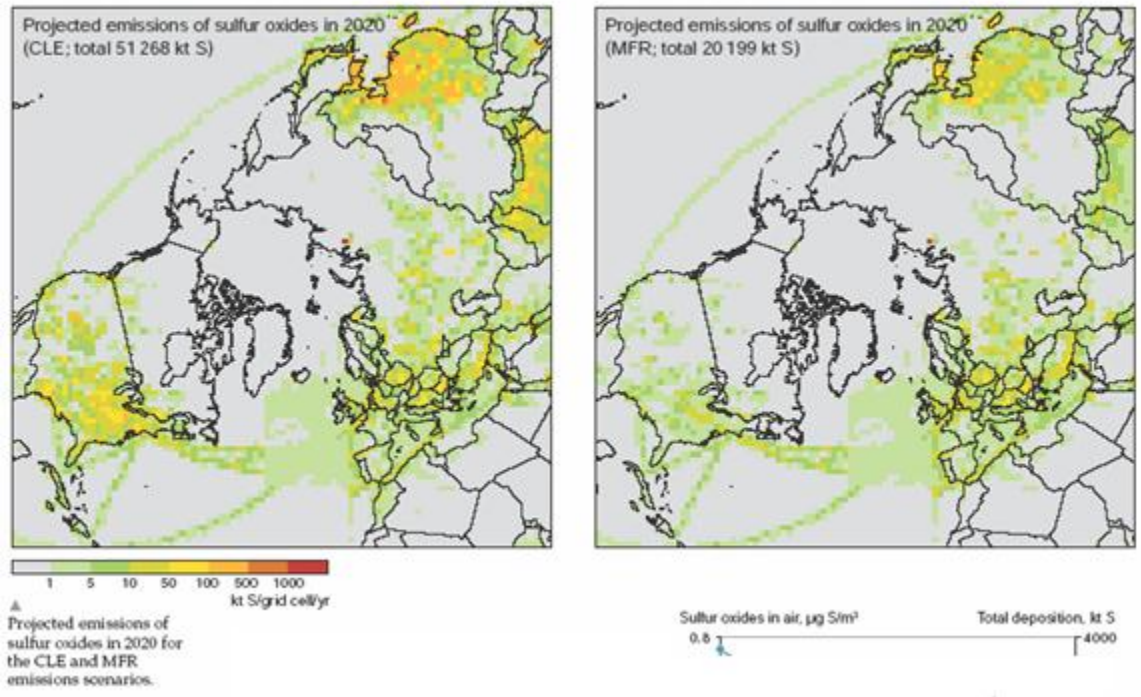
12 **Arctic Monitoring and Assessment Programme. 2006. Arctic Pollution 2006: Acidification and Arctic Haze. Oslo, Norway (www.amap.no). 28pp.**

full implementation the Gothenburg Protocol, decreasing trends in deposition noted between 1990 and 2000 are predicted to likely to level off according to modeling. Measurement data indicate that this may be occurring at some sites. Canada has signed but has not yet ratified the Gothenburg Protocol, which would more clearly set out critical loads for Canada.

Figure 17: Trends in Factors Affecting Artic Haze



Estimated emissions of oxides of sulfur (95% of which is sulfur dioxide) and nitrogen for 2000. The heavily populated and industrialised areas of Europe, the northeastern United States and Southeast Asia are the main source areas for long-range atmospheric transport to the Arctic. Within the Arctic, sulfur dioxide emissions from Norilsk, and the Kola Peninsula are evident.



Projected emissions of sulfur oxides in 2020 for the CLE and MFR emissions scenarios.

Critical loads of acidity for soils in Canada are not projected to be exceeded in any regions north of 60° N. The minimum critical load is about 84 eq/ha/yr and the maximum sulfur and nitrogen depositions are about 30 to 40 eq/ha/yr. Thus, not even the combined sulfur and nitrogen deposition will exceed a critical load in northern Canada for soils.

6.3 Resource Use Activities

6.3.1 Cause

Global prices

Global prices for commodities such as diamonds, gold, oil and gas continue to climb as existing supplies become depleted (see Figures 18, 19, 20, 21, 22). As a result, previously uneconomic sources of these commodities are becoming economically viable to develop.

Figure 18: Polished Diamond Price Index, 2005-2006

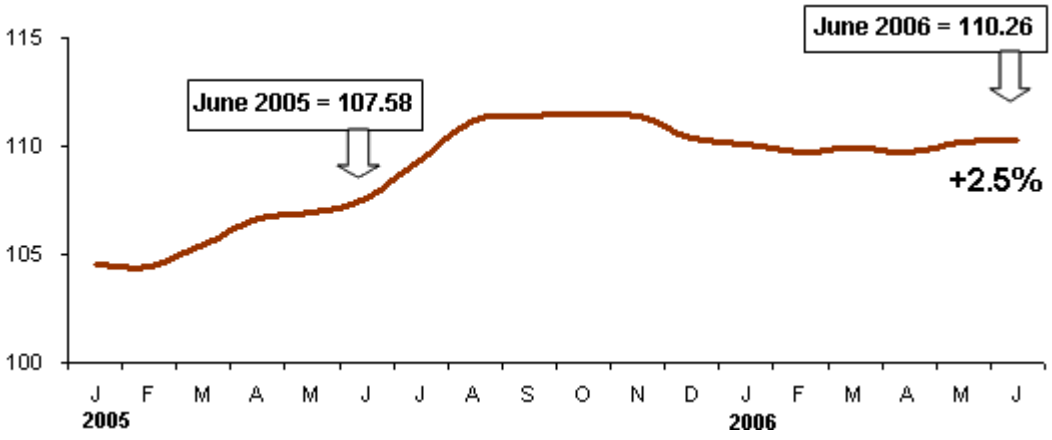


Figure 19: Global gold prices, 2005-2006

Figure 20: Crude Oil Prices in 2006 dollars

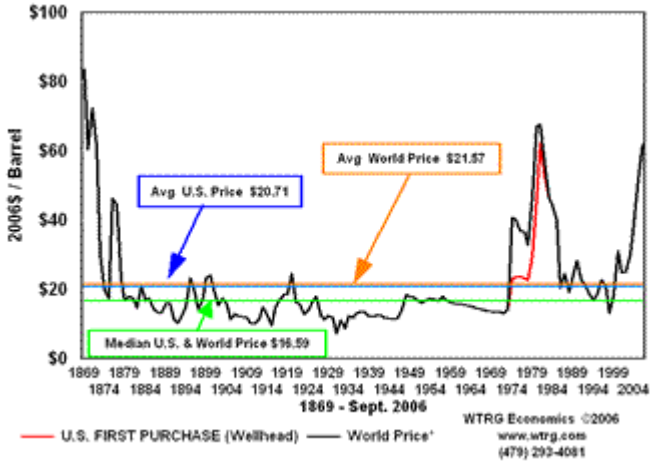


Figure 21: Natural gas prices over the last 12 months demonstrate a continued upward trend

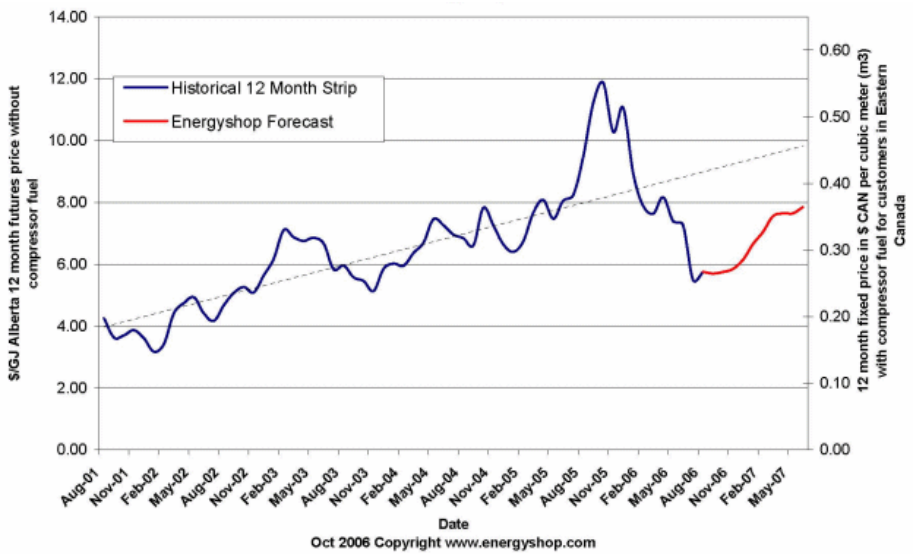
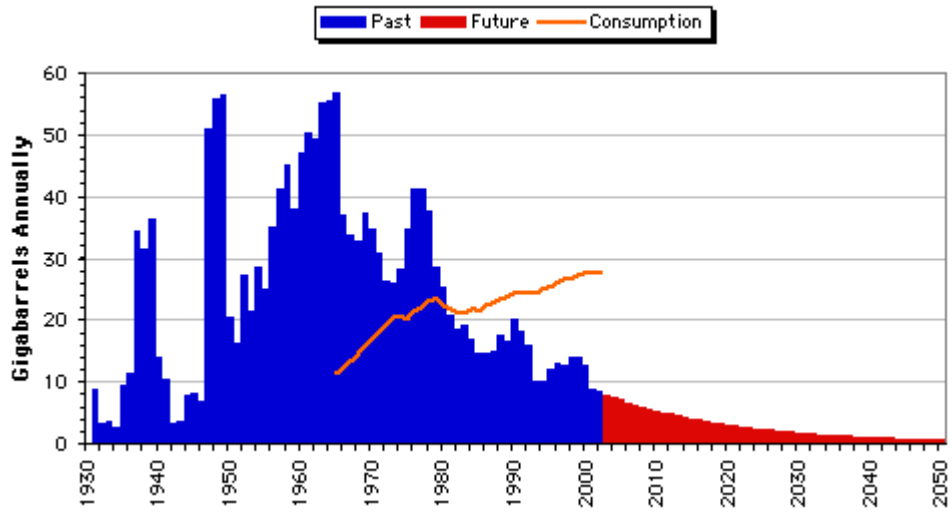


Figure 22: Global reserves and known deposits of oil and energy decreasing relative to global demand



A number of factors act to support the development of natural resources in the north, including free entry, an increasing number of settled land claims, and increasing evidence of large capital investments in the North, which support further development in the form of energy and transportation architecture. These are briefly explored below.

Free entry

The free entry system is the dominant means of granting mineral tenures in Canada today. It gives companies wanting to develop subsurface resources the exclusive right to Crown-owned mineral substances from the surface of their claim to an unlimited

extension downwards. There are three primary rights associated with the law of free entry:

- the right of entry and access on virtually all lands;
- the right to locate and register a claim without consulting the Crown; and
- the right to acquire a mineral lease with no discretion on the part of the Crown.

In the north, mining, oil and gas companies continue to enjoy the right of free entry onto the land. The crown can impose conditions on licensing and permitting projects once free entry has taken place, including royalty regimes, and a need to mitigate environmental impacts.

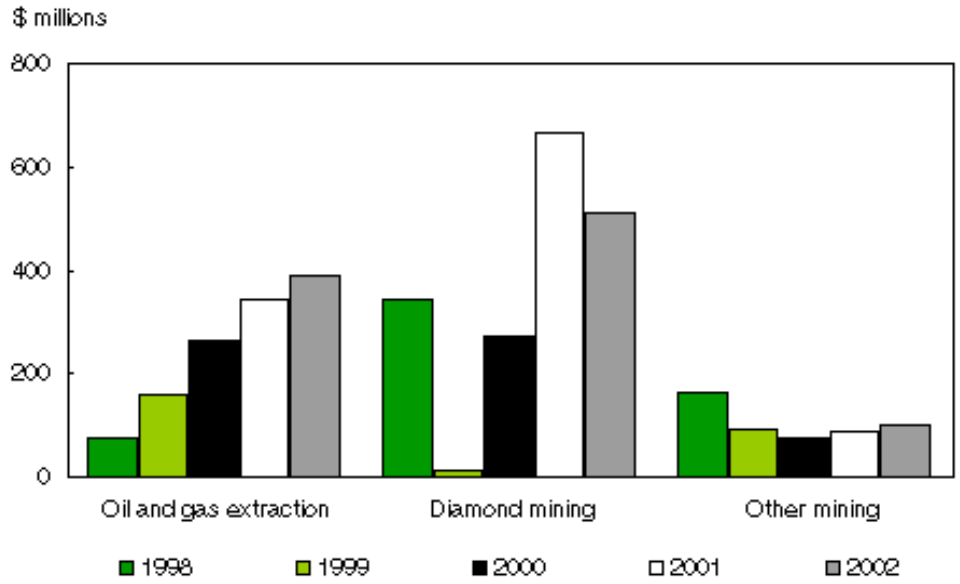
Settled land claims

A key driver of investment in the mining, oil and gas development industries is the security of the project, in particular, the security of access to the land where the project is located. As devolution occurs and land claims are settled, and the potential for impact benefit agreements and benefit sharing agreements improves, the risks associated with projects in the north decrease, providing an increased likelihood the project will be found and developed in the north.

Capital Investments

Mining, particularly diamond mining, and oil and gas capital expenditures have risen in the past decade, indicating future additional development of resource use projects (Figure 23).

Figure 23: Capital investments in resource development in the NWT and Nunavut



[1] *1998 data include NWT and Nunavut.*

Source: *Investment and Capital Stock Division, Statistics Canada.*

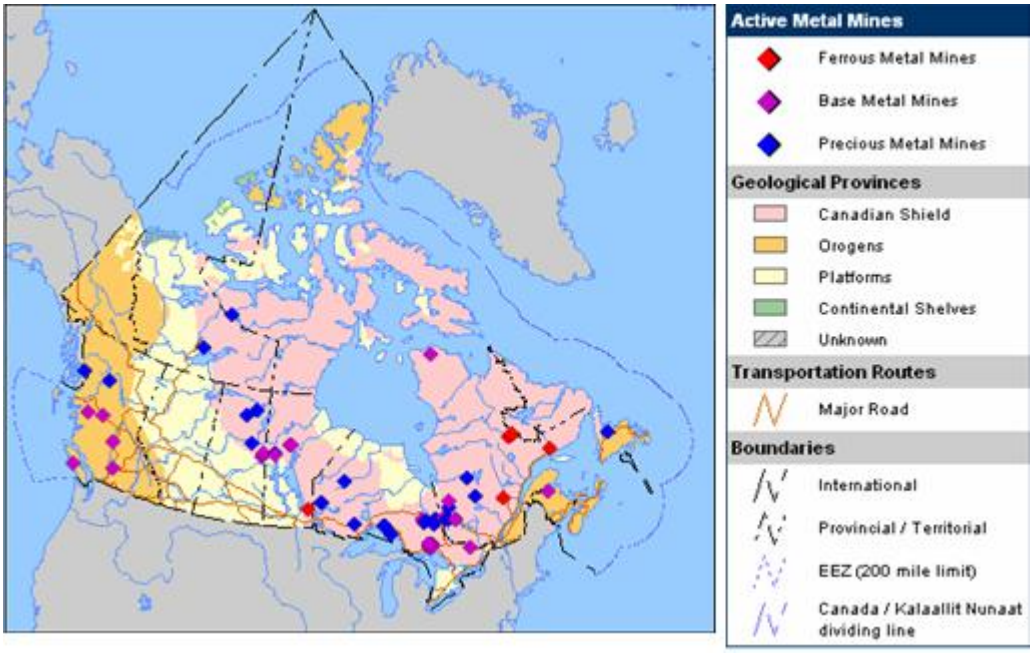
6.3.2 Threats/Stresses

Mining Development

There are a few active mines in the north. In addition, Canada has become a major player in the international diamond scene. From 1998 to 2002 roughly 13.8 million carats have been mined, collectively worth $2.8 billion. This is roughly a 1.5-kilogram bag of ice each day for five years, with each bag worth $1.5 million. Recent production data suggest that by the end of 2003 Canada will have produced almost 15% of the world's supply of diamonds, the third largest producer of diamonds, behind Botswana and Russia.

The activities of this industry show no sign of abating. The EKATI and Diavik diamond mines are expected to be viable operations for the next 11 and 20 years, respectively. Once they are up and running, Jericho is expected to operate for eight years, and Snap Lake for about 18 years. Several projects are at the advanced exploration stage in other regions of Canada, and there are a number of existing and active metal mines in the North (see Figure 24).

Figure 24: Active Metal Mines in Canada



In addition to capital investments, levels of investment in exploration and appraisal are indicators of future mining activity. For example, the number of known kimberlites in Canada has increased as a result of exploration activities, as set out in Figure 25. Also, diamond mineral resource investment has increased between 1998 and 2002 (Figure 26).

Figure 25: Known locations of Kimberlites in Canada

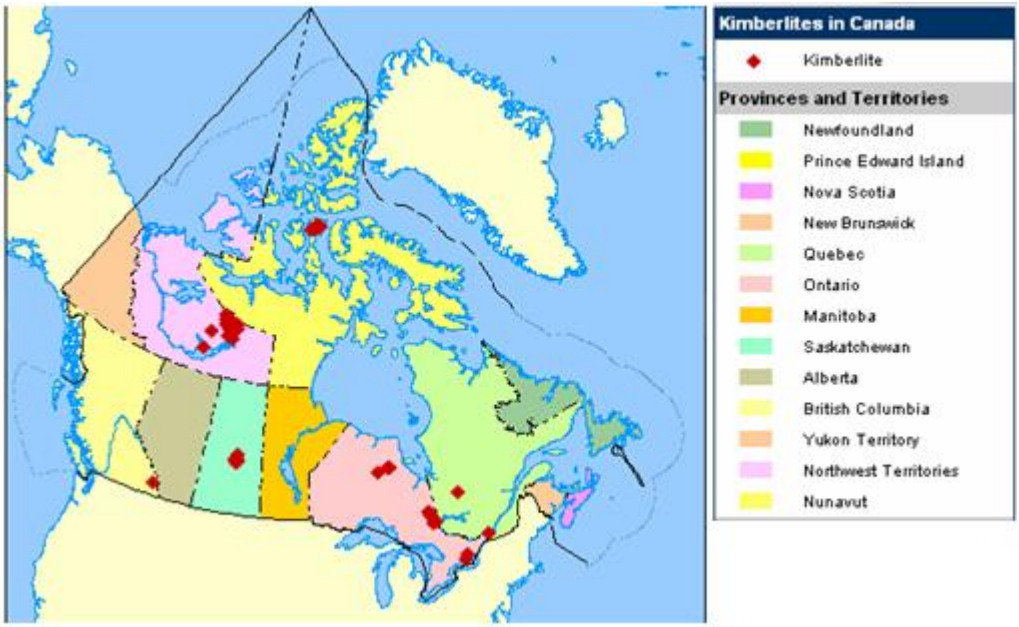
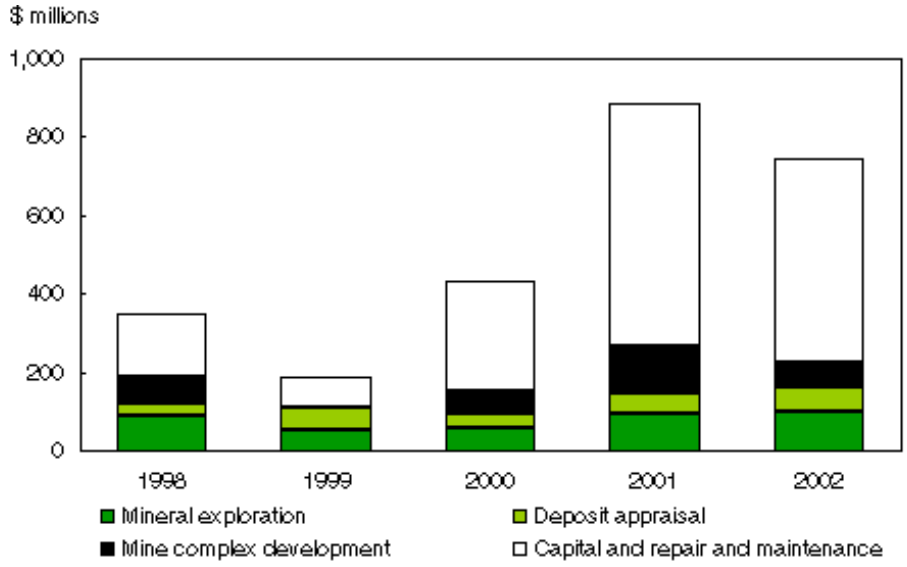


Figure 26: Breakdown of diamond mineral resource investment, 1998 to 2002



Source: *Federal-Provincial-Territorial Survey of Mining and Exploration Companies, Natural Resources Canada.*

Oil and Gas Development

Oil and gas development potential in the north is large and could grow with further assessments. There are large oil and gas deposits off the east coast and north of Labrador that if developed have impacts on the local economy and environment of

Labrador. There are also large oil and gas development potentials in the western arctic. For example:

- Mackenzie Valley and onshore Yukon have been associated with 26 significant discoveries and three producing fields: the Norman Wells oil field produces oil at rates of 30,000 bopd (6.294 = 1 cubic metre) with initial recoverable reserves of 235 million barrels; the Kotaneelee and Pointed Mountain fields close to the BC-Alberta border have produced 417 billion cubic feet (35.3 cu.ft. = 1 cubic metre) of gas by the end of 1997.
- Arctic Islands: 19 significant discoveries after fewer than 200 exploration wells; the Bent Horn field in the Arctic Islands which produced high-quality light oil for many years on a seasonal basis has only recently been abandoned.
- Mackenzie Delta/Beaufort Sea: discovered resources of in excess of one billion barrels of oil and nine trillion cubic feet (tcf) of gas in 53 significant discoveries. Four trillion cubic feet of marketable gas have been discovered in three onshore discoveries and offshore discoveries include over 200 million barrels in the Amauligak field. On the Mackenzie Delta, the Ikhil gas discovery is being developed to supply natural gas to the town of Inuvik where it will replace imported diesel oil for power generation and domestic use.

Analysis of Mackenzie Valley pipeline options forecasts very large returns in employment, income and fiscal benefits, not only to northern economies but to the Canadian economy as a whole, in the order of $US 5 billion, making it the largest single capital project in northern Canadian history. Depending on the option, pipeline construction would bring between 6,000 and 11,000 person years of work to the NWT, and five times that in total to Canada.

Other Energy Development

Current energy production is predominantly through diesel, though this has point source pollution and is a source of green house gas emissions. Perhaps more significant to NEI however, are likely hydroelectric developments. There are several new projects expected, in NWT to support the resource development industry, which has created a market for cheaper sources of power, and in Labrador, for example on the lower Churchill, where power could be used to supply existing and upcoming mining projects, as well as power to Quebec and the United States.

The impacts of power development are fairly well studied in many parts of Canada, though their impacts on northern ecosystems is largely unknown. In addition, the impacts of long term issues like climate change is not well-understood, and may affect the viability of these projects or further their impacts. An example is Great Whale in northern Quebec which interviewees identified as operating below capacity by 10-15%, a significant margin that affects the overall economic viability of the project, and which may necessitate further diversions to improve viability. These diversions will enhance the environmental impacts of the project.

Community Development

Populations in northern communities are already growing and likely to grow further in the future with resource development (Table 3).

Table 3: Population Estimates and Annual Rate of Growth, by Territory, July 1, 2003 to July 1, 2006[13]

Province/Territory	2006	2005	2004	2003
	1-Jul	1-Jul	1-Jul	1-Jul
Northwest Territories	41,861	42,629	42,798	42,231
Nunavut	30,782	30,040	29,633	29,165
Yukon	31,229	31,121	30,896	30,574
British Columbia	4,310,452	4,257,833	4,203,315	4,155,370
Alberta	3,375,763	3,277,582	3,206,953	3,161,371
Saskatchewan	985,386	989,957	994,888	994,732
Manitoba	1,177,765	1,174,148	1,170,475	1,161,896
Ontario	12,686,952	12,558,669	12,416,749	12,262,560
Quebec	7,651,531	7,597,768	7,548,589	7,494,690
New Brunswick	749,168	751,481	752,080	751,222
Nova Scotia	934,405	936,130	937,993	936,513
Prince Edward Island	138,519	138,176	137,876	137,325
Newfoundland & Labrador	509,677	513,962	517,209	518,428

[13] See Statistics Canada, December 2006 at http://www40.statcan.ca/l01/pro01/pro112.htm

Solid Waste and Waste Management

Solid waste is a particular challenge for northern communities, where there is little natural decomposition of waste materials, and where assumptions about leaching from dumps may be in appropriate. Solid waste disposal facilities in northern communities are often rudimentary as a result of the lack of staff and funds, climatic restrictions and the frequent presence of permafrost which forces many communities to dispose of their wastes in open sites. These wastes take decades to degrade because of the extremely slow rate of decomposition in the Arctic environment. Recent water and sediment studies confirm that concentrations of heavy metals and organic pollutants can be found downhill of these facilities. Many communities also continue to open burn their solid waste as a means of reducing volume. This practice results in metals, organic pollutants, ash and other contaminants to be discharged directly to the atmosphere where they are distributed by wind to locations many kilometres away. Community residents, businesses and institutions also generate quantities of hazardous wastes which must be properly managed and disposed. The most common types include used lubricating oils and waste fuels, antifreeze, batteries, solvents, paint and oil filters. Recent surveys indicate that more than two million litres of waste oil and fuel, and approximately 260 tonnes of other hazardous wastes, are produced annually by northern communities.[14]

Ocean disposal of wastes is a related issue. The ocean disposal of wastes is controlled in Canada by the federal government under the *Canadian Environmental Protection Act*. From 1982 to 1997, forty eight ocean disposal permits for the dumping of dredge spoils and seven permits for the dumping of scrap metal were issued for Canada's Arctic. A small number of disposal permits have also been issued authorizing the dumping of petroleum for oil spill experiments and the use of freeze-accelerating additives used in the construction of ice islands. While the issuance of permits to dispose uncontaminated dredge spoils into the ocean continues to be supported by the federal and territorial governments, the disposal of scrap metal into the Arctic Ocean was essentially stopped in 1994 as a result of local community concerns and opposition. The long term impact of these practices is uncertain. Ocean disposal permits have been issued in the past because it was thought that there were no immediate and practical solutions to the problem of land-based dredge spoils and scrap metal disposal. It was often cheaper to dump materials into the ocean than to remove them to other locations for reuse or disposal. The major disadvantages of ocean disposal remain the potential for discharge of floating debris and the release of toxic substances into the marine environment. [15]

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14 Pressures On The Arctic Ecosystem From Human Activities, Resources, Wildlife and Economic Development - Environmental Protection Service, March 16, 1998

15 Pressures On The Arctic Ecosystem From Human Activities, Resources, Wildlife and Economic Development - Environmental Protection Service, March 16, 1998

Water and Wastewater Management

The *Guidelines for Canadian Drinking Water Quality* (GCDWQ) are developed in collaboration with all provinces and territories through the Federal-Provincial Subcommittee on Drinking Water. This committee is overseen by Environment Canada.

On the basis of these guidelines, Indian and Northern Affairs conducted a survey of the water supplies of aboriginal communities, including northern communities. Of the 740 water systems that were assessed, 29 per cent (218) were classified under Category C as posing potential high risk that may negatively impact water quality. These systems were operating but were not consistently meeting safety parameters as well as experiencing operational difficulties. This does not mean that water in those communities was not drinkable at all times. Should an immediate threat to the health and safety of the community be identified, such as the presence of *E. coli* in the community's drinking water, it is the responsibility of the First Nation to take necessary action to protect the residents. In a situation where water is considered unsafe for consumption, Environmental Health Officers (employed by Health Canada or First Nations stakeholders) immediately advise Chiefs and Councils to issue Boil Water Advisories (BWA).

Of the 462 wastewater systems that were assessed by Indian and Northern Affairs, 16 per cent (74) were classified under Category C as posing potential high risk resulting in wastewater quality problems related to sewage discharge. Repetitive incidences of not meeting the federal guidelines and frequent operational difficulties resulted in this classification.

Given the growth of populations in northern communities, and a move towards the wage economy, water and wastewater management will continue to be a growing concern in areas where there is little buffering or assimilative capacity in source and sink waters related to community water use.

6.4 Ecosystem and Biodiversity Impacts

The land and wildlife remain vital to northern cultures and a way of life for many families, who still rely heavily on the land and wildlife for food and for spiritual strength. Understanding the impacts of climate change, contaminants and resource development on traditional ways of life is key to the mandate of Environment Canada and fundamental to the well-being of northern communities. There are a variety of impacts that these issues can have, and understanding them will be key to adapting and managing activities differently, including those activities that have an impact on such systems, and activities that depend on such systems. Examples of these impacts are set out below in Table 4, which indicates a further understanding needs to be developed. In some cases, extensive community knowledge is available, and needs to be brought into formal streams of research and monitoring that demonstrate how change is happening.

Table 4: Summary of trends, knowledge, capacity and influence in relation to ecosystem impacts

Impact	Trend	Knowledge of the Impact	Current Capacity	Influence, Role of NEI
Ecosystem Health (mobilized contaminants)	▲	Low	Low to medium	High (monitoring)
Health of populations of northern wildlife species	▲	Med	Med to High	High
Wildlife disease	▲	Low	High (community)	High (monitoring)
Exotic/invasive/opportunistic species	▲	Low	Med	High

In general, the overall observation from interviews and the research done during the course of the project is that there are is extensive knowledge and capacities within communities that needs to be tapped and shared to document the biological change that is going on, and that could be used to complement and target science-based monitoring and research. Yet, while knowledge and capacity are relatively low, the influence of NEI over these issues is high.

6.5 Cultural Issues

6.5.1 Traditional Lifestyles

Given the reliance of traditional lifestyles on natural systems, and given the pace of change projected for the northern physical environment, it is our assertion that traditional lifestyles are at risk in northern Canada. Many land claim agreements themselves aim at ensuring that northern and aboriginal peoples can sustain their traditional lifestyles. Some adaptation related to traditional lifestyles has already take place. An example, the Northern Contaminants Program has assisted northerners to adapt and understand risks around the consumption of country foods. However, the pace of change is so significant that many keystone species for northern cultures are likely themselves to be at risk, in turn affecting traditional lifestyles. These lifestyles are also placed in jeopardy as (1) there are increased opportunities for a wage economy, (2) there is increased contact with others through enhanced shipping, roads, and through ecotourism.

6.5.2 Traditional Knowledge

Traditional knowledge is premised on experiences, both personal and cultural, of how the land changes, season-to-season, decade-to-decade. Northern peoples have extensive experience with the land, and this historical tradition has allowed them to survive and flourish in severe northern and Arctic climates. Given the pace of change driven by the strategic issues identified in this paper, and now addressed by the NEI, the very essence of knowledge about northern ecosystems will be taxed in the next 25

years. Assumptions about the past, in terms of weather patterns, or patterns in the natural cycling of wildlife populations, may no longer be valid, and will need to be closely examined by those who hold such knowledge to allow northern peoples to adapt as their environment changes.

6.6 Program Issues

6.6.1 Capacity Building

The United Nations Development Program defines capacity building as "the process by which individuals, organizations, institutions and societies develop abilities (individually and collectively) to perform functions, solve problems and set and achieve objectives." The World Bank has similarly defined "capacity" (as opposed to the activity of capacity *building*) as "the combination of people, institutions, and practices that permits countries to achieve their development goals."

The NEI is committed to building and enhancing the capacity of Canadians to address ecosystem priorities in the North. Currently, projects and activities supported by NEI must involve elements of capacity building. For NEI, capacity building involves:

- Supporting northern peoples and communities in their efforts to initiate new research initiatives, evaluate the current state of knowledge, utilize new tools, and better manage northern ecosystems or influence policy and decision-making at the regional, national, and international level;
- Being responsive to community concerns or to those of regional organizations, including co-management boards;
- Actively involving both northerners and the science community in the setting of project objectives and design, project implementation, and communication of project results;
- Utilizing local and/or traditional knowledge systems and methodologies in combination with western science knowledge systems and methodologies;
- Including innovative and appropriate tools and approaches for communicating results to northern communities and organizations, as well as scientific agencies and key policy and decision-making bodies at the regional, national, or international level; and
- Sustainability - This could include improved knowledge and/or skills in northern people or their organizations; the development of new and beneficial tools; and education, training or employment opportunities for northerners.

Based on the UN definition of capacity building, what is not clear for NEI is exactly what objectives the program is supporting with respect to capacity building. With respect to monitoring itself, capacity to monitor causes and physical changes of issues identified in this report is relatively high; the capacity to monitor biological impacts however appears to be considerably lower. It should be noted that there appears to be some community capacity and knowledge related to biological impacts that remains to be tapped by the program.

The program's logic model, proposed earlier, would have it influencing decisions. In doing so, the program needs to complement other existing initiatives, including those funded by Environment Canada like the Ecological Monitoring and Assessment Network (EMAN), and the community ecoAction program, as well as external initiatives such as the Northwest Territory Cumulative Effects Assessment and Management (CEAM) Strategy work on cumulative effects and work going on among academics and through international venues. With a project focus, the program has not really yet articulated a clear strategy for building capacity. Our recommendations work to address this by proposing a focus for the program.

6.6.2 Identifying Decisions NEI can work to influence

In the programs results structure, it is not clear about the decision makers it is trying to reach, or the decisions it is trying to influence. Options raised during the course of interviews completed during the project include:

- Community planning and community development, particularly around environmental issues like water, waste and waste management;
- Sovereignty and the need to assert sovereignty by taking responsibility for environmental change through monitoring and research in areas where sovereignty may be in question;
- Trans-boundary wildlife management, in particularly the management of species that cross a range of boundaries in the north. Boundaries in this context are (1) international, (2) territorial, (3) related to areas under land claim, and involve wildlife management boards.
- Climate change policy – adaptation rather than mitigation. Current climate change policy in Canada is "south of 60" focused, and is targeted primarily towards the mitigation of climate change, and reducing emissions to meet international agreements.
- Project approval in the context of cumulative effects, particularly in areas where there are a number of synergistic and adverse affects of the issues and trends identified in this report, and where knowledge is insufficient.
- Stewardship actions and the need for stewardship programming in the north, where the strategic role of NEI needs to be carefully considered, and where such activities should potentially be left to other funding instruments.
- The better capture and use of traditional and community knowledge, as communities are experiencing many of the effects of the trends and issues identified in this report first hand.

In order to influence, the program needs to set out a path of influence that tells a consistent story about what information it will provide to inform these decisions, and how it will deliver it in a timely way. In addition, information management is another critical capacity function the program needs to develop in order to assist in informing decisions.

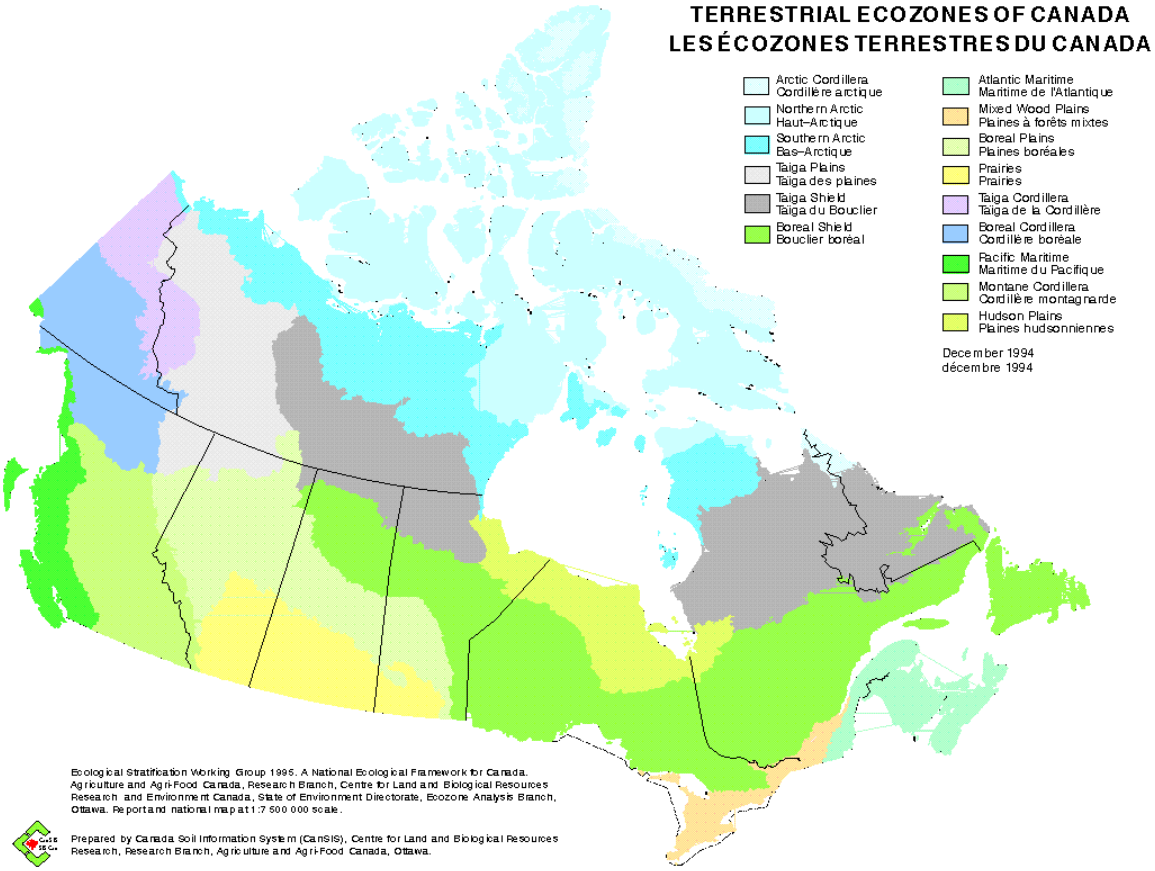
6.6.3 Moving Towards Integrated Approaches

Currently the governance model of the program is driven at a high level by many of the issues identified in this paper. The program needs to consider an approach that more strongly reflects the mandate of Environment Canada, that ties more strongly into devolution and the strengthening authority of territorial governments, and that more formally ties into decision making under land claim agreements, in addition to respecting the important role of communities in decision making.

The program is called an 'ecosystem initiative', and its pan-northern, partnership-driven approach and current priorities have improved the relevance of its efforts. However, given its limited funding, it is still spread very thinly across northern Canada. This is a consistent comment heard during interviews. While there are political realities that must be addressed through the program, political realities need to be layered with the realities of environmental change that is occurring in the north in order to be able to effectively influence decisions at a variety of scales. The program needs to acknowledge there are links among the issues, and in fact for some projects it has funded, this has been the case, though the current issues table approach keeps them separate. Considering a stronger move towards an ecosystem approach may help to target and focus the program, and should be done in partnership with northern and aboriginal peoples.

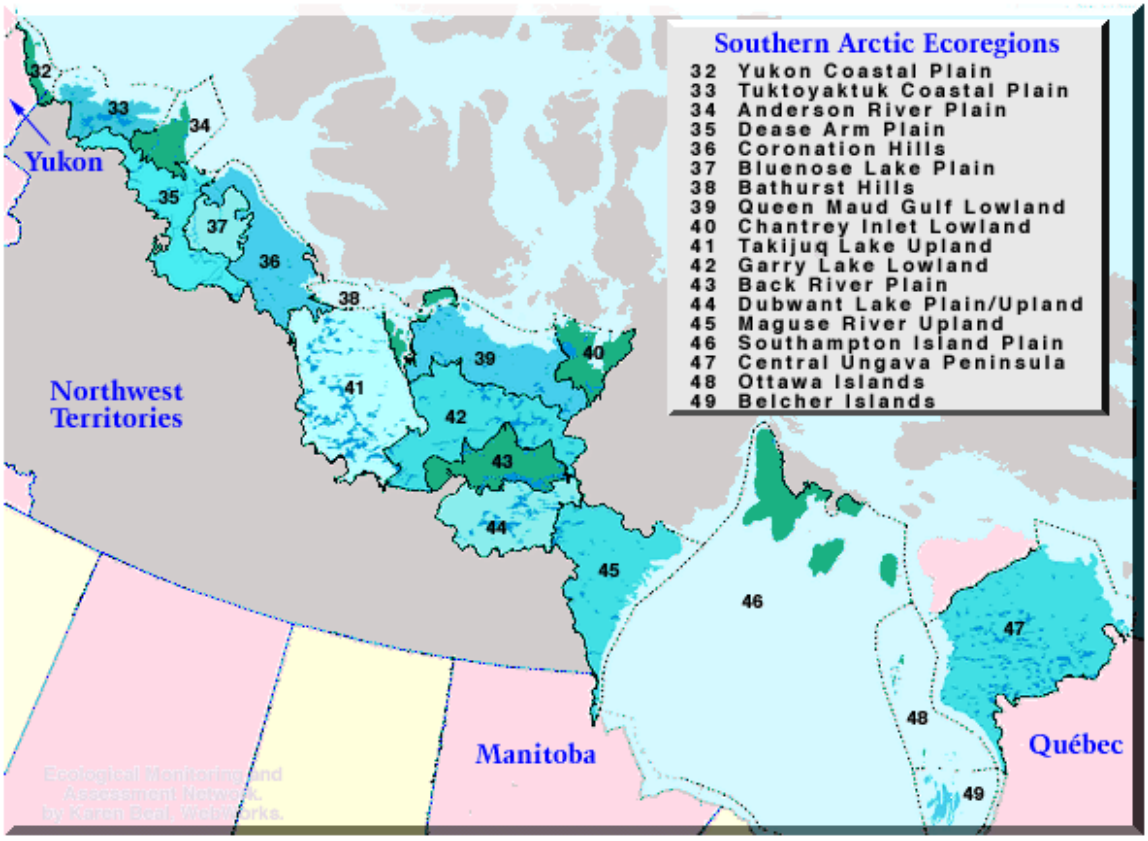
A further assessment needs to be done of how and where the program should focus its research and monitoring efforts, perhaps around Canada's ecological framework. Working with program partners above, the issues identified above can be and have been broadly mapped against ecozones in Canada (see Figure 27 below), and could be further refined into ecoregions (see more detailed ecoregions for the Southern Arctic ecozone in Figure 28 below) and a number of other criteria should be considered to create more focused efforts that cut across issues and address the diverse cultural and political nature of the north.

Figure 28: Terrestrial Ecozones of Canada[16]



16 Details on this framework can be found at the Agriculture and Agrifood Canada website at http://sis.agr.gc.ca/cansis/nsdb/ecostrat/intro.html, December 20006

Figure 29: Southern Arctic Ecoregions[17]



Case Study – CEC's and the Berring Strait to Baja California (B2B) Initiative[18]

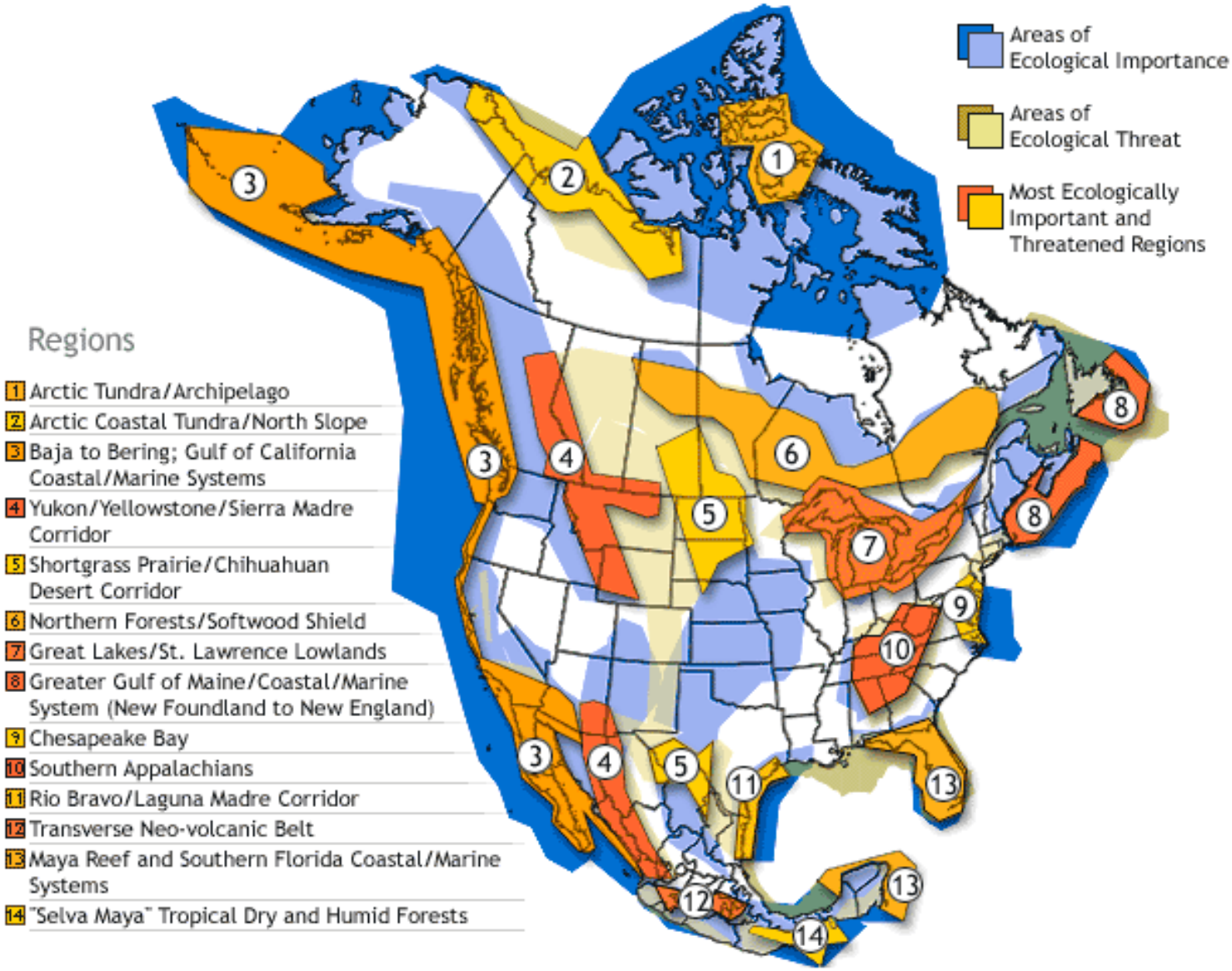
As a case study, in 1999, the CEC embarked on the development of North America Biodiversity Strategy and an "ecoesparanto" – a common language among Canada, the United States and Mexico around an ecological approach to managing a range of issues. The CEC developed, at the largest scale, an ecological framework for North America. Subsequent to this, the CEC worked to establish 14 priority conservation regions on the basis of (1) ecological importance and (2) most threatened. One of these regions was the pacific coast of North America, now known as the Baja California to Berring Strait or B2B. On the basis of this, and within the B2B, the CEC has worked with partners in Canada, the United States and Mexico to identify priority conservation areas (Figure 30), and more recently is now working to develop consistent monitoring and indicators in this area. The CEC is also working to put a web-based clearing house in

17 **Details on this framework can be found at the Agriculture and Agrifood Canada website at http://sis.agr.gc.ca/cansis/nsdb/ecostrat/intro.html, December 20006**

18 **Details on the north American ecological framework and marine protected areas in the B2B can be found at http://www.cec.org/pubs_docs/scope/index.cfm?varlan=english&ID=12 as of December 2006.**

place that will allow comparisons across priority conservation areas, and across ecoregions, in an effort to better aggregate data on core indicators, and on broad results related to initiatives in the B2B.

Figure 30: Priority Conservation Regions in North America[19]



[19] Strategic Plan for North American Cooperation in the Conservation of Biodiversity, Commission for Environmental Cooperation, 2003

7 RECOMMENDATIONS

7.1 Focus on Ecological Research and Monitoring

We recommend an exclusive focus of the program on this theme, and capacity building projects only where such capacities related to research and monitoring are needed. On the basis of its work, the program should work to influence the stewardship efforts of other programs. Most strategic issues facing the north and identified in this scan are not directly in the control of northerners, nor unique to Canada. Those that are closer to home, like those related to resource development, where northerners can clearly have influence, are also being driven by global trends in commodity prices, that are increasingly making projects more economically viable. As such, NEI needs to contribute to a long term strategic story that is tied together across Canada's north, as well as on a circumpolar basis. The NEI's strongest niche, supported in part by interview results, would be in coordinating and creating consistency around monitoring efforts of ecological change as a result of the issues identified in this scan in northern Canada.

7.2 Move Towards a More Integrated Ecologically-based Approach

As demonstrated by the B2B initiative, a simple exercise of (1) identifying priority ecoregions of concern in the north, and (2) establishing common monitoring protocols and indicators to allow northerners to tell a consistent story about what change is happening, and the biological impact of this change. This approach would alone create new capacity, and present a greater opportunity at influencing a range of project, program and policy decisions in the north.

NEI has some hints at the value of this approach, as set out in the Environmental Action Plan for Quebec, though the program retains an issues focus. We recommend the program consider balancing an issues focus with an ecological approach, by working with partners to identify areas where environmental change needs to be monitored, and allow them to focus monitoring and research efforts in these areas. The role of the program is coordination and ensuring consistency in the effort.

Criteria to consider in selecting such areas should be driven by partnerships, and could include:

- What areas could be chosen as representative of ecozones as set out in Canada's ecological framework and as sensitive to ecological change?
- Which of these areas are at greatest threat in the North? What are the priorities for management and monitoring?
- Is there an integration of threats where more than one (all) issue(s) can be explored?
- Within these areas, are there opportunities for NEI to build on existing efforts and work effectively with other programs to improve coordination and bring consistency to monitoring efforts?

- Within these areas, what key natural and environmental features are most valued and should be sustained?
- Are there monitoring protocols and capacity already in place tied to valued components?

7.3 Enhance Governance to Include Territorial and Regional Land Managers

Currently the program has an issues focus. Investing in improved governance around research and monitoring, particularly governance that involves territorial governments more deliberately as environmental managers in the North under devolution, and that involves regional land managers, such as boards and more local managers established under land claim agreements. This would flow from an approach that examines biophysical change, socio-economic impacts and that pulls in regional and territorial managers. The priority for building such partnerships should be established through a focus on an ecologically-based approach, and by the program steering committee. The program steering committee itself should be expanded to include territorial and key regional land managers.

7.4 Focus Capacity Building on Monitoring, and Move Towards a Program Versus Project Focus

With respect to capacity building, the project focus of the program needs to shift and program managers need to recognize the important role of NEI itself in creating capacity as a program. While projects can help to build local capacity, such capacity needs to be linked. The program could do this, for example, by creating venues whereby northerners identify priority ecosystems for monitoring, identify valued ecosystem components or services, to pull in cultural values, develop common or consistent research and monitoring protocols on the basis of these, and focus these on key geographic areas in the north, as developed and selected by northerners. A valued ecosystem component for NEI could be a resource or environmental feature that is important (not only economically) to a local human population, and that has a potential national or international profile, or if altered from its existing status, will be important for the evaluation of environmental impacts of industrial developments, and the focusing of administrative efforts.

7.5 Develop a Strategy to Inform

NEI needs to create a map of what decisions it will work to inform as priority, on the basis of issues above, and on the basis of an eco-systemic approach. For example, issues the NEI is addressing are not unique to Canada's north. Canada needs to influence other circumpolar nations to develop (1) a common ecological language akin to the work of the Commission for Environmental Cooperation, (2) identify core monitoring needs across the north, including for other polar countries.

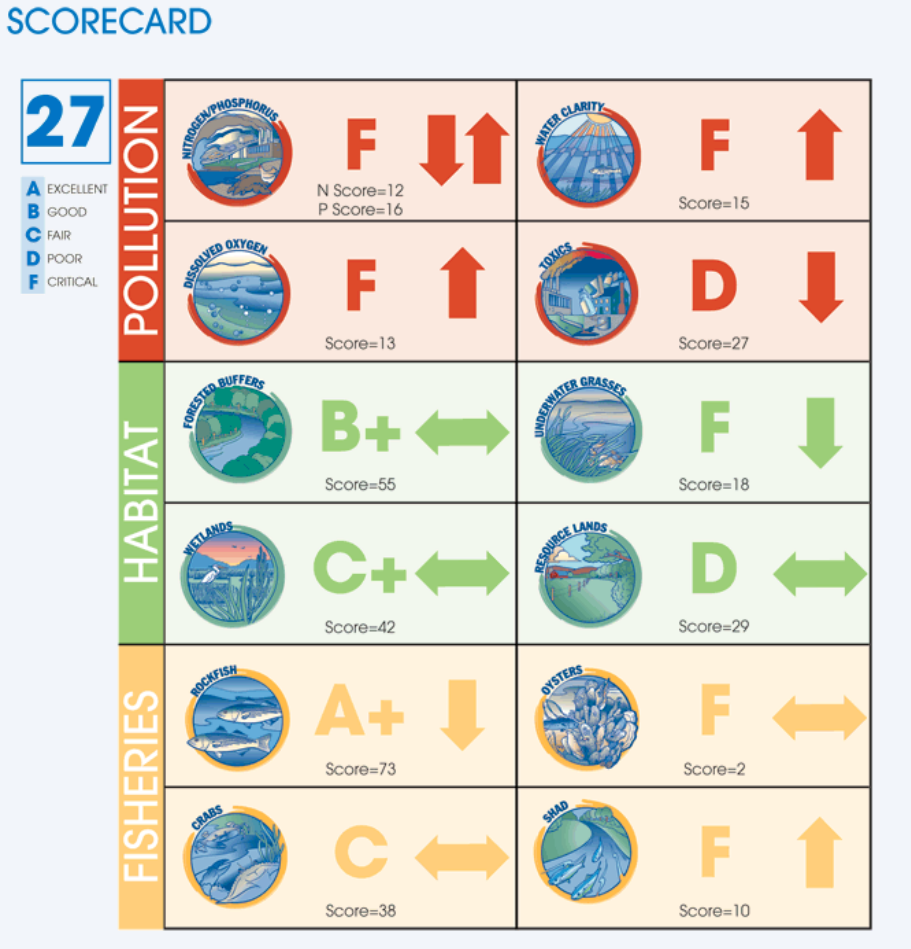
We suggest the following priorities:

1. Climate change policy
2. Use and integration of traditional knowledge

3. Trans-boundary wildlife management
4. Project approval in the context of cumulative effects, for example, by working towards thresholds
5. Community planning and community development
6. Sovereignty

As a pan-northern program, NEI should consider how it might conduct system-wide reporting on monitoring efforts, building on the work it has done with regards to indicators and monitoring efforts. Monitoring through the NEI needs to focus on core themes or categories, perhaps to inform the development of "scorecards" of ecosystem health that inform. Though monitoring does not have to completely overlap, such a scorecard could allow comparison of the health of key regions of the north, or key areas in the north as a whole. The scorecard would be informed by a blend of monitoring, as evidence of change, and professional judgement by experts and those with extensive community knowledge. An example of a scorecard appears below, though the scorecard could be expanded to include a statement of the intensity and trends of key issues identified in this scan.

Figure31: Scorecard of the Health of Chesapeake Bay[20]



7.6 Tie to Other Programs

Consistent with a focus on monitoring, NEI's role in stewardship actions and the need for stewardship programming in the north, needs to be carefully considered. Stewardship activities should potentially be left to other programs like ecoAction, the Habitat Stewardship Program or the Climate Change Action Fund. In this regard, a focus as set out above will allow NEI to create a stronger tie and influence over (1) the priorities and potentially northern funding levels of other Environment Canada programs, (2) other federal programs, and (3) partner programs, including those by territorial governments.

A first priority however should be to create better links internally to EMAN and Ecoaction. As the program focuses on an ecological basis, it should work to develop better linkages to EMAN and try to develop a stronger capacity to conduct monitoring outside areas identified as priorities under an ecological framework. Developing a

[20] Cheseapeake Bay Foundation website, http://www.cbf.org/site/PageServer?pagename=sotb_2004_scorecard as of December 2006.

cross-walk between key monitoring protocols needed in the north, and protocols developed under EMAN and identifying northern monitoring gaps where NEI either has experience or can develop experience and expand EMAN protocols, will allow it to reach out to other communities as it tries to build a focus on priority ecological areas. System-wide monitoring will need to be informed by data and information from a broad range of monitoring initiatives, and NEI could help to influence (1) where such monitoring initiatives occur, and (2) the type of monitoring that needs to be conducted. In addition, the program should work to support investments of other stewardship initiatives needed to take action in relation to climate change or contaminated sites.

7.7 Make Investments in More Integrated Information Management

NEI needs to make better investments in a network approach to management and monitoring of ecological change in the North. Developing improved capacity for sharing knowledge across the North, working with other existing systems where possible, and developing tools for analyzing, viewing and reporting program monitoring data (for example, as scorecards) will help the program to influence decisions. For example, the program's efforts in support of indicators should be narrowed down to a set of "scorecard" indicators that focus on state variables within systems, trends in key threats, and directions in core policy, program and project decisions in relation to these trends.

8 CONCLUSION

This scan has reaffirmed and made suggestions for adjustments to the NEI's priorities and program governance. The north will experience significant changes in the coming decades, and the program can play an important and strategic role in informing northerners, Canadians and the International community on the nature and impacts of these changes. Doing so may require adjustments on the basis of a strategy and vision given the programs relatively modest resources, and the vast area it must work across, northern Canada. The report has made some recommendations that may be worth exploring in this regard.