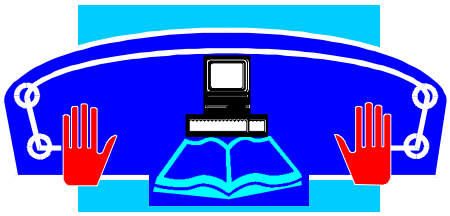


THE ARCTIC ENVIRONMENTAL STRATEGY: FIVE YEARS OF PROGRESS

REFERENCE - GENERAL

Reference Material

Plans/Strategies

1996

CANADA - INDIAN AND NORTHERN AFFAIRS

9-5-433

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

THE ARCTIC ENVIRONMENTAL STRATEGY: FIVE YEARS OF PROGRESS

Sector: Reference Material

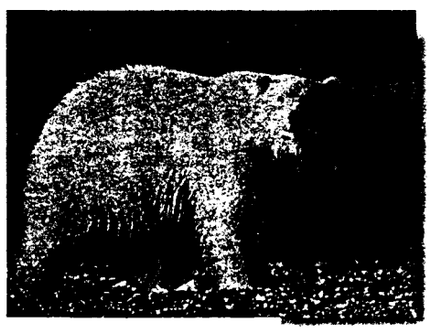
9-5-433

Plans/Strategies

The *Arctic Environmental Strategy*: Five Years of Progress

La *Stratégie pour l'environnement arctique* : Cinq années de progrès

ᐃᓄᐃᑦ ᓄᓇᕗᑦ ᐊᕐᓇᒥᐅᑕᓕᕆᓂᖅᓯᒪᑦ ᕿᑎᐃᓂᖅ: ᑕᕐᒪᓂ ᐅᑭᐅᓂ ᐱᐅᓯᖏᓐᓄᑦᑎᓂᒃ

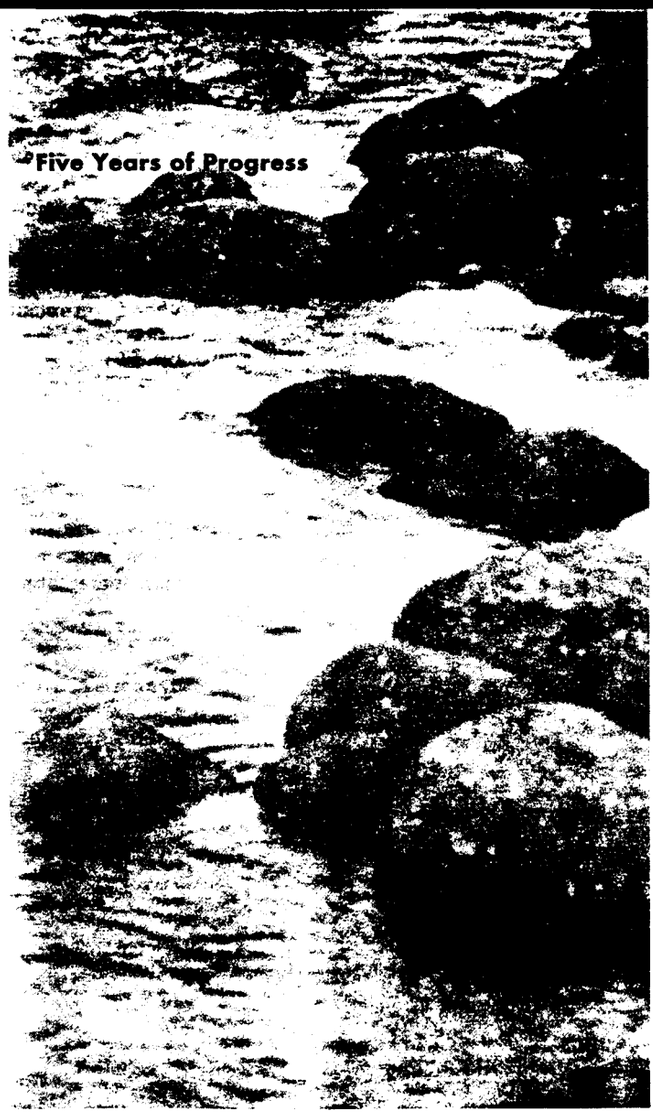


Canada

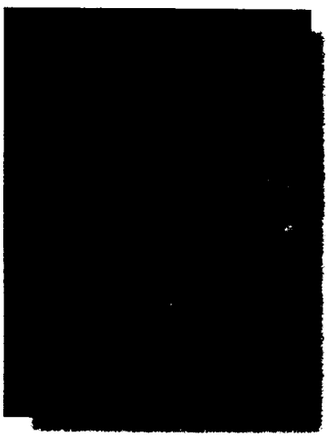
NWT GOVERNMENT LIBRARY
3 1936 00030 696 7 .

LEGISLATIVE LIBRARY
YELLOWKNIFE, N.W.T.

The *Arctic Environmental Strategy*



A Thank You to Our Partners



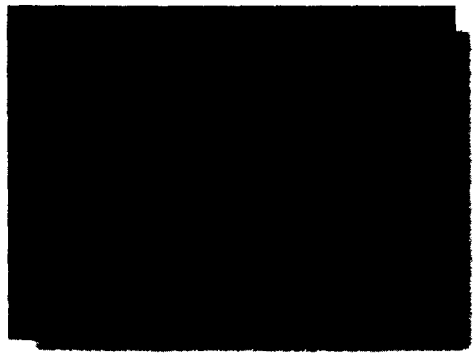
This report celebrates the achievements of the people who are making the *Arctic Environmental Strategy* a success.

The ***Arctic Environmental Strategy*** is a success for one main reason—partnership. Northerners worked with southerners. Scientists worked with northerners, Schoolchildren worked with federal government staff. As the federal government department responsible for the ***Strategy, we*** at the Department of Indian Affairs and Northern Development are grateful to those who partnered up with us and others to make the ***Arctic Environmental Strategy*** succeed.

Specifically, we say a warm thank you to the following: Council of Yukon First Nations, Dene Nation, **Inuit Circumpolar** Conference, **Inuit** Tapirisat of Canada, and M&is Nation-NWT. Our thanks also go out to the other government departments, research institutions, universities and ***Arctic Environmental Strategy*** staff that gave of their time and expertise.

The ***Arctic Environmental Strategy*** proves that partnerships and cooperation are the secret to delivering successful environmental programs in the North. Thank you to everyone who helped make it a success. Working together, we will make the North a safer and more prosperous place for present and future generations.

Table of Contents



Introduction

Canada's North: An Environment at Risk

Canada's *1991 State of the Environment Report* describes how contaminants and long-range pollutants have affected northern ecosystems during the last 50 years.

Contaminants from distant sources
Soot, acid rain, polychlorinated biphenyls, pesticides, heavy metals and other contaminants from sources thousands of kilometres away in industrialized and developing countries are found in the Arctic. This long-range contaminant transport is perhaps the greatest threat to the northern environment.

Wastes at abandoned sites
Before 1972, land use in the North was not regulated. Consequently, wastes were abandoned throughout the region. These wastes included buildings, electrical equipment, mine tailings, chemicals, fuels, oil drums and garbage.

Mining, development, and oil-and-gas exploration
By *1984,* companies had dumped more than *250,000* litres of waste drilling fluids in pits and sumps across the North. These wastes came from more than *300* oil and gas exploratory wells and included about 20,000 tons of contaminated drilling muds, soils and other solids. Many mining companies left behind toxic concentrations of zinc, lead and arsenic.

Water quality
Because wastes do not break down and disappear as quickly as they do in southern Canada, and because standard sewage treatment systems cannot be installed in muskeg, permafrost or rock, it is difficult to dispose of municipal and industrial waste. River and lake systems pick up and carry contaminants from both the air and land, and from industrial and community sites.

The Arctic Environmental Strategy

To meet these environmental challenges in Canada's North, the Government of Canada, in 1991, created the *Arctic Environmental Strategy*. The aim of the *Strategy* is to develop a comprehensive way to maintain the integrity of the Arctic environment. This means looking at the entire ecosystem of the North, including northerners and their health. While the *Arctic Environmental Strategy* is delivered primarily in the Yukon and the Northwest Territories, some work has been done in Northern Quebec and Labrador. The terms "North"

and "northern" in this report refer to the Northwest Territories and Yukon except where Northern Quebec and Labrador are specified. To help readers, we have separated the components of the *Arctic Environmental Strategy* in this report, although, in the field, they were often conducted as integral parts of other projects.

The *Strategy* aims to help northerners achieve *sustainable* development—development that meets present needs while helping future generations meet theirs.

The ***Strategy*** has five main objectives

The 1991 *Arctic Environmental Strategy Action Plan* explains how northerners and their partners are to put the *Strategy* into action. The *Action Plan* has five main objectives:

1. ensure the health and well-being of northern ecosystems
2. protect and enhance environmental quality and sustainable use of resources, including their use by Indigenous peoples
3. ensure that Indigenous peoples' perspectives, values and practices are accommodated in the planning, development, conservation and protection of the North
4. improve decision-making by integrating local, regional, national and international interests as part of new legal, constitutional and cooperative arrangements
5. develop international agreements and arrangements to use, conserve and manage resources and protect the circumpolar environment.

The years before the ***Arctic Environmental Strategy***

Environmental regulation began in the North following the passage of the 1970 Department of *Indian* Affairs *and Northern Development Act.* The Department of Indian Affairs and Northern Development began studying contaminants in traditional foods in 1985 in cooperation with other federal departments and the territorial governments. In 1989, this group expanded to include the five Arctic Environmental *Strategy* Aboriginal groups (see below). In 1988-89, in response to the Mackenzie and Yukon River basin studies. the Department of Indian Affairs and Northern Development began an ecosystem-based program to monitor the quality and quantity of water in the North.

A few years later, the Government of Canada introduced the *Green Plan* and a policy of partnering with provincial and territorial governments, and others, to implement environmental programs. As a consequence, the Department of Indian Affairs and Northern Development held consultations with other federal departments, territorial governments and northern Aboriginal groups.

The Arctic ***Environmental Strategy*** begins

As the federal department responsible for more than 90 percent of land in Canada's North, the Department of Indian Affairs and Northern Development led the development of the *Arctic Environmental Strategy* to address the most pressing northern environmental issues. In 1990-91, Cabinet and Treasury Board approved the *Arctic Environmental Strategy*.

Within the Department of Indian Affairs and Northern Development, the *Arctic Environmental Strategy* is managed by the Northern Affairs Program, which carries out the federal government's strategy for northern political and economic development, as well as resource management and environmental protection.

Aboriginal Partners: A Vital Part of the Arctic Environmental Strategy

Aboriginal peoples are a vital part of the success of the *Arctic Environmental Strategy*. The five groups involved became known as the *Arctic Environmental Strategy* Aboriginal partners. They are the Council of Yukon First Nations (formerly the Council for Yukon Indians), the Dene Nation, the Métis Nation–NWT, the Inuit Tapirisat of Canada, and the Inuit Circumpolar Conference. These groups, because they represent the northerners most directly affected by the *Arctic Environmental Strategy*, made a strong bid for early participation in putting the *Strategy* into action, especially the *Action on Contaminants* program.

The Department of Indian Affairs and Northern Development and the Aboriginal partners subsequently developed a work plan with agreements for multi-year funding between the department and each of the five groups. This money gives the groups the resources to hire full-time environmental specialists to work on the environmental agenda of their respective organizations, in addition to promoting *Arctic Environmental Strategy* goals and objectives. These environmental specialists also:

- liaise on local, national and international issues
- participate in environmental reviews of development projects
- help communities apply for Community Resource Management Programs and Environmental Action Programs
- manage clean-ups
- review legislation, such as the *Canadian Environmental Protection Act* and the *Canadian Environmental Assessment Act*
- publish newsletters on *Arctic Environmental Strategy* activities and related matters.

Aboriginal partners applaud the Arctic Environmental Strategy

In March 1995, the five Aboriginal partners evaluated the *Arctic* Environmental Strategy. In their report, they concluded that the Strategy succeeded in part because of the strength of the Aboriginal partnerships. They liked two things about the *Strategy* in particular: (1) some programs removed "red tape" to let communities decide what environmental action to take; and (2) many programs created jobs.

The Aboriginal partners said they are worried about toxic substances in traditional foods. They appreciate information on how to protect themselves from these contaminants. The Aboriginal partners believe work in this area is incomplete. Overall, the Partners are eager for the work to continue.

The *Arctic Environmental Strategy* also provides resources so that Aboriginal partners can launch their own special environmental projects.

In 1993, the five Aboriginal partners and *Arctic Environmental* Strategy Contaminants Program researchers worked together at a Yellowknife workshop to develop the *Guidelines for Responsible Research.* The workshop was led by the Inuit Tapirisat of Canada. Guidelines for Responsible Research provides a protocol and methodology that shows communities how to participate in *Arctic Environmental Strategy* research, from designing projects to communicating results. The Yukon had already agreed to a protocol with the Council of Yukon First Nations.

The **Centre** for Nutrition and the Environment of Indigenous Peoples

The Centre for Nutrition and the Environment of Indigenous Peoples gives northerners the research tools and resources they need to deal with food and water contaminants, and nutritional issues. It was launched in 1992 with money from the *Arctic Environmental Strategy,* and operates at McGill University, MacDonald Campus in Ste-Anne de Bellevue, Quebec. The Centre is managed by a governing board of seven Aboriginal organizations: the five northern groups, the Assembly of First Nations and the Mohawk Council of Kahnawake. The Mohawk Council of Kahnawake hosts the board.

The Centre for Nutrition and the Environment of Indigenous Peoples works in communities, gathering data, training and employing community members and answering health and environmental questions. The Centre also answers questions through its quarterly newsletter. To make sure that research is welcome and that projects are carried out in a way agreeable to the community, the Centre worked with delegates to produce a new research model called the Research Agreement.

Grass-roots participation produces success

Grass-roofs participation in decision. making, *resource allocation* and *clean-ups is vital to program success. So far,* virtually *every* community in *the Northwest* Territories *ond Yukon has* had one *or more projects* under *the* Arctic Environmental Strategy.

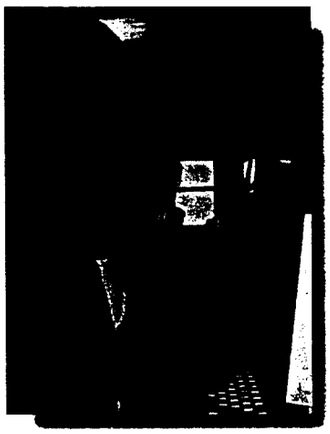
What We Achieved: **A** Summary

The *Arctic Environmental Strategy* began by setting ambitious goals for each of four components: Environment-Economy Integration, Waste, Water and Contaminants. Further research and consultation has led *Strategy* staff to work with territorial governments, other federal departments and Aboriginal partners in planning and decision making.

The *Arctic Environmental Strategy* provides stakeholders—Aboriginal peoples, other northern residents, territorial governments and federal departments—with a forum to consult, cooperate, make joint decisions and take action to protect the environment in the North. These dynamic partnerships bring traditional and scientific knowledge together to tackle long-standing environmental concerns.

Action on Environment-Economy Integration

About 46 communities in the Northwest Territories and 11 in the Yukon designed and ran 360 ***Action on Environment-Economy Integration*** projects. These included recycling, nature trail construction, and environmental education and awareness. These projects produced economic benefits: training, jobs and sustainable business opportunities for local people and firms, as well as income to supplement the traditional hunting that is integral to northern cultures.



Action on Waste

Action on Waste created 250 jobs in the Northwest Territories in 1993 alone. The program also trained many people in ways to clean up hazardous wastes at abandoned mines and other sites. Training in the operation of environmental clean-up tools, such as metal shredders and barrel crushers created jobs and business opportunities.

Action on Water

Action on Water improves the management of water resources by: (I) conducting comprehensive water monitoring; (2) by changing legislation; and (3) by working with communities to identify problems and accomplish solutions. ***Action on Water*** can now answer questions about the health of water ecosystems in the Northwest Territories and Yukon, particularly questions about what water is safe to drink and which fish are safe to eat,

Action on Contaminants

Action on Contaminants helps northerners understand both the need to monitor contaminants, particularly in traditionally harvested food, and ways to control them. The program's scientists gave expert advice that helps northerners make informed decisions about which foods are safe to harvest and eat.

Around the World

Canada and its northern Indigenous peoples have established considerable credibility and influence when seeking circumpolar cooperation. They have done this through the *Arctic Environmental Strategy* and the international *Arctic Environmental Protection Strategy*. The *Arctic Environmental Protection Strategy* is a regional cooperation plan among the eight countries that share the circumpolar ecosystem: Canada, Denmark (Greenland), Finland, Iceland, Norway, Russia, Sweden and the United States. This *Strategy* evolved from a proposal by Finland, and was endorsed by all parties in 1991.

A Model for Doing Business in the North

Everyone has a stake in the *Arctic Environmental Strategy*. And everyone must work together to make the *Strategy* succeed. The Arctic Environmental Strategy Partners Committee gets this cooperation going by giving key stakeholders a forum in which to discuss policy and to develop strategies.

"The Arctic Environmental Strategy ***was the first program to recognize that First Nations had an important role in protecting the environment for future generations."***

First Nations *Leader*

Source: Assessment of the Partnership between the Department of Indian Affairs and Northern Development and Five National Northern Aboriginal Organizations in implementing the *Arctic Environmental Strategy*. March 1995.

partnerships are essential to success

Committees for each of the four *Arctic Environmental Strategy* components are made up of members of stakeholder groups. These committees support the *Strategy* by setting priorities, evaluating project proposals and deciding where money should be spent. Because communities take a direct role in planning projects and proposing new ones, communities are motivated to commit money, workers and other resources to *Arctic Environmental Strategy* programs. Community involvement in *Strategy* projects is one reason for the *Strategy's* success. Another reason is the partnerships that northerners made with other agencies, such as territorial governments, Fisheries and Oceans Canada, Environment Canada, Health Canada and universities.

Arctic Environmental Strategy partnerships benefit from the traditional knowledge and experience of northerners, and the expertise of environmental scientists and technicians.

Response to the ***Arctic Environmental Strategy*** way of doing business in the North is best summed up by the observation to the left.

Explanation of Contaminant Icons used in this report

A contaminant is a substance that is found in a place where it should not be. This does not necessarily mean that it is harmful, but depending on what it is and the amount that is present, it may be. The contaminants of priority concern for this *program are organochlorines,* metals, radioactivity and *radionuclides.*

Contaminant particles are often so small that you cannot see them or even smell them. Because it is hard to visualize *something that you can't see or even smell, we use icons to represent the priority groups of contaminants.*

Organochlorines

Organochlorines are manufactured chemicals; they do not occur naturally. Often they are pesticides or products from industrial processes, old electrical components or they are released from burning garbage. Some examples of organochlorines are DDT, PCBs and toxaphene.

Metals

Metals are elements that occur naturally in rock or soils. Some metals are essential for life processes and cannot fall below critical levels without harm to plants or animals, but metals can also produce harmful effects at excessive concentrations. There are also some non-essential metals such as mercury, cadmium and lead, which are called *"heavy metals," that* are toxic to most living things, *even at* relatively low *concentrations.*

Action on Environment-Economy Integration

What We Set Out to Do

A healthy economy needs a healthy environment, You can't have one without the other if you want sustainable development. Integrating the economy with the environment is the goal of *Action on Environment-Economy Integration.* This goal, explained in the 1991 *Arctic Environmental Strategy Action Plan,* is two-fold:

- promote economic opportunities for Northern communities by developing and using traditional values, knowledge and resources
- make better decisions by using scientific and traditional knowledge.

Because everyone has a stake in the *Arctic Environmental Strategy,* Aboriginal partners, territorial governments, other federal government departments, non-government organizations, businesses and communities formed partnerships to achieve this objective. *Action on Environment-Economy Integration* has three elements:

1. Community Resource Management Program
2. Environmental Action Program
3. Northern Information Network.

What We Accomplished

Even though it had the smallest portion of the *Arctic Environmental Strategy* budget, *Action on Environment t-Economy Integration* ran projects in 90 percent of the Northwest Territories and Yukon communities—greater penetration than any other component of the *Strategy*. *Action on Environment-Economy Integration* projects were highly visible and widely accepted by northerners.

The greatest success of *Action on Environment-Economy Integration* was the new way it did business in the North. This model involved as many people from the community as possible. That was also the reason for its success.

Action on Environment-Economy Integration obtained maximum community participation by:

- reducing the amount of paperwork that communities had to do to get funding
- reducing the amount of reporting that communities had to do
- making decisions by consensus
- providing advice only when needed
- getting communities to plan and conduct their own projects.

The results of this new model speak for themselves. Ninety percent of Environmental Action Program and ninety percent of Community Resource Management Program projects met the goals that their communities set. That is a healthy success rate. These projects encouraged people in the communities to get personally involved in practical ways. Those who helped were not just people with special skills. They came from every part of the community.

Some of their successes will last for decades. Recycling programs, for example, were started in 80 percent of northern communities. The Environmental Action Program funded the development of school programs that teach traditional ways of understanding and managing land and resources. Because so many children took part in projects, future generations will have better attitudes about sustainable development. Elders saw that their communities had gone through a major shift in attitude and were participating more than ever before to improve their environment.

Environmental Action Program and Community Resource Management Program projects prepared Aboriginal partners and northern communities for the resource management responsibilities that come with land claim settlements. The projects also created jobs, training and other economic benefits in the communities, all of which gave northerners a sense of community participation and ownership of their common future.

"Every environment committee in our communities is a direct result of CRMP [Community Resource Management Program]. "

Aboriginal partners' representative

Source: Assessment of the Partnership between the Department of Indian Affairs and Northern Development and Five National Northern Aboriginal Organizations in implementing the *Arctic Environmental Strategy*, March 1995.

Community Resource Management Program: Learning to Manage Our Land

Northern communities want to protect their resources for the benefit of themselves and future generations. Community Resource Management Program projects address community issues and interests, are developed and implemented by communities, and depend on community participation for their success. Sustainable development depends on such factors. Also, by doing much of the work themselves, Communities:

- show that they believe projects are relevant
- demonstrate that they are getting better at taking on such projects
- prove that a project is the right size for their community.

The first study funded by the Community Resource Management Program took place in 1992, and addressed the Clyde River community's concerns about the local population of East Arctic bowhead whales. Community Resource Management Program projects since then have ranged from improving Arctic char habitat to managing polar bear populations to planning forest use and conservation. By 1995, about 55 resource management projects were either underway or completed across the North. Ninety-five percent of 1993-94 Community Resource Management Program funding went directly to projects rather than to government program administration.

Helping the salmon

Before adding to salmon stocks in the Stewart-Mayo River system, the Stewart Valley Salmon for the Future Society surveyed salmon, salmon fry, other fish species and predatory bird populations to determine how many extra chinook salmon the river system could handle. Community volunteers ran the Society. The program created summer jobs for members of Nacho Nyak Dun First Nations and local junior high school students who conducted the surveys.

Yukon

Yukon communities have completed 12 projects under the Community Resource Management Program. At least four are underway. All are either resource management planning or wildlife monitoring and enhancement, and most were initiated by Aboriginal peoples.

To manage fire-killed timber and forest resources, the Selkirk First Nation started an Environmental Protection and Resource Management Plan. The plan included consulting with the community, training research assistants and field crews, documenting historical and current uses, identifying land use categories and developing an interim plan.

Northwest Territories

In the Northwest Territories, 45 out of 62 communities have participated in more than 40 Community Resource Management Program projects. Thirteen of these projects maintain community-based committees that are doing resource management work. For example, the Deninu Ku First Nation Little Buffalo River training project gave a band member hands-on training in fisheries management. Other projects include the Beluga Traditional Knowledge Study, Great Slave Lake Fisheries Management Plan, and Radelih Koe Community Resource Management Project.

Environmental Action Program: Helping Northerners Help Themselves

The Environmental Action Program provides money and help to northerners. Communities design Environmental Action Program projects themselves to improve the environment and to increase awareness of environmental responsibilities. Environmental Action Program projects usually involve many community members and are run by volunteers. These projects educate the community about the environment, provide creative and innovative solutions, and generate economic spin-offs.

***"...the program is pushed by** people,*

not by paper."

***North west Territories Environmental Action Program** participant*

Source: Assessment of the Partnership between the Department of Indian Affaira and Northern Development and Five National Northern Aboriginal Organizations in implementing the ***Arctic Environmental Strategy.*** March 1995.

Studying the whales

As the next step in the bowhead study that launched the Community Resource Management Program, the Clyde River community is taking the lead in developing the Iqalirtuuq National Wildlife Area, on important breeding and feeding ground for Baffin Bay–Davis Strait bowhead whales. The area is expected to be officially established by the end of 1996. It has also been proposed as an international biosphere reserve.

A guide for the future

The ***Whitehorse*** Hikes and Bikes Trails ***Guide,*** published in 1995 by the Yukon Conservation Society, received port of its research funding from the Environmental **Action** Program. The 145-page guide describes more than 35 hikes, along with articles on flora and fauna, wilderness ethics and safety, geology and aboriginal place names. The ***Guide*** makes a substantial contribution to environmental education and to tourist appreciation of the Whitehorse area.

Environmental education is the most important component of the Environmental Action Program, comprising nearly 45 percent of projects in the Yukon and the Northwest Territories. One index of its importance-and its success—is seen in the *50* out of 75 Northwest Territories schools that took part. The Environmental Action Program's legacy will be the way it helped communities understand their environment and ways to take action to preserve it.

Yukon

Every First Nations band in the Yukon has run at least one Environmental Action Program project. In one of these projects, grade four students throughout the Yukon discovered environmentally sound farming methods through an Environmental Action Program project sponsored by the Yukon Agricultural Association. Through in-class demonstrations, a video and farm visits, the children learned how farmers protect soil and prevent erosion, and compost instead of using chemical fertilizers.

Another project involved the Carcross caribou herd range. Twenty-seven elders explained their knowledge of land use and settlement, wildlife populations, and their concerns about past and present ways of managing wildlife. Those who listened learned about wildlife distribution and how land is used. A clearer description of wildlife movement needs to be collected over time. Among the elders' concerns were:

- outfitting practices
- rural development
- mining and mine site garbage
- unregulated all-terrain vehicles and snowmobiles
- air pollution
- community meat wastage
- ways to prevent tires
- wolf control
- over-fishing
- caribou counting.

Northwest Territories

In the Northwest Territories, 46 communities have managed over 300 Environmental Action Program pro jects, ranging from awareness campaigns and recycling to nature trails and workshops. Community members brought money and people together to develop ideas into project proposals and then make them work. Communities are motivated because they know that protecting their land and resources safeguards their future.

The Environmental Action Program Committee, which helped applicants at every stage of their projects, draws its membership from a broad range of organizations:

- Dene Nation
- Department of Economic Development and Tourism (Government of Northwest Territories)
- Department of Education (Government of Northwest Territories)
- Department of Indian Affairs and Northern Development
- Department of Renewable Resources (Government of Northwest Territories)
- Ecology North
- Environment Canada
- Inuit Tapirisat of Canada
- Métis Nation–NWT
- Yellowknife Chamber of Commerce.

Several Northwest Territories schools received Environmental Action Program funding for worm comporting: a natural way to recycle organic household waste such as fruit and vegetable peels into rich compost for house plants and gardens. The Yellowknife Playschool Association, Mildred Hall Elementary in Yellowknife, Ilihakvik School in Cambridge Bay and Ataguttaaluk School in Igloolik are using the worm kits to teach children science and environmental awareness.

Residents of Fort Liard used the Environmental Action Program to set up a recycling depot. In its first year of operation, the depot diverted thousands of beer, pop and food cans from landfill. Surrounding communities flew their cans to Fort Liard via Deh Cho Air Limited.

Northern Information Network: Getting the Word Out

The Northern Information Network, managed by the Resource Planning and Conservation Division of the Department of Indian Affairs and Northern Development in Hull, Quebec, is helping northerners access the information they need to manage their own resources. The Northern Information Network is an on-line service that consists of a directory and a bulletin board. The directory lists Canadian and international geographic databases that contain information on the North (the directory

Reading, writing and red wrigglers

The awareness and **action** are impressive at **Joamie** School, **Iqaluit. Joamie** is the first Canadian school to complete 1,000 environmental **projects,** many af them funded by the Arctic ***Environmental Strategy.*** Students recycled, conserved energy and water, created an environmental resource library and ran on environmental adventure camp. One class even adopted a piece af land and o pond as a biosphere **to** care for and study. **Joamie** is inspiring lifestyle changes that will help future generations.

Information for all

The Northern Information Network gives northerners computer access **to** the information they need to make decisions and manage resources. As part of ***Action on Environment-Economy*** Integration, the Northern Information Network directory **contains** 475 descriptions of computerized maps owned by universities, businesses, governments and **non-governmental organizations.** You can access the Northern Information Network with yaur computer and modem as follows:

. national bulletin board: 1-800-567-6935
. Ottawa-Hull service: (819) 994-2557
• on-line **directory:** (819) 997-0804

"gee-references" databases by latitude and longitude). The bulletin board encourages northerners to share economic, environmental and traditional information that is critical to planning and decision-making. Researchers, communities, governments and others are using the directory and bulletin board.

By integrating scientific and traditional knowledge, and by making this information available to all northerners who need it, the Northern Information Network is reducing the number of times that separate groups waste time and money collecting the same data. The challenge for the next several years is to increase the number and type of community groups that use the Northern Information Network.

In Conclusion

Through its three programs—the Community Resource Management Program, the Environmental Action Program and the Northern Information Network—Action *on Environment-Economy Integration* has shown a new way of doing business in the North. Less red tape, greater use of partnerships, and a determination that northern communities develop and run their own projects, have pushed bureaucratic processes to the background.

Environmental show and tell for everyone

Students and teachers of **Qitiqliq School** in the **Arviat** community hosted an environmental conference in April 1994. Forty participants learned about "Setting up recycling in your community," "Energy management in the North," as well as compacting, conservation and related **environmental** issues. **Community** support was high, with many private **sponsors.**

Action on Waste

Learning from the Past, Working for the Future

Before land use was regulated, people working in the North dumped waste with little concern for the environment. Mines and military bases were the main sources of these wastes. Today, northerners want the environment-especially the land and water around their communities-cleaned up. They are particularly concerned about contaminants in traditional foods and water supplies, and physical hazards, such as abandoned mine shafts, that endanger health.

What We Set Out to Do

The *Action on Waste* component of the 1991 *Arctic Environmental Strategy* Action *Plan* aimed to eliminate unsafe, hazardous and unsightly waste by:

- cleaning up all known hazardous wastes
- identifying, assessing and remedying suspected hazardous sites
- cleaning up 21 abandoned Distant Early Warning Line sites
- cleaning up wastes near communities
- supporting local waste management strategies.

Northerners did a great deal to achieve these objectives. They ran major clean-ups near their communities, completed environmental assessments and cleaned up hazardous materials at several abandoned mines and military sites.

The Action on Waste Approach

Northerners have appreciated—and continue to appreciate—waste clean-ups at their communities. Increasingly, *Action on Waste* programs have concentrated on cleaning up or managing hazardous sites to remove risks to human health and the environment. The *Action on Waste* program is also helping the Department of Indian Affairs and Northern Development meet its legal obligations under land claims settlement acts, the *Fisheries Act,* the *Canadian Environmental Protection Act* and other legislation.

Clean-up begins with identifying waste sites. Workers determine if wastes are: (I) harmless; (z) hazardous and needing action; or (3) potentially hazardous and needing assessment. How soon a site is cleaned up depends on its level of environmental risk and the risk-management controls in place.

A snapshot of waste sites, as of July 1995

- 477 out of 1,246 sites in the Yukon and Northwest Territories—including 200 hazardous sites—have been cleaned up
- 481 sites are non-hazardous and do not need further work
- 77% of inventoried waste sites pose no significant health risk
- 215 sites need further assessment
- 73 sites need remedying because of physical or chemical hazards.

Cleaning up our own backyard

Ninety percent of waste clean-ups under the *Arctic Environmental Strategy were* done by local **contractors** and **community labour.** ***Action on Waste*** has generated economic and environmental benefits in the Yukon and the Northwest Territories. Through extensive training and employment, the **program** has helped communities became financially viable. **Northerners** are now more skilled at running **programs,** running businesses, and operating equipment **to** handle, reduce and eliminate waste.

The Department of Indian Affairs and Northern Development follows the principle of "polluter pays." The Department holds industry and government departments accountable whenever their responsibility for site or waste abandonment is clear.

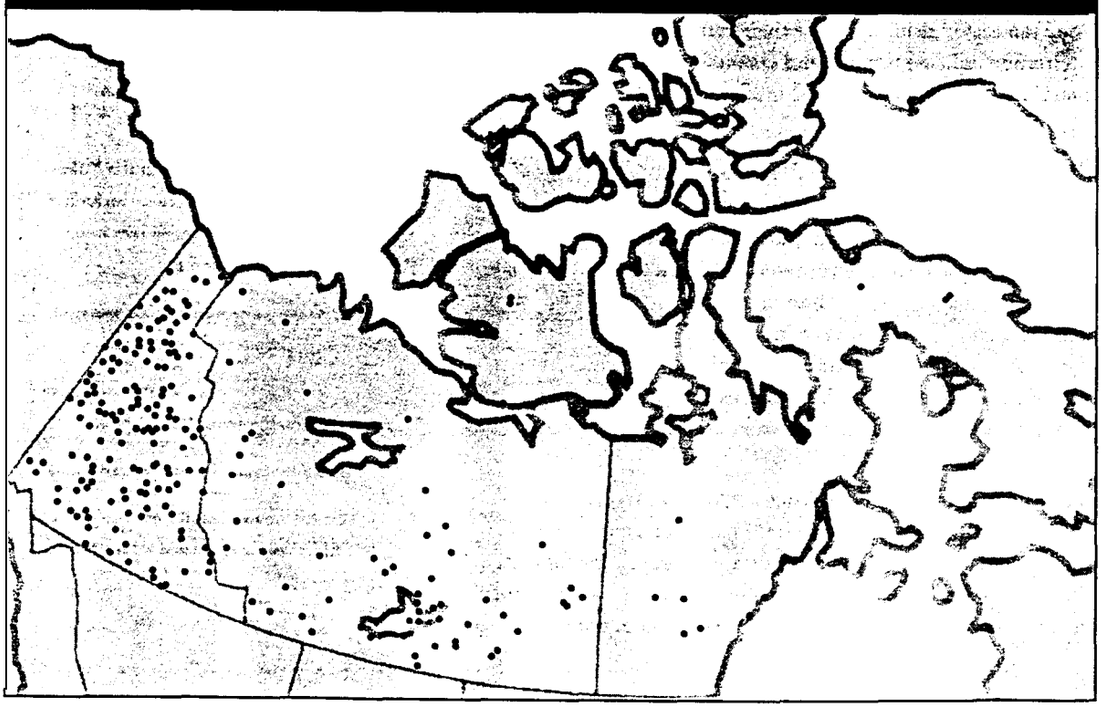
Action on Waste and Human Health

Action on Waste was created partly to address the threat that waste poses to the health and safety of northerners. Through site inventories and assessments, *Action on Waste* identifies physical and chemical hazards at waste sites. Physical hazards include abandoned buildings, and abandoned mines. Chemical hazards include those that contaminate water supplies and food chains.

Action on Waste reduces these risks to human health in a number of ways. Physical hazards, for example, have been reduced by sealing mines and building entrances, and by dismantling buildings and other structures, such as communication towers. Chemical hazards have been mitigated by removing or containing contaminants, and by changing drainage courses.

Action on Waste is integrated with other Arctic *Environmental Strategy* components. Some projects that started in this program developed into studies by *Action on Water* or *Action on Contaminants* (Rankin Inlet and Lake Laberge, for example).

Waste Sites cleaned-up by *Action on Waste*



What We Accomplished

Before the *Arctic Environmental Strategy*, there was no inventory or description of waste sites on Crown lands in the North. Thanks to the work of partners in the *Arctic Environmental Strategy*, four critical elements are in place:

1. a regularly updated inventory of waste sites
2. a process to evaluate sites for: (1) level of risk to health and safety; (2) legal obligations; and (3) ability to manage these risks and obligations
3. capable management to run site clean-ups
4. a protocol for cleaning up military and other waste sites.

Cleaning up Great Slave Lake
The Métis Nation of the Northwest Territories has been running a successful program to clean up Great Slave Lake. For three summers, Métis Nation, with funding from the Arctic Environmental Strategy and Public Works and Government Services Canada, hired more than 60 students each year to do the clean-up. The students removed about 958 cubic metres of debris, garbage and drums from the shores and islands of the Yeke-that's almost 564 cubic feet per student. Among the sites cleaned up were Outpost Island, De Staffan Mine and Cooper Pass.

Case Studies

Northern cooperation and innovation made national news

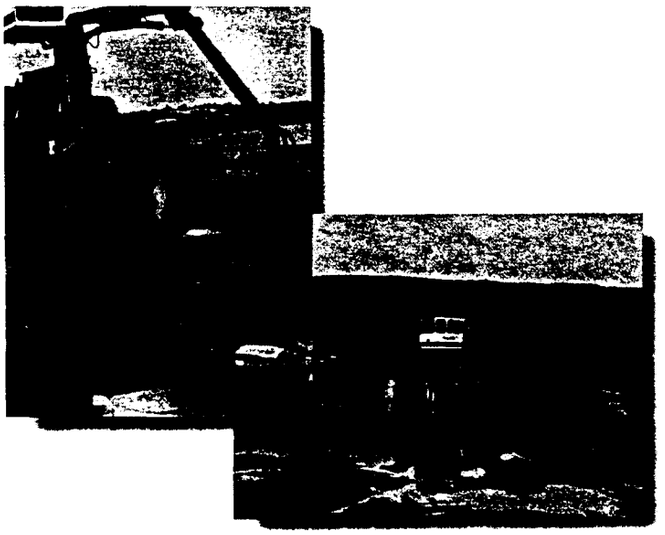
The Rankin inlet clean-up was too large for any nearby company, so *Action on Waste* encouraged a consortium of local companies to handle the project. The territorial government helped by managing the clean-up, and Environment Canada assisted through the National Contaminated Sites Remediation Program. The clean-up involved removing tailings (waste materials from the mineral recovery process) and pond wastes from the abandoned Rankin Inlet nickel mine. The project needed a year of field and laboratory experiments to discover how to remove the nickel. This research produced an innovative clean-up technology "made in Canada."

Yukon community reclaims sacred site

Members of the Champagne/Aishihik First Nations demolished an aircraft control and maintenance building and returned the once-sacred site to the community. Workers removed asbestos and building debris from the site. The *Arctic Environmental Strategy* taught local people how to handle the hazardous materials, and paid their wages to do the clean-up.

Give us the tools, we will finish the job

An Aboriginal company, the Deton 'cho Band Corporation, trained 10 people under an *Action on Waste* initiative to clean up the abandoned Beaulieu Yellowknife Mine and the Sunset Lake Mine. The Corporation can now provide services to the private sector.



Squeezing the profit out af abandoned drums
Used in the North for more than two years, barrel crushers reduce abandoned drums to one-eighth their original size. This reduces the volume of local landfills, and produces salvageable metals.

The Distant Early Warning Line and Military Sites

The North has 42 abandoned Distant Early Warning Line sites. The Department of Indian Affairs and Northern Development is responsible for 21 of these sites, plus several other abandoned military sites. The Department has completed environmental assessments for all of these sites.

Horton River

The Department of Indian Affairs and Northern Development cleaned up the first of the abandoned Distant Early Warning Line sites at Horton River, Northwest Territories, in 1994. The federal government abandoned the site 30 years ago. Wastes included more than 800 barrels of oil, diesel fuel, gasoline and grease. Some were leaking onto the tundra. Through *Action on Waste*, workers removed these barrels along with a gravel conveyor, a warehouse, assorted garbage and the contents of two 20,000-gallon fuel tanks. Also removed were polychlorinated biphenyls (PCB)-contaminated materials, including soils, which were packaged in barrels and moved off-site to Swan Hills, Alberta for disposal. The clean-up created jobs for more than 40 people from Tuktoyaktuk in the Inuvialuit Settlement Region. Everyone considered the Horton River site clean-up a success.

Iqaluit clean-up shows how to work together

In 1995, the Department of Indian Affairs and Northern Development conducted major clean-ups of abandoned military installations at Iqaluit and Pearce Point in the Northwest Territories, and at Snag and Aishihik air bases in the Yukon. A major undertaking, the Iqaluit clean-up saw scientists and engineers working with a committee from Nunavut Tungavik Incorporated, the Baffin Regional Inuit Association, the Department of Indian Affairs and Northern Development, and the municipality of Iqaluit. This clean-up shows how interested parties can work together to improve their shared environment.

The project started by training 50 people—48 of them Inuit—to handle asbestos and PCBs, and operate waste fuel incinerators, shredders and heavy equipment. After training, the workers placed PCB-contaminated soils and materials into containers for disposal. They placed non-hazardous contaminated soils, asbestos and debris from dismantled buildings into a special landfill on-site. The workers also did tests to determine what was in abandoned barrels, and then either incinerated the contents on site, or shipped them to a registered disposal facility. The barrels were shredded for disposal.

In Conclusion

Cleaning up waste sites in the North remains a priority for the Department of Indian Affairs and Northern Development. Through *Action on Waste,* the Department now has an inventory of waste sites that will help the Department set priorities for clean-ups. The Department has improved tools for dealing with contaminants in the North, thanks to new technologies that have resulted from *Arctic Environmental Strategy* research. The Department has also developed successful awareness programs and action plans that get northern communities involved in their own clean-ups. Remaining waste sites will be cleaned up over the next 10 years, based on availability of funds, with the high risk sites being the priority. The Department is exploring funding options.

***Arctic Environmental Strategy* High Priority Waste Sites**

Action on Water

Protecting the Key to Life

People who live in the North are concerned that natural resource development, municipal sewage systems and other activities are contaminating their rivers and lakes, and thus contaminating the water they drink and the fish they eat. Measuring these contaminants in water and fish enables resource managers to assess impacts on human health. The findings may be used in the regulatory process.

Before the *Arctic Environmental Strategy* began, monitoring of water quality in the North was not sufficient to help resource managers make informed decisions. Those who negotiated interjurisdictional water agreements also went without vital data on the quality of water, as did environmental impact assessments. Today, accurate information on how upstream industrial development affects water quality is essential to communities, governments and industry.

What We Set Out to Do

The Action *on* ***Water*** component of the *Arctic Environmental Strategy Action plan [1991)* aimed to:

- establish a comprehensive water monitoring network
- determine water quality
- improve knowledge of water flows
- measure changes in northern waters
- improve laboratory services in the North.

Action on Water has done many studies to discover the type and concentration of contaminants that exist in northern waters. *Action on Water* monitors both the quality and the quantity of water. Working with stakeholders, water quality monitoring stations assess background conditions, impact of local development, and condition of streams at interjurisdictional boundaries.

Action on Water and human health

Action on Water deals with issues of human health, such as the safety of drinking water and whether freshwater fish are safe to eat. The program is successful because it responds quickly to community concerns on these issues. The next section discusses tainted drinking water, contaminated fish and other human health issues.

What We Accomplished

Water quality networks have expanded under the *Arctic Environmental Strategy* in both territories. Stations in the Northwest Territories more than tripled in size, going from 19 stations to *69* in only a few years. Ten of these stations are operated by samplers from the community. The Yukon has 20 stations, six of them new. In addition, the Northwest Territories has five stations that measure contaminants in snow; the Yukon has 10. These added stations mean that northerners know far more about the health of their water than they did before the *Arctic Environmental Strategy* began.

Other accomplishments are the Water Quality Agreements made between Environment Canada and the territorial governments. These agreements help partners share work and account for costs.

The Yukon

People in the Yukon are concerned about treating sewage from communities. This is because the Yukon's high latitude makes sewage treatment difficult. Extreme cold, fewer daylight hours and ice conditions reduce the biological action that breaks down sewage in treatment plants.

Tackling the *Giardia* parasite

Of particular concern among Yukon communities was *Giardia* in their water. *Giardia* is an intestinal protozoan parasite found in the excrement of humans and most warm-blooded animals. It causes mild to severe intestinal irritation. Northerners wanted to know what the main source of *Giardia* was—humans or animals—and if sewage treatment plants were removing *Giardia*.

The difficulty of determining the source of *Giardia* led the Department of Indian Affairs and Northern Development, in partnership with Health Canada, to develop a genetic probe. After analyzing 614 water samples, the team learned that human excrement is the main source. As a result of this work, the Yukon Conservation Society published a *Giardia Fact Sheet* on sources, symptoms and protection from the parasite.

Action on Water examined sewage treatment systems in several Yukon communities to see if *Giardia* and faecal coliform were being removed. The inspections showed that Dawson City, Carmacks and Whitehorse need to change their treatment processes to remove *Giardia* and get cleaner effluent. Modifications are underway.

Northwest Territories and Yukon get improved water laboratories

The Northwest Territories Water laboratory in **Yellowknife** is integral to Action on Water. Arctic ***Environmental Strategy*** funds helped the laboratory increase the kind and amount of analysis it does. The laboratory bought equipment to conduct a wider range of tests, including examining fish and wildlife tissue far heavy metals. The **laboratory** is **accredited** by the Canadian Association of Environmental Assessment laboratories. The quality of its analyses matches that of the best laboratories in southern Canada.

The Arctic ***Environmental Strategy*** called far the establishment of a Yukon water laboratory to analyze the greatly increased number of water quality samples. Once the Strategy was underway, Yukon water managers held extensive consultations with interested parties. The result was a decision to build a small field lab for basic tasks, and to continue buying most analytical services fram other laboratories.

Communities learn to sample their own water

Northerners work together when planning and conducting water sampling. The Northwest Territories and Yukon have each trained 11 lay people to sample water quality. The goals of the lay sampling program include increased community involvement and awareness of water quality issues, and more efficient program delivery by sewing money on logistics and transportation.

Cleaning up tailings at Venus Mine

Action on Water and Action on Waste cooperated to seal and cap arsenic-laden tailings at the disbanded Venus Mine on Windy Arm of Tagish lake, Yukon, Wind-blown tailings were contaminating nearby vegetation, and storms were washing tailings into the /eke. Action on Water monitored and assessed the quality of the lake water. Action on Waste, in conjunction with Carcross-Tagish First Nation and Public Works and Government Services Canada, built a wall to contain the tailings, This teamwork made the mine a safe site, and prevented the tailings from contaminating the local area.

Water is more than just H_2O

The Department of Indian Affairs and Northern Development and Environment Canada completed a Yukon baseflow chemistry study to define the natural chemistry of groundwater at about 100 sites. The study confirmed that bedrock geology produces most differences in water chemistry. Specialists will use this finding to predict when and how mining, construction and other development work will harm the quality of nearby water.

Water Quality in the Northwest Territories

In the Northwest Territories, *Action on Water* went beyond sampling water. Instead, it took an ecosystem approach to measure contaminant levels in water, sediment, fish and lake-bottom flora and fauna to establish risks in these different ecosystem components. *Action on Water* used this approach to determine the health of the Slave and Laird river basins ecosystems, which have tributaries in industrialized areas of Alberta and British Columbia.

Beyond water sampling

Expanded with money from the Arctic Environmental *Strategy*, the Slave River Environmental Quality Monitoring Program tested fish, water, sediment and benthic (or bottom-dwelling) organisms at Fort Smith to see if they were contaminated from pulp mills, tar sands, upstream developments and long-range airborne pollutants. Preliminary results of this cooperative study between territorial and federal agencies determined that water, sediment and fish are clean compared with similar rivers in the South. However, researchers did find toxaphene in the livers of burbot, a freshwater fish of the cod family. This contaminant may have entered water systems from the atmosphere. In 1991, Health Canada recommended that locals eat no more than one Slave River burbot liver each per week,

The results of the Slave River Environmental Quality Monitoring study form a baseline data set that will be used in future comparisons. It will also help negotiators from Alberta and the Northwest Territories to conclude bilateral water negotiations,

A similar study on the Liard River between 1992 and 1995 examined contaminant levels in fish, water, sediment and benthic organisms. The health assessment for 1992-93 indicated that concentrations of organochlorines, PCBs and polycyclic aromatic hydrocarbons in Liard River fish were low enough to make the fish safe to eat.

Trout Lake

Action on Water ran many smaller water studies to address specific concerns. Residents of Trout Lake, Northwest Territories, for example, reported skin rashes and increased numbers of dead fish floating in their lake. With the help of the Trout Lake Band Council, scientists analyzed fish and water from the lake. Tests revealed that the fish deaths were related to a natural phenomena that had affected several lakes in the area. Further tests revealed that the lake water contained bacteria that is found in human sewage. This bacteria came from a nearby waste disposal site. The Government of the Northwest Territories has since built a replacement waste disposal site. Treated properly, the drinking water from Trout Lake is safe to drink.

Studying Great Slave Lake

Yellowknives Dene Bands, the Government of Northwest Territories Health Department, the Department of Indian Affairs and Northern Development and Fisheries and Oceans Canada sampled fish, water and sediment from Great Slave Lake's Yellowknife Bay and Back Bay. They were responding to the Dettah and Ndilo communities, who were worried about drinking water and eating fish from the lake. Researchers set up 13 water and sediment sampling sites and six fish sampling sites. The results showed that the water is safe for drinking and swimming. Health Canada is conducting a health assessment on the fish data; results are pending.

Fort Resolution

A Fort Resolution Fish Monitoring Program examined fish to see if they were contaminated by wastes from the closed Pine Point Mine. Locals helped design the study, collect fish for sampling and present the results to the community. After examining the data, the Mackenzie Regional Health Board concluded that the fish were safe to eat.

Consultations with northerners led to a review of mercury in the area of Great Bear Lake. During community meetings, locals in Fort Good Hope expressed their concerns about mercury levels in Lac à Jacques, a fishing lake near the community. Fish from this lake contain more mercury than is normally found in fish from other lakes, just as fish do in other small lakes in the area. Health assessments are underway.

The Northwest Territories' Native Women's Association expressed concern about the health effects of uranium tailings at the Port Radium mine. In response, *Action on Water*, during 1993-94, monitored surface water and fish for trace metals and radionuclide contaminants. This monitoring was done at new sites and at sites monitored in 1985. Health Canada concluded that fish and water at Port Radium contained the same levels of radionuclide and trace metals that are found in fish and water elsewhere in Canada.

Cooperating at Wolf Creek

The Wolf Creek Basin *Project* is *an excellent* example *of how a partnership led by the Deportment of* Indian *Affairs and* Northern Development *reduced costs and improved understanding of the* hydrologic eyele. Partners *included* Action on Water, Action on Waste, and scientists *from Université de* Quebec, McMaster University, University *of Saskatchewan, York* University, *University of* British Columbia, Simon *Fraser University,* University of Western Ontario, Yukon College, Agriculture Canada and Environment Canada. The partners study and describe /he hydrologic *and water quality characteristics of a Yukon subarctic mountain* stream. The *Wolf Creek* Basin Project is *now part of the international Global Energy and Water Cycle Experiment.* Scientists *will use the* information *collected from* this work *to* predict what hydrologic conditions *are* like in other river *basins.*

Keeping hazardous tailings where they belong

Mine tailings contain contaminants—such as arsenic and heavy metals—that must be contained to protect the health of humans, animals and vegetation. To find the best way to contain these contaminants, Action on Water ran evaporation studies at four abandoned mines in the Northwest Territories. At each site, researchers installed weather stations to record solar radiation, air temperature, humidity, wind speed and other meteorological data. This information helped the researchers learn how fast water evaporates from tailings ponds, and helped them evaluate water balance calculations for mining proposals. The study will help others to manage tailings ponds after mines close. As a result of this work, several mining companies are using similar instrumentation and methods.

How Much is Enough? The Importance of Freshwater Quantity

Decision makers need reliable data on how much water exists around northern communities. This data helps them to:

- estimate the amount of contamination in bodies of water
- forecast and monitor floods
- estimate water availability for industrial use
- generate hydroelectric power
- design and build culverts and bridges to the right size
- forecast water levels for river barge traffic
- negotiate interjurisdictional water agreements.

What We Accomplished

Before the *Arctic Environmental Strategy,* the Department of Indian Affairs and Northern Development and Environment Canada operated an incomplete network of stations that monitored water quantity in the North. Through the *Arctic Environmental* Strategy, extra stations have been added in both territories. Many stations have been upgraded with satellite and electronic data-collection equipment. The *Arctic Environmental Strategy* funds 17 stations in the Northwest Territories and 23 stations in the Yukon,

Protecting ourselves against flooding

Many Northern communities, such as Old Crow, Dawson City, Mayo, Ross River, Hay River and Aklavik, are built on flood plains and face flooding each spring. In the Yukon, *Action on Water* developed a computer program that combines data on levels of winter snow with weather measurements to forecast spring floods. Water levels and ice-flow patterns at the berm along the Yukon River at Dawson City are important to this program.

In the Northwest Territories, Hay River is threatened every year with ice jams that cause flooding. Severe floods arrive about every 11 years. The last severe flood was in 1985. *Action on Water* compiled information on ice jamming. The Hay River Flood Watch Committee uses this information to warn communities of coming floods.

Freshwater Resources: Keeping Northerners Informed

As part of *Action on Water*, northerners helped produce materials that educate northerners about water in the North. *Action on Water* has produced a video for Yukon residents that explains the risks of using surface water, differences between surface and well water, sources of contamination, and simple ways to make the water safe to drink. In the Northwest Territories, teachers and others helped *Action on Water* produce a seven-unit teachers' resource manual for grades 10 to 12. Teachers can use the resource in an integrated approach to teaching science, technology and society. Subjects include: water properties and uses, regional processes, global connections, conservation, management, and water quality and quantity. Print copies have been distributed, and an electronic version is being placed on the Internet.

Fishers and scientists examine fish together

The Fort Good Hope Fish and Water Quality Study investigated concerns about deteriorating whitefish and burbot in the Mackenzie River, Local people found that burbot livers were discolored and inedible. Also, whitefish flesh was watery, The study combined the traditional ecological knowledge of local fishers with analysis of water, sediment and fish for contaminants. It is on excellent example of community and govern. men! cooperation. Preliminary results indicated slightly elevated metal concentrations in fish tissue. More data are being collected to confirm these findings.

In Conclusion

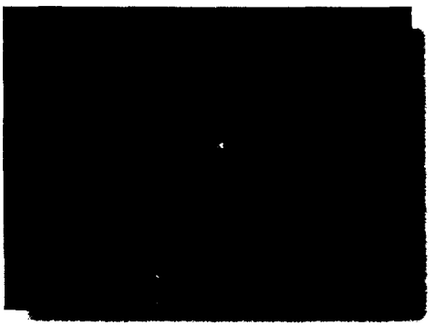
Action on Water programs and studies give communities confidence in their water. After five years, *Action on Water* has achieved its principal goal of developing a comprehensive way to manage water in the Northwest Territories and Yukon. This includes updated water legislation, a comprehensive water monitoring network, area-specific studies, and laboratories to meet the challenges of today and tomorrow.

Town of Old Crow, Yukon devastated by flood, 1991.

Snow pillow stations

Snow pillow stations automatically record levels of snow foil. Knowing how much snow has accumulated over winter helps northerners forecast floods, estimate seasonal run off for water supply, operate hydroelectric plants, plon recreational trips, recognize forest fire hazards, and manage wildlife.

Action on Contaminants



A Problem from Over the Horizon

Northerners are concerned about contaminants in their traditional food and water. These contaminants are invisible and tasteless, and are transported mainly to the North from human activities thousands of kilometres away by a process known as "long-range transboundary air pollution." These contaminants may cause health problems in humans, mammals, birds and fish if they build up over time. Some of the contaminants known as persistent organic pollutants accumulate in animal fat and increase in successively higher levels of the food chain. Because northerners eat some traditional foods that are high in fat—such as seals and whales—they are particularly exposed to these contaminants.

Canadians have been tackling the problem of long-range transported atmospheric contaminants for about 25 years:

- early 1970s—specialists began measuring long-range transported atmospheric contaminants in Canada's North
- 1985—the Department of Indian Affairs and Northern Development responded to northerners' concerns about widespread ecosystem contamination and risks to human health by forming an intergovernmental Technical Committee on Contaminants in Northern Ecosystems and Native Diets
- 1989—the Technical Committee on Contaminants expanded to include the five Aboriginal partners, and developed a five-year research and monitoring framework known as the Northern Contaminant Program's Strategic Action Plan
- 1991—the Northern Contaminants Program became part of the Green Plan and a component of the new *Arctic Environmental Strategy*. The Science Managers Committee on Northern Contaminants (which included the five Aboriginal partners) was struck to oversee the program's policy and funding
- 1992—scientists published a benchmark study on Northern contaminants in *The Science of the Total Environment,* an international research journal
- 1993—the Science Managers and Technical Committees on Northern Contaminants updated the five-year Strategic Action Plan.

What We Set Out-to Do

The *Action on Contaminant ts* component af the 1991 *Arctic Environmental Strategy Action Plan* aimed to "reduce and wherever possible eliminate contaminants in traditionally harvested foods . . . resulting in renewed confidence in [these] as a safe diet. " *Action on Contaminants* research focuses on three types of contaminants that are carried about by water and air (see Table I, Appendix I):

1. persistent organic pollutants, particularly organochlorines, such as PCBs, dichlorodiphenyl trichloroethane (DDT) and toxaphene
2. heavy metals, such as cadmium, mercury and lead
3. radionuclides, such as cesium, strontium and plutonium.

Action on Contaminants projects sample the air, water, snow, ice, sediments, soil, plants and animals of the North to determine:

- sources, pathways and fate of contaminants
- ecosystem uptake and effects
- risks of contaminants to human health.

This strong scientific research base has been supported by communication, education and community priorities, as well as initiatives to promote international action and control of contaminants. In the first five years of the *Arctic Environmental Strategy,* participants conducted more than 100 *Action on Contaminants* projects. The Department of Indian Affairs and Northern Development uses this information to take a leadership role in seeking global cooperation and remedial action. A separate section at the end of this report discusses Canada's international work.

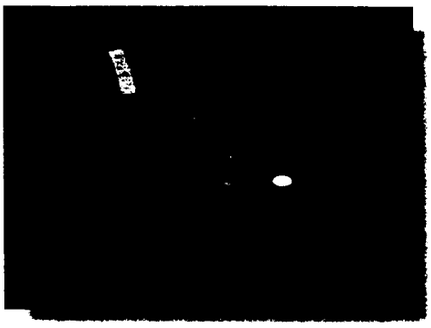
With the joint participation of the Aboriginal partners and the territorial contaminants committees, the program sought community partnership from the beginning. Based on the 1993 *Guidelines for Responsible Research,* northern communities participated formally in research design and data collection. In the Yukon, Aboriginal and community involvement was built in from 1991. Communities are receiving the results from some of these studies in the form of human health risk assessments, newsletters, workshops, fact sheets, videos and other means.

Current Knowledge and Accomplishments

Persistent organic pollutants

While most Western countries have banned or restricted the manufacture and use of some persistent organic pollutants—such as PCBs, toxaphene and DDT—many developing countries have not. Because of their chemical properties, persistent organic pollutants can be carried great distances in the air, and accumulate in animal and human

tissue. This raises concerns because high levels of persistent organic pollutants in fish and wildlife in the Great Lakes region have caused: impaired development in prenatal and juvenile stages, higher incidence of cancers and mutations, disruption of immune and endocrine systems, and reduced resistance to disease.



Heavy metals

The heavy metals-cadmium, mercury and lead—enter the atmosphere from industrial activities that include mining and fossil fuel combustion. Erosion, weathering and volcanic eruptions release heavy metals naturally. At certain levels, heavy metals harm wildlife, birds, fish and humans. Cadmium, for example, accumulates in the tissue and organs of several species, including caribou, and at high levels can cause liver and kidney disorders. Organic forms of mercury, such as methylmercury, can be toxic. Similar to persistent organic pollutants, methylmercury accumulates to toxic levels in animals and humans, near the top of the food chain.

Radioactive cesium

The majority of radioactive cesium in the North came from nuclear and thermonuclear testing that started in 1955 and ended in 1963 with the moratorium on atmospheric weapons testing. Levels of radioactive cesium have fallen since the moratorium. Fallout from the 1986 nuclear reactor accident at Chernobyl, Ukraine, contained radionuclides that settled in the North. Radionuclides from re-processing discharges in Europe have been detected at low concentrations in the Eurasian part of the Arctic Ocean. The local environmental effects of underground nuclear weapons testing are unknown.

Dominant wind currents

Surface ocean currents

Most contaminants fall during the winter

***The* main *carrier of* contaminants *to the North is air currents. During* the winter, *major* air masses move *from south (Eurasia) to* north; these *reverse and become weaker* in *summer. As a result, deposits of contaminants ore* heaviest in *winter.* Rain *and* snow *drop* contaminants *onto oceans, rivers and* land.

Long-range transported atmospheric pollutants

Most contaminants enter the North as long-range transported atmospheric pollutants. Canadians cannot identify what countries these pollutants come from until more accurate and more complete emissions information is available. The comprehensive emissions inventories and registration requirements of North America and Europe help staff of Environment Canada's Atmospheric Environment Services to estimate emissions from North America and Europe better than they can for emissions from Asia. Little is known about emissions from Eastern Europe and the Commonwealth of Independent States (former Soviet Union). More comprehensive knowledge of national and international sources of pollutants will help Canada persuade countries to sign international agreements that reduce or eliminate pollutants at the source.

Measuring atmospheric contaminants

The North gets more snow than any other kind of precipitation, and this snow brings atmospheric contaminants. Snow sampled from land, sea-ice and lake surfaces shows traces of organochlorines, heavy metals and radionuclides. As snow melts, it releases these contaminants into its surroundings, where they can be taken up by fish and wildlife, or transported by ocean and river currents.

Since 1992, researchers have periodically measured persistent organic pollutants in the atmosphere using four high-volume air samplers: one in the Yukon, two in the Northwest Territories and one in Russia.

Scientists have measured heavy metals in the atmosphere at three Canadian Arctic sites during the last 14 years, with the most complete records collected at Alert, Northwest Territories.

Contaminant pathways

persistent organic pollutants, heavy metals and radionuclides are transported to the North from distant sources via the atmosphere, ocean currents, rivers, and migrating birds, fish and marine mammals.

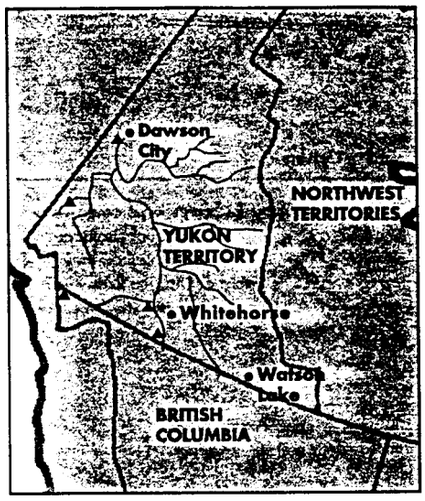
Ocean currents bring smaller amounts of contaminants compared with the atmosphere. Rivers act as pathways for contaminants that originate from the land, including by-products of heavy metal mining. How rivers carry contaminants from place to place is poorly understood. Eight major rivers (seven Russian and one Canadian) drain the 10 million square kilometres of northern Asia, northern Europe and North America into the Arctic Ocean. The Mackenzie River, Canada's major north-flowing river, contributes about 16 percent of all freshwater to the Arctic Ocean, while three of the Russian rivers, the Yenisey, Lena, and Ob contribute about 70 percent. We know little about levels or types of contaminants in Russian rivers.

How the North responds to contaminants

Action on Contaminants scientists measured contaminant levels in Arctic fish and wildlife in order to:

- discover how easy it is for wildlife to come into contact with contaminants
- assess how contaminants harm ecosystems
- assess how the health of northerners is affected by eating wildlife that contains contaminants, especially wildlife that is an important part of their diet.

The way that contaminants behave in northern ecosystems is different from the way they behave in more temperate regions in the South, for several reasons. Northern animals grow more slowly, take longer to reach sexual maturity, have

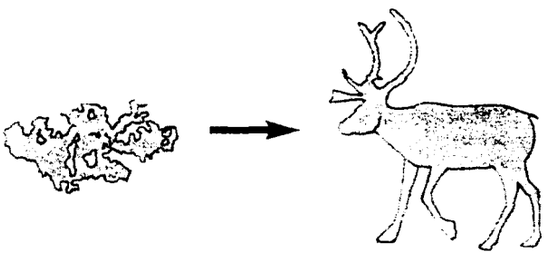


A Snowpack **sampling** sites

Tonnes of trouble

The Yukon's comprehensive program for sampling snow shows that roughly eight tonnes of PCBS settle on the Yukon every year from the atmosphere. Contaminants that fall on the Yukon ore similar to those that fall elsewhere in the North, although levels of contaminants deposited in a given area depend on how much precipitation that area gets.

The Northern Terrestrial (Land) Food Web



lichen Caribou

lower reproductive rates, and live longer. A long life means a long time for contaminants to accumulate in the body. Also, animals in the North have more fat on their bodies, and fat is where persistent organic pollutants accumulate. Northerners, because they eat more fat than people in the South, are more exposed to the contaminants that the fat contains. See Appendix 2 for further information on contaminants in northern wildlife.

Caribou kidneys and cadmium

Concerned about contaminants in the caribou they were eating, the Ross River Dene Council worked with the Yukon Contaminants Committee to test caribou in the Kaska Nation homelands, Action on Contaminants researchers checked livers and kidneys in three wood/and herds, and found high levels of cadmium. Health Canada ran a human health assessment which established a maximum number of livers and kidneys that were safe to eat. The maximum was well above what people actually eat. Cadmium does not accumulate in muscle tissue, only in some organs, so eating the meat of the caribou is safe.

In Conclusion

Scientists cannot tell if contaminant levels are harming ecosystems of the North. The critical, and most complex, challenge is to find out how high levels of contaminants need to get before harmful effects are found, Meanwhile, *Action on Contaminants* staff continue monitoring contaminants to ensure the health of Arctic ecosystems and the safety of northerners who eat traditional foods.

***Working together to keep northerners** informed*

A communication strategy ensures that Action on Contaminants *participants communicate results to northerners.* The *strategy also ensures that northerners' concerns and priorities play a role* in program development and delivery. *The communication strategy aims to:* (1) *give northern ers the information and* resources *they need to* decide about eating traditional *foods;(2) renew confidence in traditional foods as a safe diet; and (3) help preserve traditional lifestyles. Several initiatives are underway.*

The Métis Nation-NWT is developing adult education programs for the Arctic College. as well as instructional materials that are integrated with existing Northwest Territories *school curricula for grades seven, eight and nine. Material for grades* 10 *and 11 is being developed. The Yukon Contaminants Committee has assembled a library collection of information on contaminants, and has produced fact sheets on* cadmium. *toxaphene* and *other contaminants,*

Several groups have run contaminants workshops throughout the Northwest Territories and Yukon. The Department of Health of the *Government of the North west Territories, the Inuit Tapirisat of Canada, Dene Nation, Métis Nation–NWT and the Yukon Contaminants Committee have worked in this area. While some of the workshops were designed as part* of a monitoring program *for human health (e.g. the cord Mood monitoring program run by the Department of Health of the Government of the Northwest Territories], others addressed the broader issues of contaminants in the Arctic ecosystem. All*

workshops responded to community questions and concerns, and encouraged people in the community to be part of setting priorities for the future.

Other ways to spread the word on contaminants are public media presentations. These in elude a video, "Environmental Contaminants in the North, " and a traveling display produced by the Department of Health of the Government of the Northwest Territories that presents information on contaminants and human health. The Métis Nation–NWT and the Department of Indian Affairs and Northern Development in Ottawa produced a public report, "Contaminants in Northern Canada. " The Department of Health of the Government of the North west Territories, Dene Nation and Métis Nation–NWT collaborated to prepare a resource binder that has fact sheets on contaminants, nutrition and traditional foods.

In uit Tapirisat of Canada is using its research report, "Communicating about Contaminants in Country Food, " to develop guidelines and methods for improving communication. This research project assessed past incidents of contaminants in country *food in Aboriginal communities, and examined three Inuit communities to see what information on contaminants they needed. Staff are developing information modules for Inuit communities.*

The Northern Information Net work and the Métis Nation–NWT have worked together to create a number of databases on contaminants projects. A graphics package on contaminant icons and illustrations is available to Arctic Environmental Strategy *partners from the Métis Nation-NWT.*

The Action on Contaminants *communication strategy ensures that northerners have access to the information, tools and resources they need to make decisions about health risks posed by contaminants* in *traditional foods. The strategy also gives northerners access to a wealth of information on the nutritional, cultural and spiritual benefits of a traditional diet.*

A healthy alternative
Studies suggest *that broiling meat or fish, rather than* frying it, *drains off* the fat in which *organochlorines may be* stored.
Photo: A. Sekerak

Human Health Issues

The main aim of the Human Health component of *Action on Contaminants is* to help northerners make informed decisions about eating traditional foods. Thanks to the increasing role of northerners in decision making, this component has improved in many ways. The program has evolved from its original focus, which was the contaminant-related risks of eating traditional foods and the effects of ingesting contaminants. Human Health now includes research on the nutritional and socio-cultural benefits of traditional foods.

What we set out to do

Prerequisites to conducting the human health studies—and key accomplishments in the first few years of the program—were

education and consultations with northerners who would likely be affected by the results. One way this education and consultation took place was by negotiating research agreements that outlined expected benefits, limitations (including what the results of the work would and would not be able to tell us) and obligations of all parties. The partners in the agreements varied with each project and have included researchers, the Government of the Northwest Territories Health Department, Regional Health Boards, the Centre for Nutrition and the Environment of Indigenous People and the individuals volunteering samples. This process involved:

1. comprehensive consultations before, during and after health-related contaminants research
2. agreed-upon ways to communicate results and information
3. participation of representatives in all work,

Health authorities, Aboriginal organizations and community groups worked together to plan, run and report on research projects. Throughout this process, the benefits of traditional foods were emphasized to all involved.

To deliver the human health component, an infrastructure of different kinds of committees was developed. This infrastructure helped *Action on Contaminants* participants consider issues that were both relevant and sensitive to scientific requirements and the desires of communities. In addition to the national-level technical and policy committees described above, *Action on Contaminants* extended the infrastructure into the regions by creating territorial, regional and community Contaminants Committees. Wherever possible, *Action on Contaminants* invited existing committees to participate in this work. These committees worked together to identify issues, design and deliver programs, and develop communication strategies.

An important part of this infrastructure was the creation of the Centre for Nutrition and the Environment of Indigenous Peoples as a complementary way to meet the research needs of communities.

Once this preparatory work was over, teams concentrated on gathering baseline data on exposure to contaminants rather than researching their effects. Researchers assessed the ways that humans are indirectly and directly exposed to contaminants. They assessed indirect exposure by estimating the amount of contaminants that northerners take in through the food they eat. They assessed direct exposure to contaminants by determining the amount of contaminants that accumulate in the human body over time. The researchers used different ways to assess how northern communities are exposed to contaminants. Each method depended on the requests of communities and regions, the recommendations of the regional health agency, and the

input of regional, territorial and federal governments.

Before researchers could start assessing the effects of exposure to contaminants, they had to account for other factors. These included:

- small population sizes
- "con founders," such as smoking and use of alcohol
- the subtle nature of effects associated with long-term exposure to environmental levels of contaminants.

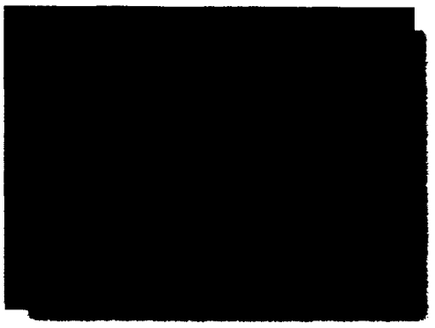
Also, when deciding what methodologies and procedures to use to test for effects, researchers wanted to be sensitive to the cultural values of the communities they were testing.

To estimate the amount of contaminants they were exposed to in their food, First Nations in the Yukon and Western Northwest Territories asked the Centre for Nutrition and the Environment of Indigenous Peoples to survey their communities. These surveys determined the types and amounts of traditional foods that people ate, and calculated the nutritional contribution that traditional foods make to a total diet. Most of the communities from these regions participated in the surveys.

Some communities completed surveys that estimated the amount of contaminants that they were exposed to from traditional and store-bought food. *Action on Contaminants* also collected data on contaminant levels in foods that northerners say they eat frequently.

Action on Contaminants conducted "body burden" studies in Northern Quebec and the Northwest Territories to measure how much people are directly exposed to contaminants. In Northern Quebec, researchers studied contaminant levels in the blood from umbilical cords of newborns, in the blood of men, women and infants, and in human milk. In the Northwest Territories, women and infants from two regions participated in maternal and umbilical cord blood monitoring. By the end of the *Arctic Environmental Strategy*, studies in two other regions in the Northwest Territories will be complete.

At all stages of the studies, *Action on Contaminants* collaborated with regional initiatives to develop protocols. These protocols ensure that the research findings of different groups can be compared, and they help develop a "Canadian Arctic" method of assessing exposure to contaminants.



What we accomplished

In areas where studies were completed, researchers observed elevated levels of organochlorines and metals in northerners who eat traditional foods from the upper level of the food chain. This is particularly true of those who eat seals, whales and other marine mammals. Studies of mothers' milk from Inuit women in Northern Quebec show elevated levels of organochlorines, in some cases 4 to 8 times higher than those of women in southern Quebec. For organochlorines, there seems to be a link between the amount of marine mammal blubber eaten and the amount of contaminants that accumulate in body tissue (the "body burden") of the person who eats the meat. However, as discussed below, the dietary value of marine mammal blubber must be considered before recommending that northerners eat less of these foods. For cadmium, smoking appears to be the most important factor in determining the amount of this contaminant that accumulates in body tissue.

While researchers have yet to run similar studies in all parts of the Arctic, we must assess the exposure of people who have diets like those of people in Northern Quebec (diets high in marine mammals). Maternal and umbilical cord blood monitoring has been completed in Northern Quebec and two regions in the Western Northwest Territories. To date, human milk has only been monitored in Northern Quebec and one community in Eastern Northwest Territories. Results from Northern Quebec confirm that infants, while in the womb, are exposed to the contaminants that have accumulated in their mother's body. After birth, they are exposed to these same contaminants through breast-feeding. In the Northwest Territories, researchers have not drawn any conclusions on cord blood studies because the results have not yet been fully analyzed. The data will, however, permit researchers to create a baseline (or background) for selected organochlorines and metals. This baseline will help them detect trends as they occur in different parts of the North at different times.

At the time of writing, workers with the Human Health component were telling participants about their individual results from work in the Northwest Territories. Once these studies are finished, communities can request information about overall program and regional results. The results will then be made available to the public.

The Human Health component of *Action on Contaminants* ran dietary surveys for many of the western Arctic communities, including those in the Yukon, although this data is limited for the eastern Arctic. The data confirms that a large part of the diet of Aboriginal peoples is traditional foods.

Researchers also looked at the benefits of traditional foods. Results show that traditional foods, and the traditional ways of harvesting them, are fundamental to well-being, nutritional health of individuals and social health of communities. Traditional food gives northerners the majority of nutrients they need to stay healthy. Nutritional studies show that traditional foods are an important source of protein, iron, fat-soluble vitamins and vitamin B-complex. Other compounds, such as omega-3 type fatty acids, play a vital role in preventing heart disease and stroke.

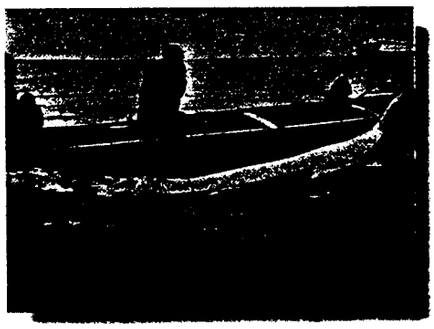
Action on Contaminants conducted preliminary research on the health effects of contaminants, but these studies are inconclusive. Research conducted outside the Arctic suggests that infants exposed to contaminants while in the womb are the most sensitive to low-dose contaminant exposure. For this reason, the human health component of the Northern Contaminants Program has focused on northern mothers and newborns.

The majority of human health data will become available in 1996-97.

Informing northerners

The Human Health component of *Action on Contaminants* assessed risks to human health by comparing the known contaminant levels of traditional foods with data on the types and amount of traditional food that northerners eat. An assessment of the benefits and risks of eating traditional foods is important in the North. Alternatives to traditional foods that have similar nutritional value are not readily available to northerners, are more expensive and are considered less palatable. A shift to eating store-bought food would weaken the social well-being and community cohesiveness that comes with hunting, trapping and fishing for traditional foods.

The Human Health component completed many assessments. It evaluated most areas and animal species in the Yukon; data from the Northwest Territories is less comprehensive. In the Yukon, the program issued health advisories about toxaphene in burbot liver and lake trout from Lake Laberge and Atlin Lake, and about cadmium in caribou kidneys and livers. In the Northwest Territories, staff issued health advisories about toxaphene in burbot liver from the Slave River, about mercury in fish from Lac Ste. Thérèse and Lac a Jacques, and about cadmium in caribou kidneys and livers.



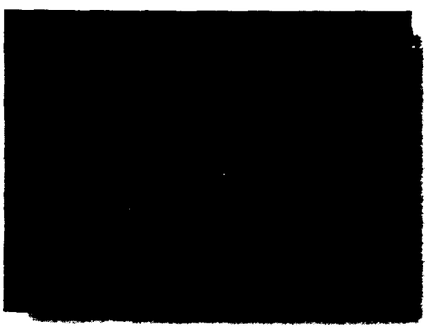
Beluga being harvested

A *recently completed assessment of organochlorines in* marine mammals *from across the* Arctic showed elevated levels of *toxaphene and chlordane in blubber. Inuit* leaders, in consultation *with territorial and federal officials, decided that it would not be appropriate* to *advise people to alter their* consumption of marine mammals. This is *because of the considerable health and social benefits of this food source, as well as due to the* high *uncertainty* regarding effects.

In Conclusion

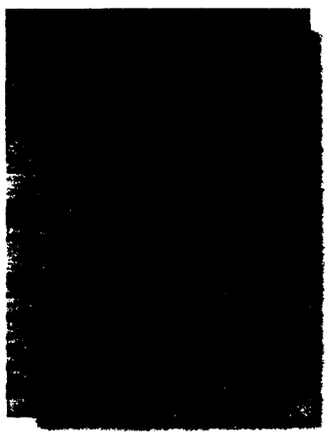
Although studies indicate that northerners are exposed to higher levels of contaminants in their food than they were in the past, the benefits of traditional foods are considerable. To date, few studies have looked at the health effects related to contaminant exposure from eating traditional foods. More research is needed to determine if current levels of exposure to environmental contamination endanger human health. The evidence to date does not warrant altering the traditional diet with all its benefits, except where health advisories (for caribou kidneys, burbot liver, and so on) have been issued.

As long as air currents continue depositing contaminants in the Arctic, northerners will be exposed to elevated levels of contaminants. Northerners, therefore, in cooperation with the *Arctic Environmental Strategy* agencies, must continue to: (I) monitor levels of contaminants in the ecosystem; (2) monitor levels of exposure in humans; (3) assess risks to human health; (4) monitor for health effects. This information would then be used to advise northerners on human health implications and to pursue international action to prevent the contaminants from reaching the Arctic.



Putting the Arctic on the World's Agenda

In addition to cleaning up the North, Canada must cooperate internationally. Contaminant release in the North is a global issue requiring global solutions. *Arctic Environmental Strategy* research is Canada's contribution to the circumpolar initiative known as the *Arctic Environmental Protection Strategy*. This Strategy is explained in the introduction to this report. The circumpolar countries that cooperate on the Strategy are: Canada, Denmark (Greenland), Finland, Iceland, Norway, Russia, Sweden and the United States. As a plan for cooperation among the circumpolar countries, the *Arctic Environmental Protection Strategy* provides for the protection, enhancement and restoration of the northern environment and the sustainable use of its natural resources. The *Strategy* recognizes the special relationship of Indigenous Peoples to their northern homeland. The Inuit, Saami and Indigenous Peoples of Northern Russia are represented through their organizations as accredited observers of the *Arctic Environmental Protection Strategy*, and are active in its implementation.



The *Arctic Environmental Protection Strategy* has five programs:

1. Arctic Monitoring and Assessment Program
2. Protection of the Arctic Marine Environment
3. Conservation of Arctic Flora and Fauna
4. Emergency Prevention, Preparedness and Response
5. Task Force on Sustainable Development and Utilization.

An Example: The Arctic Monitoring and Assessment Program

The Arctic Monitoring and Assessment Program's mandate is to monitor levels of contaminants in the North and assess how they affect the Arctic ecosystem. The Arctic Monitoring and Assessment Program builds on existing national and international programs, which are being developed into a circumpolar framework. All circumpolar countries give the highest priority to persistent organic pollutants, selected heavy metals and radionuclides. Acid rain is a priority only for Arctic Scandinavia.

The Arctic Monitoring and Assessment Program is managed by a working group of delegates from each of the eight nations as well as observing countries (Germany, Netherlands, Poland and the United Kingdom). This working group collaborates with Indigenous peoples' organizations, such as the Inuit Circumpolar Conference, Nordic Saami Council, and the

Association of Indigenous Peoples of the North, Siberia and the Far East of the Russian Federation. From 1993 to 1997, the chair and vice-chair are from Canada and Sweden, respectively. Norway provides a Secretariat, based in Oslo.

The Arctic Monitoring and Assessment Program provides direction for monitoring atmospheric, marine, freshwater and terrestrial environments, and human health. Each member country has an implementation plan. These plans, together, largely fulfill the requirements of the Arctic Monitoring and Assessment Program. Canada's implementation plan is mainly *Action on Contaminants* projects under the *Arctic Environmental Strategy*. Backed by scientific evidence, and working together, the circumpolar countries have brought the issue of northern contaminants to the attention of the international community. The first comprehensive circumpolar assessment on the state of the Arctic environment will be completed for the eight Arctic ministers in early 1997.

What We Accomplished

The United Nations Economic Commission for Europe

The parties to the Convention on Long-range Transboundary Air Pollution (under the United Nations Economic Commission for Europe) includes Canada, the United States, all European nations, and all states of the former Soviet Union. The Convention addresses the problem of air pollution crossing international boundaries. In 1991, in response to increasing information about the Arctic, Canada and Sweden began working within this forum to study persistent organic pollutants. Canada is leading the development of a possible protocol under the Convention (protocols are agreements between countries under a Convention to reduce or eliminate emission of a pollutant). Canada is helping develop a similar possible protocol on heavy metals. Formal drafting of both protocols will begin in 1996.

Russia

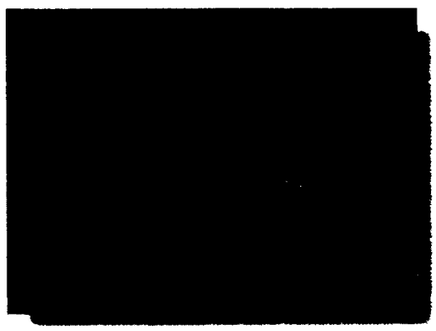
In October 1991, Canada made an agreement with Russia on monitoring contaminants in the North. There have been two major achievements. First, an air monitoring station identical to Canada's three was set up on Dunay Island, Siberia, taking everyone one step closer to a circumpolar air monitoring network. The second achievement was an exchange of environmental samples between Russian and Canadian laboratories Future efforts may include a second air monitoring station on the coast north of the Ural Mountains, and further laboratory exchanges.

International Meeting on Persistent Organic **Pollutants**—Towards Global Action

Canada is consulting about persistent organic pollutants with countries that are not part of the United Nations Economic Commission for Europe. In response to a commitment made by *Arctic Environmental Protection Strategy* Ministers in the 1993 Nuuk Declaration, followed by an announcement by Canada's Minister of Environment, Canada and the Republic of the Philippines co-hosted a meeting in Vancouver in June 1995.

Experts from 35 countries attended the meeting. After four days of discussions, participants reached the following formal conclusions:

1. Enough information exists on the hazards of persistent organic pollutants to warrant global action, including bans and phase outs. Some persistent organic pollutants will remain in limited use to control human diseases, such as malaria.
2. Immediate actions needed include: a global management strategy for persistent organic pollutants; increased recognition that the international trade of persistent organic pollutants harms human and ecological health; and greater willingness to adopt command and control mechanisms.
3. International development agencies and banks (such as the Global Environment Fund) should participate by encouraging alternatives to persistent organic pollutants.



The **United** Nations Environment Programme

The United Nations Environment Programme promotes international environmental cooperation, reviews the state of the global environment, and reports on the progress of environmental programs. In May 1995, The United Nations Environment Programme began evaluating the environmental and socioeconomic aspects of a future global, legally binding agreement to deal with persistent organic pollutants. This evaluation is scheduled to conclude in 1997. In November 1995, countries attending a high-level conference on the Protection of the Marine Environment from Land-Based Activities declared their intent to develop a global, legally binding agreement to deal with these substances.

In Conclusion

What We've Learned from the *Arctic Environmental Strategy*

Northerners are concerned

Northerners have concerns about water and traditional food—how clean are they now, and how can they be kept unpolluted in the future?

Northerners are particularly concerned about what they'll leave future generations in natural heritage and economic opportunities. A healthy economy needs a healthy environment.

The ***Arctic Environmental Strategy is*** a **model** for sustainable development and resource management

The *Arctic Environmental Strategy* has shown a successful way to manage sustainable development in the North. Future programs should consider this model.

The success of the Community Resource Management Program and the Environmental Action Program shows that northerners can and should manage their own resources.

Capacity-building in communities contributes to the sustainable use of natural resources.

Northerners must be part of the solution

Programs succeed in the North when northerners and government groups work together.

Research and monitoring must answer questions that are relevant to northerners. Pure research and simple data-gathering are not enough—northerners must be involved in studies as part of the solution.

Researchers, scientists and other specialists must explain their findings to northerners. With traditional foods, for example, clear information helps northerners make informed and confident choices about what to harvest and eat.

increased access to traditional environmental knowledge and scientific information benefits northerners and leads to better decision making at all levels.

The ***Arctic Environmental Strategy*** helped pave the way

Northerners' involvement in all aspects of the *Arctic Environmental Strategy* can help with the move to co-management of resources through Aboriginal land claims, and with federal program devolution to territorial governments.

Implications for our world

Arctic Environmental Strategy research has defined and clarified many northern environmental issues that extend beyond Canada's borders. However, we are only beginning to understand the scope of environmental problems in the North, particularly how outside activities affect the northern ecosystem. The Arctic is an indicator of the environmental health of the entire Northern Hemisphere. Even more, it is part of the global ecosystem. Global problems require global action.

For further information

To learn more about any aspect of the *Arctic Environmental Strategy*, please write or call:

Regional Communications Service
Department of Indian Affairs
and Northern Development
Yellowknife, NT
XIA 2R3
(403) 920-8198

Regional Communications Service
Department of Indian Affairs
and Northern Development
Whitehorse, YT
Y1A 3V1
(403) 667-3221

Publications Distribution (Kiosk)
Department of Indian Affairs
and Northern Development
Ottawa, ON
KIA oH4
(819) 997-0380

Appendix 1

Selected toxic contaminants and their **anthropogenic** sources or uses

Table 1

Contaminants of Concern	**Anthropogenic** sources or uses
POPS	
PCBS	Electrical transformers
Dioxins Furans	Residue from combustion and a variety of industrial processes (such as pulp and paper manufacture) and improper waste incineration of chlorine compounds (such as PCBs)
DDT and DDE Toxaphene Chlordane Hexachlorocyclohexanes Hexachlorobenzene Aldrin, dieldrin, endrin	Agricultural and disease-controlling pesticides
Polyaromatic hydrocarbons	Incomplete combustion of organic material (such as fossil fuels)
Heavy metals	
Cadmium Mercury Lead	Industrial activities (such as coal burning, ore smelting), automobile exhaust, impoundment related to hydroelectric dams
Radionuclides	
Cesium Strontium Plutonium	Atmospheric weapons testing, accidental discharges, waste dumping

Source: Adapted from Barrie, L. A., D. Gregor, B. Hargrave, R. Lake, D. Muir, R. Shearer, B. Tracy and T. Bidleman. 1992. *Arctic* Contaminants: *Sources, Occurrence and Pathways*. Science of the Total Environment, 122:1-74.

Appendix 2“

Contaminant studies in tissues of northern wildlife

Introduction

The North is summer home to a significant portion of the world's migratory species. Some six million seabirds come to the North to breed. Forty percent of North America's beluga whales and 85 percent of its narwhals move into or through Lancaster Sound during summer. The North Yukon Porcupine caribou herd is one of the largest migratory herds of any kind left in the world.

Tissue studies

Contaminants have been measured in:

Marine mammals:	*such as whales (beluga and narwhal), seals (harp and ringed), walrus and polar bears*
Saltwater fish:	*such as Arctic char, capelin and Arctic cod*
Freshwater fish:	*such as Arctic char, lake whitefish, lake trout, grayling, burbot*
Land mammals:	*such as barren-ground and woodland caribou*
Indicator species:	*such as Peregrine Falcons and mink*
Birds:	*such as waterfowl (geese, ducks, mergansers and loons), land game birds [grouse and ptarmigan) and seabirds (murre and gulls)*
Land plants:	*such as lichens*

Marine mammals

Marine mammals are the top predators in the northern marine food web. Polar bears, whales and seals generally have higher organochlorine contaminant levels than other northern animals because they live longer, “bioaccumulate” or collect higher levels of contaminants and feed at the top of food chains. This results in “contaminant biomagnification, ” which means increasing contaminant concentrations from one level of the food chain to the next. In addition, their greater mass of blubber (fat) provides a larger storage area for “lipophilic” or fat-loving contaminants.

Among the large marine mammals, walrus were once thought to have the lowest contaminant levels. However, *Arctic Environmental Strategy* studies have recently shown that walrus blubber from East Hudson Bay, Foxe Basin, and East Baffin island has higher than expected PCB levels. This population of walrus is feeding on seals, which are higher on the food chain than their usual diet of clams and cockles, resulting in greater PCB intake and accumulation.

PCBs, chlordane and DDT are the most prominent contaminants in seal and polar bear blubber, while chlordane and toxaphene are the most prominent in narwhal and beluga whale blubber. While organic contaminant levels in Arctic belugas are one twenty-fifth of those found in St. Lawrence River belugas, they are still high enough to be of concern because humans eat Arctic belugas.

The muscle tissue, blubber and organs of narwhal and beluga whales, significant to northern diets, have also been measured for heavy metals. In particular, levels of methylmercury in these marine mammals, more toxic than inorganic mercury, in several cases exceed the consumption guideline levels for mercury in fish.

Health Canada is assessing adverse health risks associated with the mercury and organochlorine levels present in beluga, narwhal and ringed seal tissue collected across the North.

Freshwater fish

Monitoring contaminants in freshwater ecosystems provides health information to northerners about the quantities and types of fish that are safe to eat. Lake trout and Arctic char are the most widely distributed species of fish analyzed for organochlorines in the Canadian North. These fish, in addition to burbot and whitefish, are key to the traditional subsistence fishery of Aboriginal Peoples in the Northwest Territories, northern Quebec and the Yukon. *Action on Contaminants* and *Action on Water* programs addressed these issues in a number of studies.

Similar to marine ecosystems, freshwater food chains may explain differences in contaminant levels in predatory freshwater fish. Burbot liver from Lake Laberge and Atlin Lake, in the Yukon, exhibited the highest organochlorine levels found to date. In 1990 and 1991, Lake Laberge lake trout and burbot showed toxaphene levels up to 125 times greater than the same species in nearby lakes. Research showed that biomagnification was higher in Lake Laberge lake trout because they feed higher up the food chain, that is, exclusively on smaller fish, while lake trout elsewhere feed on invertebrates.

In 1991, high toxaphene levels in Lake Laberge samples led to the issuing of a public health advisory recommending that people eat limited amounts of lake trout, and no burbot liver. On nearby Atlin Lake, a 1992 advisory recommended limited consumption of burbot liver, while Atlin Lake trout is safe to eat.

The maximum recommended mercury level in fish for subsistence fishers and heavy fish consumers is 0.2 parts per million (Health and Welfare Canada 1978; 1982). Commercial northern species are closely monitored since their sale is restricted in Canada if mercury levels exceed 0.5 parts per million. The subsistence guideline level is lower than the commercial guideline level because it accounts for a higher rate of fish consumption by fishers compared with the national average, Average mercury levels in lake trout from many Northwest Territories and northern Quebec locations frequently exceed mercury limit guidelines both for commercial fish and subsistence fish consumption.

Migratory birds

Migratory birds are generally exposed to higher contaminant levels in southern latitudes, but determining exact contaminant sources is extremely difficult, Migratory waterfowl, as well as land birds and their eggs, are consumed by northerners. Traditionally hunted game birds, such as geese, grouse and ptarmigan, however, do not accumulate high contaminant levels and are safe to eat. *Arctic Environmental Strategy* studies found the highest organochlorine levels in birds that feed at a higher levels of the food chain—fish-eating mergansers and loons.

Land animals

In general, organochlorine levels are lower in land mammals than they are in marine mammals because of shorter food chains on land and lower body-fat levels. Caribou, however, are long-living herbivores who can bioaccumulate significant levels of heavy metals (such as cadmium), in some cases at levels that may be of concern to northerners who eat large amounts of liver and kidneys.

Action on Contaminants found that elevated cadmium levels in caribou kidney from several northern herds are due to accumulated airborne contaminants in lichen, the main food that caribou eat, Risk assessments suggest a similar cadmium distribution throughout the Northwest Territories, which is consistent with long-range contaminant transport over wide geographical areas. Higher cadmium levels in Yukon woodland caribou herds are due to a local natural source.

Current cesium levels in caribou are low, and *Arctic Environmental Strategy* research has found no major

human health risk. Radionuclide levels have significantly declined since the 1963 moratorium on atmospheric nuclear weapons testing.

While the reproduction of Great Lakes-area mink have been affected by elevated levels of PCBS and other organochlorines, the *Arctic Environmental Strategy* has not found this problem with northern mink. Northern mink have lower contaminant levels than mink in other regions of North America, reflecting their generally cleaner food supply.