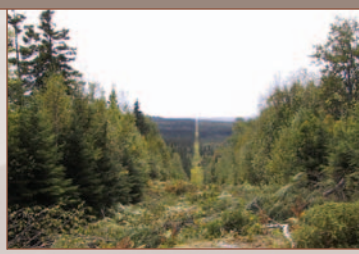
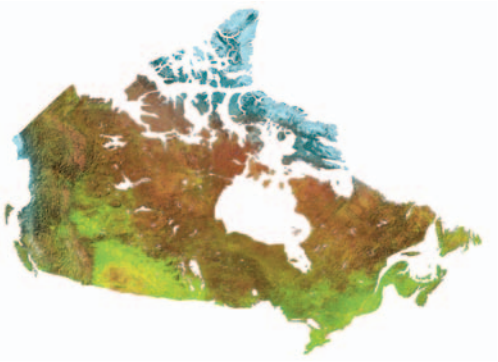
Natural Resources Canada
Ressources naturelles Canada

Earth Sciences Sector

Responding to Federal Priorities





Annual Review 2001-2002

Canada

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Message from the Minister

As Minister of Natural Resources Canada (NRCan), I know that knowledge is one of our most vital resources and is the foundation of the new economy. NRCan's Earth Sciences Sector (ESS) is a dynamic hub of science and technology expertise within the Government of Canada. Over the past year, it has continued its excellent work in building an in-depth knowledge of our landmass — knowledge that can be used to help us manage our natural resources wisely.

ESS is renowned for its sophisticated and innovative technology in the fields of geoscience and geomatics. As well, the sector is providing Canadians with the tools to take advantage of opportunities in this economy, ensuring that they are connected to new technology.

By encompassing the history and forward thinking of the Geological Survey of Canada, the innovation and technology of Geomatics Canada, and the support and expertise of the Polar Continental Shelf Project, ESS is playing a key role in supporting NRCan's commitment to sustainable development — balancing our environmental, social and economic needs. It nurtures partnerships that encourage trade and investment, while at the same time building strong and safe communities in rural and remote areas.

The work of ESS builds upon the Government of Canada's commitment to supporting research and development that create a world-leading economy driven by innovation, ideas and talent.

I congratulate the dedicated staff of the Earth Sciences Sector for yet another year of outstanding accomplishments that have had a direct impact on Canada's economic strength, technological ingenuity and innovation, and offer my best wishes for continued success.

Herb Dhaliwal

The Honourable Herb Dhaliwal
Minister of Natural Resources Canada

Message from the Assistant Deputy Minister

I am pleased to introduce the *Earth Sciences Sector Annual Review* for 2001–2002. This Review highlights the Sector's accomplishments during the past fiscal year.

ESS provides Canada with comprehensive geoscience knowledge, and with quality products and services that describe the Canadian landmass in the form of surveys, maps, remotely sensed data and geographically referenced information. The combination of our expertise and global connections helps Canadian businesses expand internationally, and also provides science and technology (S&T) assistance to humanitarian projects in developing countries.

Our vision is to be, and be recognized as, a leader in the development, deployment and integration of S&T into policy- and decision-making by NRCan, the federal and provincial governments, industry and other stakeholders. To achieve this vision, amongst other things, we need to be a high performance, issues, outputs and outcomes driven organization. We must be aligned with government priorities, and we must be appropriately linked with other parts of Canada's innovation system — industry and universities. We want to be known for excellence in everything we do.

The past year has been one of transition, as we implement the new ESS S&T Strategy aimed at improving our effectiveness in providing knowledge and service to Canadians. This Strategy was developed in response to advice given to Ministers by the Council of Science and Technology Advisors. The advisory body was charged with recommending ways to improve the effectiveness of S&T conducted within the Canadian federal government.

We are reorganizing the Sector into a flexible, responsive organization built around addressing and resolving issues, as well as responding quickly to new priorities. These changes will align us with government priorities and build a strong and relevant organization to deliver government S&T requirements.

I am proud of the successes of the Earth Sciences Sector as it moves to ensure its continued relevance and leadership in the S&T community. I hope you enjoy this snapshot of our accomplishments during the 2001–2002 fiscal year.

Irwin Itzkovitch, Ph.D.
Assistant Deputy Minister
Earth Sciences Sector

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A Description of the Earth Sciences Sector

ESS is one of four scientific sectors within NRCan. ESS is Canada's principal Earth sciences agency, and provides Canadians with timely and reliable geomatics and geoscience knowledge. The Sector supports the environmental, social and economic priorities of Canada by focusing its science and technology programs on innovative projects whose objectives are to improve Canadians' quality of life. It also shares its knowledge and expertise in partnerships and cost-recovery projects with clients around the world. The generation and dissemination of information that contributes to the well-being of Canadian citizens is at the forefront of all ESS activities.

The Sector houses the Geological Survey of Canada, Geomatics Canada and Polar Continental Shelf Project. Each of these vital organizations has retained a strong identity under ESS and each continues to maintain a separate Web presence.

The **Geological Survey of Canada** (GSC) consists of the Minerals and Regional Geoscience Branch, and the Sedimentary and Marine Geoscience Branch. The GSC is Canada's premier agency for geoscientific information and research, with world-class expertise focusing on geoscience surveys, sustainable development of Canada's resources, environmental protection and technology innovation. For more information, please see: **http://www.nrcan.gc.ca/gsc**.

Geomatics Canada (GC) consists of the Mapping Services Branch (MSB), the Canada Centre for Remote Sensing (CCRS), the Geodetic Survey Division (GSD), the Legal Surveys Division (LSD) and the GeoConnections Secretariat (a national partnership initiative led by NRCan). The GC is an internationally recognized organization that provides geospatial information using sophisticated technology. GC is responsible for gathering, analyzing, interpreting, distributing and using geographic information. For more information, please see: **http://www.nrcan.gc.ca/geocan**.

Polar Continental Shelf Project (PCSP) coordinates logistics support for and offers expert advice to Canadian government and university scientists and independent, private-sector and non-Canadian researchers working in isolated areas throughout the Canadian Arctic. For more information, please see: **http://polar.nrcan.gc.ca**.

The Sector's **Policy, Planning and Coordination Division** provides corporate support to ESS and NRCan in the areas of policy analysis and development, strategic planning and reporting, and coordination.

The Sector's **International Division** coordinates efforts and monitors issues related to trade and investment, enhances the use of Canadian Earth sciences knowledge and technology in supporting sustainable development of developing countries, and provides leadership in ESS business practices.

Doing Business with ESS

Geospatial information has a wide range of applications, from emergency response to crop management and resource development. The Sector's geoscience and geomatics knowledge and skills support Canadian companies that want to compete internationally and take advantage of global opportunities presented by an increasingly technology-driven economy.

ESS makes its expertise and services available to the Canadian geoscience and geomatics communities on a collaborative and/or cost-recovery basis. In the case of collaborative projects, ESS works closely with industry and academia, sharing costs and expertise on projects of mutual interest. Collaboration can take various forms (e.g., technology transfer or cooperative research) and the information generated by ESS's collaborative programs is made available to the public.

ESS staff work with industry, universities and other government organizations throughout the world, providing their expertise in such areas as surveying and mapping, natural hazards, remote sensing, environmental issues and mineral-exploration technology. Under certain circumstances, ESS can also make its unique expertise and facilities available to the international community on a cost-recovery basis.

Strategic alliances with provincial and territorial governments and First Nations are critical to the Sector's ability to carry out its responsibilities. The partnership between the federal and territorial governments in establishing the Canada–Nunavut Geoscience Office is an excellent example of this strategic approach to national issues. Also, as a key player in the National Geological Surveys Committee (a federal, provincial and territorial consultative body), NRCan is in the process of renewing the Intergovernmental Geoscience Accord with the provinces and territories. Another example of effective partnership is the Targeted Geoscience Initiative (TGI), a three-year, $5-million-per-year initiative to stimulate new investment in mineral exploration in Canada.

The Sector chairs the Inter-Agency Committee on Geomatics (IACG) and is a member of the Canadian Council on Geomatics (CCOG), which are working with other partners of GeoConnections in the public and private sectors and with academia to build the Canadian Geospatial Data Infrastructure (CGDI). This national partnership initiative has completed the mid-point of its mandate, and the CGDI is providing Canadians with ready access to some geographic tools and services and to some geographic information maintained by public agencies across Canada. Over the duration of the initiative, the amount of information accessible through the CGDI is expected to increase substantially.

Linkages between ESS and Canadian universities have always been an important aspect of the Sector's research and development (R&D) program. These linkages are aimed at maximizing the use of resources to meet national needs for Earth science knowledge and expertise, and developing a sufficient supply of graduates in disciplines of interest to ESS and the Canadian Earth sciences community. These linkages take many forms: research partnerships, logistics support, scholarship programs, ESS research scientists acting as adjunct professors, sharing of laboratory equipment and much more. These interactions lay the foundation for strong ESS–university partnerships and enable the Sector and Canadian universities to maximize their intellectual and operational resources.

For information on business opportunities with ESS, contact the International Division at 615 Booth Street, Ottawa, Ontario K1A 0E9. You can reach them by telephone at (613) 996-7643, by facsimile at (613) 995-8737 and by e-mail at **business.ess@nrcan.gc.ca**. Please see their Web site at **http://www.nrcan.gc.ca/ess/business**.

Information on Earth Sciences

The ESS Info Division provides leadership and a central focus for the information functions of the Sector. It provides library services through the **Earth Sciences Information Centre** (ESIC), which maintains a comprehensive collection of geoscience information for the use of all Canadians. It also publishes and distributes the GSC's scientific output.

The ESIC holds Canada's largest Earth sciences collection of books, journals, maps, atlases and photographs, with world-wide coverage. Research can be done in person or via the Internet. Clients can access more than two million holdings on the Library Catalogue, along with the federal geoscience database GEOSCAN. Also available are a reference service, the Ask-a-Geologist service and document delivery.

Clients can visit ESIC on-line at **http://www.nrcan.gc.ca/ess/esic**. Requests for document delivery should be sent to **ESIC.ILL@nrcan.gc.ca**. Enquiries can be sent via the Web site or e-mailed to **ESIC@nrcan.gc.ca**.

Contact information for the **GSC Regional Libraries** is as follows:
Calgary: Telephone (403) 292-7165 or e-mail **calgary.ref@gsc.nrcan.gc.ca**.
Québec: Telephone (418) 654-2677 or e-mail **sdupuis@nrcan.gc.ca**.
Vancouver: Telephone (604) 666-3812 or e-mail **libvan@gsc.nrcan.gc.ca**.

The Canada Lands Survey Records (CLSR) is the official public repository of all original plans, journals, field notes and other papers connected with surveys made under the authority of the *Canada Lands Surveys Act*. Please see the Web site at **http://www.lsd.nrcan.gc.ca**.

The **GSC Bookstore** carries about 20 000 geoscientific publications produced from the research of GSC staff. The material focuses on the geological structure and resources of the nation's landmass, including the offshore regions. The publications range from maps to memoirs, with some dating back to near the turn of the 20th Century. There is a Map and Publications sales office on Robson Street in Vancouver and distribution outlets in the GSC offices in Calgary, Ottawa, Halifax and Québec City.

Please see the Web site at **http://www.nrcan.gc.ca/gsc/bookstore**. Clients may search the catalogue on-line at **http://www.nrcan.gc.ca/ess/esic/geoscan_e.html** or e-mail requests to **gsc_bookstore@gsc.nrcan.gc.ca**.

The **Canada Map Office** is responsible for distributing maps of the National Topographic Series (NTS), as well as other GC products, to a network of Regional Distribution Centres across Canada. These centres, in turn, distribute maps to end-users through map retailers world-wide. With over 400 000 topographic maps distributed in 2001–2002, these products are widely recognized as an authoritative source of consistent topographic information for Canada. For more information, please visit **http://maps.nrcan.gc.ca/cmo/** or e-mail **topo.maps@nrcan.gc.ca**.

The **National Air Photo Library** has over six million aerial photographs covering all of Canada, some dating back 70 years. The Library indexes and stores all federal aerial photography for Canada, and maintains a comprehensive historical archive and public reference centre. Please visit the Library at **http://airphotos.nrcan.gc.ca/** or e-mail **napl@nrcan.gc.ca**.

For information about places, digital maps, facts, geographical information and learning resources about Canada, please see the Web site for the Atlas of Canada at: **http://atlas.gc.ca/site/english/index.html**.

A Clean Environment

ESS is contributing to the health and cleanliness of our environment on a number of fronts. These include research into the characteristics of groundwater, extracting and analyzing an ice core for insight into climate change, and gathering and analyzing the teeth of marine mammals — some 500 years old — for mercury content.

Workshop Participants Plan a Collaborative Groundwater Program

ESS is committed to building a strong national groundwater program in partnership with its stakeholders. In September 2001, during the 2nd National Workshop on Groundwater, some 70 participants from municipal, provincial and federal agencies, universities and industry met in Calgary to develop the Canadian Framework for Collaboration in Groundwater. The workshop stressed the importance of closer collaboration in groundwater research and provided general directions and key actions needed for a concerted approach to improve the management and protection of Canada's groundwater resources. Program goals include the development of an inventory of groundwater resources and assessment of regional aquifer dynamics.

Please see: **http://www.cgq-qgc.ca/cgsi/index.html**.
The French site is at: **http://www.cgq-qgc.ca/cgsi/index-fr.html**.

Water Resources Research Benefits Oak Ridges Moraine

When the Ontario Municipal Board met to decide on the future of the Oak Ridges Moraine north of Toronto, they called upon ESS scientists to provide key scientific evidence. The moraine is a complex glacial deposit formed in the last Ice Age, and it harbours valuable water resources and forests that provide habitat for several plant and animal species that are rare, vulnerable or threatened in the province. As a result of this information, the moraine is now protected by a conservation act and will be managed more effectively.

Groundwater
Groundwater, a renewable and sustainable resource, is vital to the Canadian economy and our ecosystems. Groundwater supplies water to 30% of Canadians, and that number is growing. There are, however, major gaps in our understanding of this resource. While it is known that Canada's surface water represents 20% of the world's useable freshwater, the amount of available groundwater is unknown. More needs to be known about the number, size, characteristics and dynamics of Canada's main aquifers.

Climate Change
Geoscience knowledge has become increasingly important for the fundamental understanding of climate change. ESS contributes to this understanding by studying past climate changes, examining the potential for geological storage of carbon dioxide, contributing relevant data on current climate trends, and researching the impacts of climate change and possible adaptative response.

The Oak Ridges Moraine team, involving ESS and many partners, provided the province's Ministry of Environment with a set of digital maps, reports and reporting protocols that will lead to a moraine-wide groundwater vulnerability map for the Greater Toronto area. These products are providing mapping protocols for the $10-million groundwater-protection program across southern Ontario, which will yield information integral to developing an enhanced national Groundwater Program.

Mount Logan Helps ESS Understand Glaciers

ESS scientists are looking to Mount Logan for answers as to why Canada's western mountain glaciers have undergone drastic changes in their ability to regulate stream flow, which they do by storing water during cool, wet weather and releasing it during dry, warm periods.

The Sector led a recent study, in partnership with Environment Canada's National Water Research Institute and the National Research Council's Canadian Hydraulic Centre, that examined glacier fluctuation, meteorological and streamflow records. It was funded by the Program for Energy Research and Development (PERD) and the Climate Change Action Fund–Prairie Adaptation Research Collaboration (CCAF-PARC), and a new partner, Alberta Environment.

While a general climate warming would suggest that glaciers supply additional melt water, the work concluded that because glaciers have become so much smaller in area since the Little Ice Age maximum (ca. 1850), their contribution to stream flows during warm, dry periods has diminished. This has implications for groundwater recharge and exacerbates the recent drought in the western prairies, where river flows have been, in part, derived from melting snow and glaciers.

Now scientists are using the unique snow-accumulation record from ice cores, such as that of Mount Logan, to determine whether melting conditions in summer or changes in glacier nourishment by snowfall in winter are responsible for the accelerated demise of western Canadian glaciers.

The foundation for this work stems from the long-standing records of glacier fluctuations (e.g., mass balance) being collected and assessed by ESS glaciologists in GSC. This information is used in national and international programs on climate-change detection and impacts.

Monitoring Metals in Marine Mammals

ESS is working with the Department of Fisheries and Oceans and the Canadian Wildlife Service, in a study that compares the mercury content of the teeth of modern beluga whales to teeth collected from 500-year-old campsites. The findings may have important health implications for Northern populations, particularly the Inuit, who depend on these mammals as part of their diet.

Beluga whales, walrus, seals and fish are among the large marine animals favoured in the traditional diet, and recent studies of Inuit populations have revealed higher than average mercury levels among those who consume significant quantities of these meats.

The study was undertaken to determine the relative amounts of natural vs. anthropogenic mercury in modern and pre-industrialization beluga whales. A comparison of their teeth revealed that the modern whales had from 4 to 17 times the mercury content of the pre-industrialization whales, depending on the age of the mammal. This discovery, and the results of studies currently under way on seal teeth, may have important health implications for Inuit populations who continue to consume these mammals on a regular basis.

Sustainable Development of Natural Resources

Geoscience for Sustainable Development
Geoscience is a cornerstone of Canada's intellectual infrastructure. ESS provides integrated geoscience knowledge and technology to enhance decision-making for sustainable resource development.

The mandate that guides NRCan includes promoting the sustainable development and responsible use of Canada's mineral, energy and forestry resources, and collecting and disseminating information on sustainable resource development. For its part, ESS is developing a geospatial knowledge base to assist informed decision-making. It conducts science and technical surveys to assess Canada's resources, including the geological structure and legal boundaries, and prepares and publishes maps and reports. One of its goals is to provide Internet access to current data for the benefit of all Canadians.

NATMAP Projects in Western Superior and Western Churchill

The National Geoscience Mapping Program (NATMAP) has projects under way in Northern Canada that are leading to a 4-D (that is, includes time) understanding of rock distributions and their formation. ESS is providing the integrated geoscience, knowledge and technology that enables informed decision-making in the area of sustainable-resource development. The result is ongoing industry investment in the mineral potential of these regions.

New paradigms of how the Earth's crustal plates interacted in the past in these regions have resulted in new scientific products in the form of CD-ROMs, Web-accessible databases and university theses, as well as traditional and innovative maps and print publications at detailed and regional scales.

NATMAP Project in the Appalachian Foreland and St. Lawrence Platform

In collaboration with eastern Canada provincial surveys and universities, ESS research has refined the stratigraphic and structural frameworks of the ancient continental margin of eastern North America. The resultant improved appreciation of the region's hydrocarbon potential has revived interest in the entire eastern Quebec area, and these promising but under-explored basins are now almost entirely staked. Results of the project, published in a special Bulletin of the Canadian Society of Petroleum Geologists, will be applied to hydrocarbon exploration across eastern Canada.

Mapping Central Baffin Island

A project to map Central Baffin Island is entering its final year, with one-quarter of the area yet to map. The Government of Nunavut urgently needs bedrock-geoscience information, and ESS is providing regional geoscience maps and the knowledge necessary to analyze the geological resource potential. The resulting critical base information will guide exploration and drilling campaigns over the coming years.

ESS has gathered the information by combining magnetotelluric and teleseismic data with airborne survey data and on-the-ground geological mapping. Products include CD's and Web-accessible databases, as well as traditional print publications. ESS is also transferring geoscience knowledge and technological capability to the local communities.

Northern Resources Geoscience
ESS is contributing to the development of the North by providing geoscience maps and knowledge to stimulate resource exploration, underpin infrastructure and land-use planning and capacity-building by local communities.

Ancient Pacific Margin NATMAP

ESS is in the third year of a four-year project to study rocks that formed the ancient Pacific margin of Yukon and British Columbia, and that host significant mineral deposits. Most recently, the work focused on the Stewart River area of Yukon and the south-central area of B.C. (Vernon, Seymour Arm and Ashcroft map areas). The areas include the Wolverine and Kudz Ze Kaya deposits in Yukon, and Pogo and Fort Knox deposits in Alaska.

In the Stewart River area, a multi-parameter airborne geophysical survey, a till geochemistry survey and an accelerated bedrock mapping program were completed, with all the data released in March 2002. In south-central B.C., the geological mapping of 22 1:50 000 map sheets is complete.

Mapping the Scotian Shelf

The Scotian Shelf sea floor is revealing new secrets through the visualization power of multi-beam mapping. ESS has integrated existing geoscience data with imagery of the sea floor and biological data to produce a suite of maps to support integrated ocean management. The resulting products have been used to define the proposed Marine Protected Area in the gully; to assess hazards to pipelines and cables crossing the shelf; and to revolutionize the management and fishing practices in the offshore scallop fishery. The project has been delivered in partnership with the Department of Fisheries and Oceans, and is providing a foundation database for the Eastern Scotian Shelf Integrated Management (ESSIM), the first Large Ocean Management Area (LOMA) Plan to be developed for offshore eastern Canada.

Ocean Management
Coastal and offshore territories, including the Great Lakes, comprise almost 40% of Canada's land area and contain valuable hydrocarbon and mineral resources. ESS provides the knowledge base to support sustainable Integrated Ocean Management and the regulatory requirements of federal and provincial governments. By understanding benthic habitats and the physical nature of the seabed, stakeholders are able to make informed land-use decisions in these areas.

Research Report on the Offshore Assists ESS

Academic researchers published a report on Canada's offshore for senior managers and stakeholders in government and industry. It provides background information that will allow ESS to more effectively influence the investment of resources in the property rights infrastructure in Canada's offshore.

ESS Assesses Hazards to Hydrocarbon Exploration and Development in the Beaufort Sea

Renewed interest in hydrocarbon exploration in the Beaufort Sea has led ESS to investigate hazards to offshore structures and pipelines, and the impact on benthic communities. At the request of Indian and Northern Affairs Canada (INAC), and in consultation with stakeholders, GSC Atlantic has provided new insights into hazards from abandoned ice islands, ice scour and pockmarks, and has completed preliminary resource assessments of aggregate potential. Data and maps will be used to aid navigation, plan exploration activity in the Beaufort Sea, and assist Northern communities in developing management plans for offshore resources.

The Targeted Geoscience Initiative

Launched in June 2000, the Targeted Geoscience Initiative (TGI) is producing new geological maps and data for under-explored areas with a high potential for mineral deposits. These maps will guide companies to the most promising sites, thereby increasing the effectiveness and success of costly exploration efforts. The following three stories are examples of TGI projects.

Mapping Central Nunavut

The Committee Bay area, in the hinterland of several remote communities in western Nunavut, is a high-priority area for the Government of Nunavut. With potential for gold, platinum and other precious metals, in addition to base metals, the Committee Bay area is critical for the sustainable development of communities in Canada's North. The Committee Bay project is being funded under the TGI, and combines a variety of leading-edge technologies supporting the geological mapping of an area with high economic potential and significant social need.

Providing a Modern Geoscience Database for Atlin, B.C.

A three-year project to develop a modern geoscience database of the Atlin, B.C. area, and to advance understanding of its tectonic evolution and mineral potential, has already yielded promising results. Project partners are ESS and the B.C. Geological Survey, with support from staff and students from three universities: Victoria, British Columbia, and Lyon (France).

High-resolution aeromagnetic data, together with new bedrock mapping and analyses of regional geochemical data, clearly demonstrate that the region is more promising than was previously recognized. New exploration targets for volcanogenic massive sulphide and intrusion-related gold deposits have been identified. Interest is high, with a public geoscience lecture series in Atlin during the summer of 2001 attracting capacity audiences. The project will be completed by March 2003.

ESS Findings Benefit Diamond Prospectors in Northern Quebec

ESS and the Québec Ministry of Natural Resources carried out reconnaissance work during a drift-prospecting project, as part of a joint effort to promote the development of Northern resources. This work led to the discovery of diamond-indicator minerals in the Lac Bienville area. In March 2002, they delivered their findings at the annual convention of the Prospectors and Developers Association of Canada. This generated much interest and within the next five days, 572 exploration permits were granted.

Gas Hydrates: Fuel of the Future

ESS has been leading a research consortium since 1998 to provide the scientific and technical data on which to assess gas hydrates as a potential future energy source, and to ascertain the role they have played in past global climate change. Partners in the $36-million program, carried out in the Mackenzie Delta, include Canadian industry, Germany, Japan, India, the United States and the International Continental Drilling Program.

In the winter of 2002, the first production testing of gas hydrates took place at the Mallik Gas Hydrate Production Research Well, and new quantitative data were obtained on gas hydrate properties. Some 100 scientists and engineers from around the world will be involved in the field and post-field studies.

The Many Applications of Geospatial Data

- *Developing Quality Base Geospatial Data*

  GeoBase is an ESS-led national initiative in which federal, provincial and territorial governments are co-operating to make quality digital base maps available as the core framework data part of the Canadian Geospatial Data Infrastructure (CGDI). It will minimize duplication in data collection, improve the quality of base-layer geographical data and make it freely available as the framework for other geospatial applications.

  Over time, GeoBase will become the fundamental source of geographic information that describes the Canadian landmass, above and below water. ESS is working with partners to develop the GeoBase Portal by April 2003. It will provide Minimum Level framework data national coverage of satellite imagery, elevation data, road networks, geodetic information, geographical place names and administrative boundaries.

- *GeoConnections Helps Preserve Rare Habitats and Species*

  Under the Sustainable Communities Initiative (SCI), a partnership in New Brunswick's Tracadie region will create an inventory of endangered bird species and rare habitats. The Centre sur l'environnement de la Péninsule acadienne et ses environs (CEPAE) has a mandate to promote sustainable development, and counts various federal and provincial agencies and groups among its supporters.

  For the pilot project, biologists will use the Global Positioning System (GPS), digital cameras and Geographic Information Systems (GIS) to study, identify and map habitats at risk, as well as species of endangered birds and exotic butterflies. They will also map peat bogs, vegetation cover and agricultural fields. The project will lead to the development of a large GIS environmental database for use by the region's stakeholders.

RESEARCH, STUDIES AND AGREEMENTS

A Review of the Indian Oil and Gas Survey Standards

A review was conducted on the Indian Oil and Gas Survey Standards in consultation with key stakeholders. They included Indian Oil and Gas Canada (and pilot First Nations), industry, the Registrar of Indian Lands (INAC), the Association of Canada Lands Surveyors and the Alberta Land Surveyors' Association.

- *GeoConnections Supports Rural Development and Sustainable Agriculture in Eastern Ontario*

  SCI is partnering with seven Eastern Ontario counties and five local conservation authorities to develop and implement an Internet-based system to assist 26 small municipalities in their land-management decisions. Some 50 staff members will receive user-specific training in GIS. Using Web-based GIS and customized applications, communities will have easy access to consistent regional information on soils, geology, groundwater, surface water, agricultural land-use systems, wetlands, digital elevation models and forest covers across Eastern Ontario. The counties are Prescott and Russell; Stormont, Dundas and Glengarry; and Leeds and Grenville.

- *The Atlas of Canada Eco-Map Toured the Nation*

  A "Green Legacy" exhibit that travelled across Canada included an Atlas of Canada digital map as one of its key elements. The exhibit's goal was to show younger students how human activity can affect Canadian wildlife habitats. The Eco-Map, which is available on-line, depicts population variation over 25 years in Canada using the national ecozones framework.

  The Canadian Museum of Nature in Ottawa and the Royal Botanical Gardens in the Hamilton, Ontario, area sponsored the exhibit, which began at the museum and included stops at the Royal B.C. Museum, Nova Scotia Museum and Montréal Botanical Gardens. The Atlas of Canada is partnering with GeoConnections to make Canadian geographical information, services and tools readily accessible on the Internet.

- *Landsat-7 Satellite Coverage*

  This past year (2001-2002), Landsat-7 covered over 50% of the Canadian landmass, and these data were delivered to the Centre for Topographic Information (CTI) in support of their topographic GeoBase Imagery and map update project. The entire coverage of the country is being acquired through a partnership with all provinces and territories and several federal departments. The images are further processed by CTI into precise ortho-images using the best ground control available. Landsat-7 was launched in 1999 by the U.S. National Aeronautics and Space Administration (NASA) and is operated by the U.S. Geological Survey (USGS). One of Landsat's primary applications in Canada is forest management.

Strong and Safe Communities

Earthquakes, landslides, magnetic storms and even volcanic eruptions are all potentially damaging geological hazards in Canada. Permafrost and naturally occurring metals in the environment are also geological conditions that can pose hazards. ESS provides the scientific information about these hazards that forms the basis for sound land-use and emergency preparedness planning that touches directly on the safety, health and well-being of Canadians. The Sector also maintains the international boundary between Canada and the United States under the terms of a treaty established in 1925.

Natural Hazards
ESS makes every effort to further the body of geoscience and geospatial information and knowledge that is essential to identify and mitigate potential hazards to life and property. This information can support disaster mitigation and emergency response activities in Canada.

Georgia Basin Geohazard Initiative

Researchers are studying the Georgia Basin on Canada's West Coast to garner information on the sea-floor stability, including any geohazards. They want to determine its geologic structures and processes in light of recent earthquake activity in the area. Several collaborators are involved in the $1.18-million project, including researchers from several universities, the Department of National Defence, Environment Canada, B.C. Hydro, the Province of British Columbia and Moss Landing Marine Laboratories in California.

Scientists have mapped the sea floor in exquisite detail with multi-beam swath bathymetry. These surveys, done in partnership with the Canadian Hydrographic Survey, identified a significant gas-vent field and a fault just off Vancouver, confirmed by a follow-up seismic survey as being active and relatively young. Its relationship to recent earthquake activity is being studied.

The project will be completed in March 2003 with the release of both hard-copy and Web-based maps which integrate LIght Detection And Ranging (LIDAR) coverage off the coast with the detailed swath bathymetry of the sea floor. Complementary scientific publications and related maps will also be produced.

A More Effective National Earthquake Hazards Program

ESS is enhancing and strengthening Canada's seismic monitoring network, and increasing our capacity to respond to earthquakes. They are also developing, with partners, a pilot, urban strong-motion network in which seismometers will be deployed in buildings around Vancouver. To date, the Richmond School District, the Town of Sidney and Public Works and Government Services Canada have agreed to host instruments. Additional staff has been hired to make a pair of seismologists available on call around the clock. Please see: **http://www.seismo.nrcan.gc.ca/index-e.php**. The French site is at: **http://www.seismo.nrcan.gc.ca/index-f.php**.

Understanding the Interactive Nature of Earthquakes

A question involving a 46-square kilometre area in the Ottawa Valley near Lefaivre, Ontario, has finally been answered. The area displays irregular surface disturbance which many thought to be due to past glaciations, karst or landsliding. However, when a team of ESS geologists, engineers and geophysicists analyzed a 145-metre-deep borehole, they found that the region had responded aggressively to a large earthquake some 7000 years ago.

The findings underscore the importance of better understanding the interactions between earthquakes, liquefaction and landslides — especially given the similarity of soil conditions at this site to those of other urbanized areas in the Ottawa–Montréal–Québec City earthquake-hazard corridor.

Approaches to Mitigating Flood Hazards along Manitoba's Red River

Since 1999, geologists with ESS and the Manitoba Geological Survey have been studying the history of the Red River in Manitoba. The geologists constructed a record of severe floods over the past 350 years, and this geoscience information was applied to studies examining options for enhancing flood protection and developing public safety policy in southern Manitoba.

Geologists established the flood record by examining the tree-rings of bur oak trees that grow along the banks of the Red River, as a severe spring flood causes them to form an anomalous growth ring or "flood ring." A continuous tree-ring record was established that extends to AD 1286 by cross-dating the rings of living trees, oak timbers in historic buildings and logs recovered from the banks of the river. Additional research is extending the flood record further back in time based on lake cores, and will also assess the significance of geomorphic controls that may be altering the long-term flood hazard.

Coordinating and Delivering Services to Arctic Researchers
Polar Continental Shelf Program (PCSP), which coordinates and delivers logistics services to researchers working in Canada's High Arctic, supported 132 federal and territorial government, university and private-sector science programs related to the government's environmental, economic and social priorities. Research supported included resource assessments, climate-change and environmental studies, archaeological and paleontological programs, and traditional knowledge and oral history projects involving Northern communities. Improvements suggested in a 2000 client survey, which reflected an overall user satisfaction rate of 95%, were implemented, resulting, for example, in a more streamlined electronic applications process.

Cleaning up Hell's Gate

PCSP cleaned up an abandoned research site on southern Ellesmere Island at Hell's Gate. Refuse had been left at the site by a succession of research camps in the 1970s and 1980s. With advice and support from NRCan's Office of Environmental Affairs and funding from Treasury Board, PCSP sent in a clean-up crew comprising residents from Grise Fiord and Resolute Bay. They gathered up scattered oil drums, camping gear and other garbage, and backhauled it to Resolute Bay for proper disposal. An environmental team took samples in 2002 to determine the extent of subsurface contamination.

Maintaining the Border: The International Boundary Commission's Field Activities

The International Boundary Commission (IBC) is a partnership between Canada and the United States, with each country represented by its own Commissioner. The IBC maintains the 8891 kilometres of boundary defining the two countries in an effective state of demarcation. The Canadian Section falls under the aegis of Legal Surveys Division.

The September 11, 2001, terrorist attacks raised many safety and security concerns along the international boundary. Some concerns regarding vegetation and trees obstructing the boundary vista were addressed with two additional projects that were carried out during October and November. These involved vista-clearing along the 45th Parallel (the Quebec–Vermont/New York border), in particular along the major road crossings; and along the South Line (Quebec–Maine border).

The Commissioners, Thomas L. Baldini for the United States of America, and Michael J. O'Sullivan for Canada, acting under the treaties of 1906, 1908 and 1925, met in Ottawa on November 27, 2001. They reviewed the past year's activities, considered proposals for the 2002 field season, and discussed other items concerning the work of the Commission.

During its 2001 field season, the IBC completed projects in four areas. They maintained reference monuments and carried out a GPS survey along the southwest branch of the St. John River, along with clearing a 20-km stretch of vista along the northeast section of the Highlands (Quebec–Maine border).

Next, the IBC reconstructed boundary monuments and cleared 24 km of vista on the Quebec–Vermont border and the Highlands. They maintained reference monuments and carried out a GPS survey along the Detroit, Niagara and St. Clair rivers, and the Lake Erie, Ontario–New York boundary. Last, they managed a vista-clearing contract for a 22-km stretch in the Highlands along the Quebec–Maine border.

In July, Canadian Commissioner O'Sullivan accompanied the Engineer for the Commission on visits to the crews working on the Quebec–Vermont border and along the northeast section of the Highlands. In August, the Engineer for the Commission visited the crew working along the Detroit River.

Maps and Digital Topographic Information Augment Our Safety

After the September 11, 2001, terrorist attacks in the United States, ESS provided aeronautical information for dozens of aircraft stranded at airports across Canada and stood at the ready to provide emergency mapping.

When the Red River in Manitoba flooded its banks in Spring 2001, ESS provided image maps combining topographic data and satellite imagery to the emergency community, including National Defence.

In Fall 2001, ESS partnered with the Office of Critical Infrastructure Protection and Emergency Preparedness (OCIPEP) to provide orthoimages in support of the federal Emergency Preparedness Program. The images originated from the Indian Remote Sensing (IRS) satellite and covered Canadian cities with 25 000 or more inhabitants.

Geodesy's Contribution to Understanding Climate Change and Natural Hazards

ESS is coordinating a multi-partner project in which special networks of GPS satellite-tracking stations are providing a continuous record of tiny vertical movements of the Earth's crust. Scientists can then distinguish the long-term changes in water level from the related land movement. Most networks are globally integrated through the International GPS Service and are located near water-level gauges on all three oceans and the Great Lakes.

The resultant information will provide key constraints for Climate Change and Natural Hazard models, while improving the North American spatial reference frame and contributing to satellite altimeter calibration and other oceanographic activities. ESS's partners include federal agencies and universities in Canada, the United States and Germany.

Linking Airports to the National Coordinate System

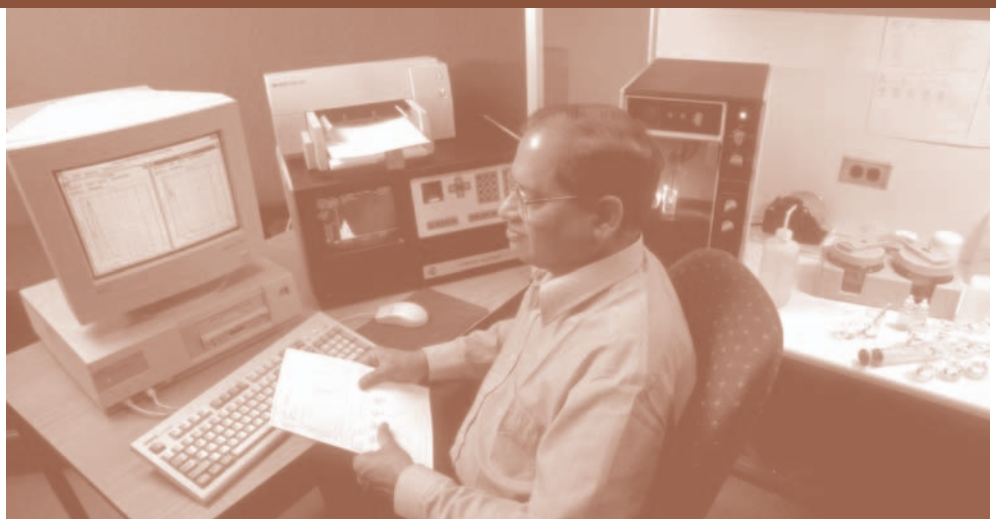
ESS enhanced airport safety by providing data to Nav Canada for the airport Instrument Landing Systems (ILS), which aircraft depend on to land safely in reduced visibility. In collaboration with ESS, Nav Canada positioned the airport GPS reference stations and all 132 ILS across the country using data from NRCan's Canadian Active Control System, thus improving the accuracy and ongoing reliability testing of these systems. By referencing data to the standard national coordinate system, the spatial compatibility throughout Canada of aircraft, airport and other local information is assured, allowing it to be shared and integrated with additional sources of information for a multitude of purposes.

GeoConnections Helping Community Planning in Alberta

SCI is partnering with Hinton, Alberta, to develop a community-planning tool that will help them analyze trends and development alternatives. Using a Web-based GIS portal, Hinton will make base maps, as well as utility, ownership and forestry information, available to the public. The community also wants to distribute forest-fire mitigation planning tools via the Internet. Satellite imagery will supplement the information, as will planning and project information developed by town employees.

Sustainable Communities Projects
Modern mapping technologies are equipping rural, Aboriginal and Northern communities to make informed decisions for sustainable development. By mid-2002, 58 projects under the SCI, a GeoConnections component, were in progress or had been completed.

Connecting Canadians



In support of Canada, innovative tools, products and services, as well as important databases, are being made available on-line. GeoConnections, a national partnership initiative led by NRCan, is the main vehicle for delivering this geospatial information, helping Canadians to become better informed, enabling better policy and business decisions, and advancing Canada as a world leader in developing and using innovative on-line content and services.

Census and Other Information Combined on the GeoConnections Discovery Portal

In March 2002, Statistics Canada released the first data sets (population and dwelling counts) from the 2001 Census. The release includes distribution of the digital census subdivision (DCS) boundaries and is available through the GeoGratis service on the GeoConnections Discovery Portal.

The DCS framework was integrated with the 1:1 M hydrography layer under a GeoConnections partnership project with the Atlas of Canada. This layer, in turn, links to other environmental frameworks (e.g. ecological regions), allowing end-users to combine a wide range of demographic and environmental information.

Making Maps for the Visually Impaired

In 2001, Internet users who are blind or visually impaired were able to go exploring through a new Web site developed as part of a Government On-Line initiative. The Mapping for the Visually Impaired (MVI) site delivers tactile and audio-tactile maps and geographical information. It complements the Tactile Atlas of Canada, which provides braille and large-print versions of provincial and territorial maps of Canada. Please see: **http://tactile.nrcan.gc.ca**.

The Evolution of Iqaluit

A new Web site of Iqaluit traces the evolution of Nunavut's capital city with maps, aerial photos, local photographs and historical accounts. The Spatial and Historical Evolution of Iqaluit Web site promises to be a valuable tool for learning GIS, and for its information on social studies and geography. Please see: **http://maps.nrcan.gc.ca/iqaluit**.

ESS and the Government of Nunavut collaborated to produce the Web site. It is part of the Internet-Based Cartographic Visualization Project, intended to investigate, develop and evaluate methods and tools for effective visualization of cartographic information on the Internet. Please see: **http://maps.nrcan.gc.ca/visualization/index.html**.

GeoConnections Project Showcase

GeoConnections partnerships have produced a range of successful projects, and the GeoConnections Project Showcase, held in Ottawa in January 2002, drew some 150 participants from the public and private sectors for a first-hand look. Attendees from Canada and the United States viewed non-technical demonstrations of 12 projects, ranging from a health-watch Web site to software for the multilingual creation of metadata for Web sites.

Information-sharing is essential to meeting GeoConnections' mandate to help accelerate development of innovative Canadian geomatics tools, products and services, and to foster the growth of Canada's knowledge economy, both nationally and internationally.

GeoConnections Supports the Canadian Geoscience Knowledge Network

The Canadian Geoscience Knowledge Network is an initiative to give users of Canadian geoscience data easy access to nation-wide data. Specifically, the Network will provide users with consistent, direct access to the information holdings of Canada's federal, provincial and territorial geological surveys, and make the data from those surveys more easily integrated.

GeoConnections and the GSC are helping to fund the Network, which received $1.4 million in 2001–2002 from the GSC, GeoConnections, provincial and territorial agencies, and the TGI. This new funding will support projects involving the National Bedrock Geology Database, National Surficial Geology Database, Toolkit for National Geochemical Database, and XML-based Data Transfer standards for mineral occurrence and geochemical data.

GeoConnections Releases Its Technical Architecture

In February 2002, the GeoConnections Technology Advisory Panel (TAP) met in Ottawa to finalize the CGDI technical architecture document. TAP includes over 45 representatives from private-sector companies, the U.S. Federal Geographic Data Committee and key Canadian public-sector agencies.

GeoNames Web Site Awarded WEB FEET Seal of Approval
In February 2001, NRCan's GeoNames Web site received the WEB FEET Seal of Approval and appeared in the monthly Subject Guide to the Best Web Sites. This recommendation tells teachers, librarians, parents and students that the site is especially valuable for research and teaching.

WEB FEET has been selecting and describing the best resources on school curriculum and personal-interest topics for schools and public libraries since 1996. Please see: http://geonames.nrcan.gc.ca.

This document is an important milestone because it identifies the technical standards and approaches for partners to adopt as they develop applications and uses of the enabling infrastructure being developed as part of the CGDI.

A working group created the architecture, which is linked to related international efforts. Canadian firms are leading the development of software products that respond to world-wide technical standards.

Contributing to the CGDI Development Network

The CGDI Development Network is intended to provide a home for collaborative innovations and advanced geospatial-systems development. This relatively new GeoConnections initiative offers a supportive environment for public- and private-sector agencies from across Canada to test technology and prototyping, and to support the continued growth of the CGDI.

In October 2001, participants from 15 organizations met in Ottawa for a key meeting, which resulted in more than 12 geospatial applications and services being made available as pre-operational contributions to the CGDI. All services and applications are based on the Internet geographic-information standards endorsed by GeoConnections.

The New Earth Sciences Sector Web Site

The new ESS Web site, developed by the Government On-Line Office, demonstrates how the Sector's work is contributing to government objectives. Please visit the Web site to explore our innovative projects, discover our products and services, and learn more about how we are working for you. The site is at: http://www.nrcan-rncan.gc.ca/ess-sst.

Northwest Territories Signs the Canadian Geomatics Accord

The signing of the Canadian Geomatics Accord by the Northwest Territories brought eight provinces and territories into the fold: Ontario, Alberta, Manitoba, Prince Edward Island, Nova Scotia, British Columbia and the Yukon. The Accord creates a framework for federal, provincial and territorial collaboration in the collection, maintenance and distribution of geomatics data. It was initiated by the CCOG and is co-led by GeoConnections. Work continues with the Geomatics Accord to negotiate data-sharing agreements with outside agencies, such as the provinces and territories.

Planning the Future of Geomatics in Canada

A private-sector study of issues confronting the Canadian geomatics industry resulted in, among other things, a cohesive national plan to develop a geomatics work force. GeoConnections contributed to the study, undertaken in partnership with Human Resources Development Canada, the Canadian Council of Land Surveyors, the Canadian Institute of Geomatics and the Geomatics Industry Association of Canada.

The study analyzed the sector and determined how global market and technology changes could affect human resources. It defined challenges and identified the number of geomatics jobs, including a breakdown by region and sub-sector. Finally, it forecast the size of the geomatics market for 2004, and identified the skills and human-resource issues and opportunities for Canadians.

Increasing the Electronic Delivery of Information

LSD launched its Web site at **http://www.lsd.nrcan.gc.ca**. The ultimate goal is to turn information into knowledge for users, clients, partners and stakeholders.

Metadata and Classification databases were created and populated according to GeoConnections geospatial metadata standards. These metadata were connected to the GeoConnections Discovery Portal.

The Internet version of the Survey Records Information System was built and tested using leading-edge Cold Fusion programming techniques. Now Internet users and internal personnel can quickly and efficiently find information filed in the Canada Lands Survey Records.

High-resolution IKONOS imagery continues to be used, where appropriate, as a cadastral and land-management tool.

Integrating Canada Lands Administrative Boundary Data into the CGDI

A new project to integrate data will provide Canadians with free on-line access to the administrative boundaries of Indian Reserves, Cree-Naskapie Lands, Yukon First Nation Lands and national parks. ESS obtained signed agreement to participate from INAC, Parks Canada, Canadian Forest Service, Yukon Territorial Government, Ontario Ministry of Natural Resources, Service Nova Scotia and Municipal Relations. The project is scheduled for completion in March 2003.

Aboriginal Peoples

ESS is contributing to better knowledge and understanding of Northern communities and the Aboriginal peoples who live in them through a range of information. This includes new maps, procedures for changing place names, training and technology transfer, and using geoscience to discover and analyze mineral wealth. Projects under the SCI, a GeoConnections component also funded by ESS, are building capacity in rural, Aboriginal and Northern communities by providing them with modern mapping technologies to make informed decisions for sustainable development. Reliable and consistent geospatial information and well-defined property rights are an important part of development and investment in the North and the people who live there.

Ensuring the Continuance of Traditional Knowledge

Through its Traditional Knowledge Program, PCSP extended logistics support to four programs involving elders in all three territories in 2001. The Iqaluktuuq Project, which involved 15 elders and students from Cambridge Bay, conducted research into long-term patterns of Inuit cultural history. The Kitigaaryuit Archaeological Inventory and Mapping Project involved oral history interviews with elders from Tuktoyatuk and Inuvik. The Inullariit Elders Society, a recipient of the Northern Science Award from INAC, conducted a series of land-skills training workshops for Inuit youth from Igloolik. Finally, the Vuntut Gwichin First Nation worked with an anthropologist to record the oral history of elders from Old Crow, Yukon, and to create a database of material gathered.

Capstone Study Examines the Flexibility of the Canada Lands Survey System

Two academics in geomatics, Dr. Brian Ballantyne from the University of Calgary and James Dobbin from the College of Geomatics Science in Nova Scotia, produced a report for ESS on the flexibility and rigour of the Canada Lands Survey (CLS) system. Known as the Capstone Study, it examined LSD's mandate vis-à-vis Aboriginal peoples with respect to devolution. The report encourages flexibility within the CLS system with recommendations for ESS to engage in fruitful discussions with First Nation clients, INAC and other users of the CLS system, and Geomatics Canada.

Aboriginal land-registration systems must be flexible so as to deal with as-yet unknown tenure structures and survey products that the groups will use. They must be designed by, or in partnership with, Aboriginal groups. Three land-registration systems meet these criteria: private conveyancing systems; a reformed Indian Lands Registry system; and a centralized First Nations land-registration system. Any of these would integrate well with the CLS system.

The Management Board of LSD is analyzing and discussing the Capstone Study to ensure that a strong property rights infrastructure is in place.

Performing Legal Surveys and Supporting Land Management Activities

Legal Surveys Division is responsible for maintaining the high quality of legal surveys required to protect Canada's interests and private interests in Canada Lands. These include the northern territories, Indian Reserves, national parks, national historic parks, national historic sites and Canada's offshore. One land-claim survey of national importance resulted in the creation of Nunavut.

Section 24 of the *Canada Lands Surveys Act* contains a detailed description of Canada Lands. Over 70 000 survey documents covering an era spanning from as early as 1871 to today are recorded in the depository. Legal documents used to transfer property rights from one owner to another make reference to these recorded survey documents in the official description contained in the transfer documents.

Working with INAC, The National Aboriginal Lands Management Association and the First Nation Land Management Act Board, LSD supports activities arising from the devolution and responsibilities of land management to First Nation groups as it relates to geomatics in property infrastructure.

LSD continued to work in cooperation with the Association of Canada Lands Surveyors (ACLS). Several staff served on numerous committees within ACLS, including a joint standards committee. LSD also supported ACLS by providing data in their practice review process.

LSD attended and assisted with the organization and presentation of Aboriginal and Offshore workshops in Victoria, B.C., in May 2002.

Capacity-Building Endeavours

Within ESS, LSD's role was clarified as that of a facilitator of capacity-building initiatives for property rights management. NRCan continued its financial support, ensuring the success of the Northwest Territories School of Community Government Land Administration Program. LSD also participated in an NRCan Northern Saskatchewan Pilot Project and helped two Tribal Councils develop their Registry Index Plans.

Delivering Professional Services to Indian Reserves

The ten Client Liaison offices within ESS continued to enjoy a good rapport and working relationship with the Indian Reserves within their jurisdiction. They assisted by providing professional advice and networking contacts for special requests in land management. The geomatics environments differ from province to province, and these client offices provide knowledge transfer wherever possible in support of First Nations aspirations. This can include working in tripartite agreements in Atlantic Canada to providing direct equity to First Nations in the Yukon Territory. An Interchange Canada agreement was signed with the Government of Nunavut to share LSD's employee for work in the Nunavut Land Titles Office.

Atlas Publishes Maps on Aboriginal Population

The Atlas of Canada, a partner of GeoConnections, published a series of five maps based on 1996 Census data to illustrate the distribution of the Aboriginal population. These maps and their supporting data are accessible over the Internet.

The Atlas of Canada is breaking new ground by publishing interactive maps on Aboriginal identity, including maps on the First Nations, Métis and Inuit. Each map offers a national and regional view of the population distribution. Users can access Statistics Canada's Community profiles for further information on education, income, work, family and dwellings for each community.

Changing Names: The Geographical Naming Process

ESS consulted with the Aboriginal community and produced a trilingual fact sheet called "Aboriginal Place Names — Charting Our Heritage." Available in English, French and Inuktitut, it outlines the process and procedures for proposing or changing geographical names in Canada. Place names play an important part of Aboriginal land-claim agreements and this publication provides information for sound decision-making.

ESS actively pursues partnerships with the public and private sectors to create a strong science and technology Earth sciences network. It contributes to the foundation of knowledge and information and builds upon it through partnerships chosen with innovation in mind. The result is data and products, information and technologies that contribute to Canadians' social and economic well-being.

Topographic Information Serving the Auto Industry

ESS is an AUTO 21 National Centre of Excellence partner in the project 'Construction of an Integrated Navigation Information Infrastructure.' Its partners are the universities of Calgary, Windsor, Laval and Sherbrooke, and industrial partners DaimlerChrysler, Bell Canada, AUG Signals Ltd. and Manifold Data Mining. The project is in the area of Intelligent Systems and Sensors, and ESS is contributing by providing topographic data and participating in collaborative research. Please see: **http://www.auto21.ca**.

Development of a High-Resolution Environmental Monitoring Tool

Developed under the ESS Metals in The Environment (MITE) Program, this new environmental evaluation methodology, based on isotopic dendrogeochemistry, allows researchers to date the onset and monitor the progression of environmental disruptions in specific ecosystems. As one example, analysis of vegetation surrounding Rouyn-Noranda has distinguished metals derived from nature vs. those from the smelter. In a related application, it was demonstrated that high levels of potentially toxic substances in boreal forests, such as sulphur dioxide emitted by smelters, greatly diminishes the carbon dioxide intake by trees, and consequently lessens their ability to reduce the greenhouse effect.

BRINGING SCIENCE TO PARLIAMENT HILL

ESS Scientist Speaks at "Bacon & Eggheads" Science Breakfast
On February 7, 2002, ESS Chief Hydrogeologist Dr. Alfonso Rivera was invited to speak at a Parliament Hill science breakfast sponsored by the Partnership Group for Science and Engineering. These events, known as "Bacon & Eggheads," are a series of breakfasts with parliamentarians, scientists and engineers to bridge the gap between policy-makers and experts in a variety of fields. Dr. Rivera spoke on the wise use and protection of our groundwater resources, a key issue since the Walkerton tragedy.

Please see: http://www.pagse.org.

Renewal of an Innovative Government–University Partnership

ESS and Institut national de la recherche scientifique (INRS) have renegotiated their collaborative agreement to reflect the new ESS S&T strategy and structural changes in INRS. The partners will pursue their collaborative work in a common scientific program within the Québec Geoscience Centre (QGC). QGC is a unique federal–provincial research collaboration model based on a sharing of scientific facilities and resources to promote cost-effective research benefiting the dynamic geoscience community in Quebec and Eastern Canada.

Geoscape Canada

Using posters and companion Web sites, the Geoscape Canada project depicts and describes the influence of the geological landscape (geoscape) and natural resources on the social, cultural and economic development of 15 communities across Canada. Completed in 2001–2002 in partnership with the Québec Ministry of Culture and Communications and the Université du Québec à Montréal, Geoscape Montréal portrays and explains the significance of recognizable features of this region's interesting geoscape.

GeoInnovations Projects Support the CGDI

The industry–partnership program of GeoConnections — GeoInnovations — brings together expertise and technology to spur the development of new applications, tools and services for the CGDI, and to promote the growth of Canada's geomatics sector. In 2001, GeoInnovations sponsored nine projects to develop commercial geospatial infrastructure tools and services, as well as three projects for CGDI geomatics applications.

All GeoInnovations projects have three objectives:
- to accelerate the industrial development of innovative geospatial infrastructure technologies, tools and services;
- to encourage the development of on-line, geospatial-based applications that use CGDI data and services; and
- to support the development of Canadian geomatics expertise and products for export.

New Products

ESS has developed *CanImage* through collaborative agreements with federal, provincial and territorial partners and GeoConnections. *CanImage* consists of Landsat-7 orthoimages that have been enhanced and reclassified, and are distributed through the NTS 1:50 000 map sheets. More than 35% of Canada is available in this format, with full coverage planned within three years.

The Sector is introducing a new digital product called *CanMatrix* to support economic development of the North and sustainable development across Canada. *CanMatrix* is a series of digital files derived from scanning NTS paper maps at 1:50 000 and 1:250 000, which duplicate the original NTS map sheets. A complete data set will first be produced for Northern Canada, with coverage of the entire country to be completed by the end of March 2003. *CanMatrix* can be used as a background display for various computer applications, and will be of interest to GPS users who are familiar with digital topographic data but are not specialists in the field of geomatics. Please see: **http://www.ctis.nrcan.gc.ca**.

The VMap1 cost-shared, three-year project with the Department of National Defence has been completed. ESS produced the Canadian data from the National Topographic Data Base at the 1:250 000 scale, for a world mapping database using the military specifications of Vector Map, level 1. Benefits include client satisfaction for the product delivered, rare expertise acquired by ESS and an improved topographic database for Canada.

GlobeSAR Educational Resource Package

The GlobeSAR-2 Education Resources for Remote Sensing CD-ROM, produced by ESS under the GlobeSAR-2 project in partnership with the Canadian International Development Agency (CIDA) and industry stakeholders, represents the most complete and authoritative Synthetic Aperture Radar (SAR) curriculum resource available today for educators and students. It is a strong and highly visible demonstration of Canadian world leadership in the area of SAR applications and technology.

The CD product is available in English, French, Spanish and Portuguese versions. Since the product's Web release in March, nearly 4000 copies of the CD have been provided, free upon request. Not surprisingly, demand is strongest from Latin America, where GlobeSAR-2 focused on long-term capacity building.

Innovation Acceleration Centre Opens

In February of 2002, ESS officially opened its Innovation Acceleration Centre (IAC) to provide a framework for cooperation between the geomatics and geosciences industry and government. The IAC strives to accelerate the development of innovative products and services by Canadian industry. Industry's response has been positive, and to date two projects are finished, two have requested extensions, eleven are under way and five are being developed.

Canada Leads a Standards Group

Through CCRS, Canada was voted by the ISO member countries to lead a working group on the development and implementation of the ISO Imagery, Gridded and Coverage Data project. Experts from more than 17 countries and various institutions are involved in this development.

Successful Earth Sciences Conference Wraps Up on the Hill
Some 430 conference participants from Canada and abroad brought science to Parliament Hill with a closing banquet at the West Block on May 17, 2001. The symbolic gesture marked the conclusion of the highly successful 27th annual scientific conference of the Canadian Geophysical Union, representing the broad field of Earth sciences.

ESS had a strong presence, and the growing influence of geodesy was an underlying theme in a diverse range of forums. These included reconstruction of the North American ice sheet (climate change), post-glacial rebound monitoring, and the role of GPS in space weather and meteorology. Peter Adams, Ph.D., MP for Peterborough and a long-standing member of the scientific community, and former Minister of Natural Resources Ralph Goodale, MP for Wascana, spoke at the closing banquet.

In Situ Earth Sensing Group Under Way

In response to the increasing importance of in situ sensor data and their assimilation into models that use remote sensing data, ESS formed the In Situ Sensor Measurement Assimilation Program (ISSMAP), led by CCRS. The group's objective is to make significant advancements in the practical use of Earth-observation data by developing intelligent in situ measurement capabilities to help generate quantitative Earth science information products. Program objectives are to design and deploy wireless networks of autonomous sensors (sensorwebs) to acquire in situ data; develop approaches to fuse in situ and remote sensing data; and facilitate the integration of in situ sensor data and/or metadata into on-line geospatial data infrastructures.

ISSMAP is a multi-faceted effort to develop an integrated Earth-sensing capacity in Canada. Since its inception, ISSMAP has provided seven contracts to Canadian industry, undertaken six leveraged collaborations and developed eleven additional partnerships. CCRS put together and deployed a prototype sensorweb to measure meteorological parameters and soil moisture in the Red River basin in Manitoba as part of a flood-forecasting effort. The next sensorweb deployment will be targeted at drought monitoring in Alberta.

ESS Photo Database More Than Doubles in Size

The ESIC maintains and develops the ESS photo database, a digital collection selected from its holdings of photographs dating back to the 19th Century. In 2001–2002, the database more than doubled its size with 3000 new images. Canadian Heritage donated $30 000 as part of an Images Canada project to develop digital-image collections.

The database is at: http://www.nrcan.gc.ca/ess/esic/galleries_e.html#Photo.

Images Canada is at: http://www.imagescanada.ca.

The Geospatial Standards in Action Initiative

The Canadian Geospatial Standards in Action Initiative showcases Canadian standards-based products as part of integrated geospatial architecture. CCRS and GeoConnections are leading the initiative, which involves 17 companies and the Standards Council of Canada. Small demonstrations of these technologies have resulted in the Canadian private sector delivering solutions for other countries, being involved in United Nations programs and helping to implement ISO specifications through the Open GIS Consortium.

New Publishing Services Subdivision

The new Publishing Services Subdivision of ESS Info publishes geoscience information in partnership with the GSC. It provides scientific and technical editing services for ESS clients, and support for the preparation of maps, posters, illustrations and scientific reports. Clients can visit one location for these services.

The reorganization led to an increase in the number of publications produced, as well as a new multi-format release of geoscience information, including an on-demand print form, Web access and digital release for some GSC publications. A Memorandum of Understanding with Communications Canada agrees to deliver on-demand products for national depository libraries.

Creating and Sharing Opportunities Globally

ESS has a long tradition of scientific excellence, coupled with leadership and advocacy of Earth sciences on the world stage. The Sector has formed international partnerships to carry out Earth scientific research of mutual benefit. Such projects have increased our understanding of the global environment and created opportunities for the Canadian geoscience and geomatics industry. ESS staff are directly involved in many international projects, ranging from the Mallik Gas Hydrate Project in the Mackenzie Delta; to the establishment of a national geomatics program in the Republic of Tunisia; to supplying knowledge and expertise in aid of humanitarian projects, such as a land-mine detection project in Mozambique.

South American Geoscience Connections

The Multinational Andean Project (MAP), which started in 1998, was successfully completed in November 2001, far exceeding the expectations of the South American partners: the geoscience surveys of Argentina, Bolivia, Chile and Peru. CIDA contributed $4.9 million toward the ESS-led project, and the partner countries contributed $7 million. MAP's key products included the metallogenic map of the Andean Border Region, airborne geophysical surveys, geochemical standard samples collection and the MAP samples database. CIDA has agreed to fund a second MAP project focused on natural-hazard mapping and mitigation.

GlobeSAR-2: Technology Transfer and Capacity Building in Latin America

The GlobeSAR-2 program, initiated in 1997, is a geomatics technology-transfer program that uses RADARSAT to improve resource management in Latin America. Eleven countries are building their capacity in radar remote-sensing through technology transfer. CCRS initiated the program, and has been the lead coordinating agency through its life span. CIDA and the International Development Research Centre (IDRC) fund the program.

The GlobeSAR-2 objectives are to demonstrate applications of RADARSAT in priority areas of natural-resource management in Latin America; to develop "in-country" expertise in the use of RADARSAT; to establish institutional linkages between Canadian and Latin American universities; and to provide exposure to Canadian geomatics companies through technology transfer and by identifying commercial opportunities.

The program's accomplishments include RADARSAT support for some 65 projects, as well as 100 radar image-processing software licences and 40 training workshops and seminars. Leading scientific journals have published research on the project, and 20 university and industry exchange projects between Canadian and Latin American institutions were established.

The GlobeSAR-2 program office will continue operating so that with the anticipated launch of RADARSAT-2 in 2004, the participants can further develop the use of radar satellite technology as tools for planning and resource management in the coming decade. Please visit the Web site at: **http://www.ccrs.nrcan.gc.ca/ccrs/homepg.pl?e**.

Northeastern Brazil Groundwater Project

A Canadian presence in drought-stricken northeastern Brazil is helping to ease the widespread hardship of the people and the economy of the region. CIDA sponsored the Northeastern Brazil Groundwater Project (PROASNE), to introduce advanced technologies for mapping groundwater and managing the limited resource.

The project was launched in April 2000 and is scheduled to continue until March 2004. The Geological Survey of Brazil (CPRM) is the main partner. It, with the other Brazilian partners, is contributing some $6.8 million of the total budget of $8.4 million.

The approach is to enhance the capacity of Brazilian institutions in groundwater exploration and management through technology transfer. ESS scientists, working in close collaboration with Canadian industry, have introduced new techniques to identify potential underground sources of potable water based on airborne geophysics and remote sensing, and they are developing new techniques to pump, treat and distribute water over large areas using solar energy.

These technologies are part of a new scheme being promoted by PROASNE that could significantly improve groundwater management practices in northeastern Brazil. The project is also active at the community level through an elaborate social program that undertakes needs assessment and provides education on water conservation, protection of groundwater sources, waste disposal and sound agricultural practices.

International Leadership in Absolute Gravimetry

In July 2001, ESS's Absolute Gravimetry Team spent two weeks exchanging knowledge with colleagues from North America, Europe and Japan at the International Inter-laboratory Comparison of Absolute Gravimeters. State-of-the-art absolute gravimeters can determine gravity to an accuracy of microgals, equivalent to that caused by less than a centimetre of elevation change.

Held every four years in Sèvres, France, the event provides a means of ensuring national compatibility with international gravity standards. This is very important for Canada's infrastructure of precise positioning. Among other things, the infrastructure contributes to northern development and exploration of our natural resources.

Linkages Across Governments: Building Geospatial Framework Data

Canada and the United States are building separate, but compatible, national spatial data infrastructures (SDI), which will ultimately contribute to the Global Spatial Data Infrastructure (GSDI). The USGS, GeoConnections and partners have completed two joint demonstration projects which compiled geospatial framework data on regions that cross the international boundary — the Yellowstone-to-Yukon Project and the Red River Basin Project.

A U.S. government summit in Colorado in May 2002 brought together representatives from ESS and USGS. Following presentations on the demonstration projects, GeoConnections and ESS representatives attended follow-up meetings at which their U.S. counterparts emphasized the need for current and accurate joint geospatial data. USGS representatives visited Ottawa in late May to continue discussions on joint ventures encompassing the areas of security and first response.

GeoConnections Boosts Canadian Firms' International Success

An Open GIS Consortium (OGC) meeting held in Vancouver in December 2001 gave some Canadian companies an opportunity to demonstrate their technical leadership. The OGC is a U.S.-led, highly influential consortium of international companies and government agencies working to develop specifications for geospatial products and services. GeoConnections and Galdos Systems Inc., from B.C., jointly sponsored the meeting, which attracted about 150 members from Asia, Australia, Europe and North America.

Through an OGC pilot project, CubeWerx Inc. (Quebec), Compusult Ltd. (Newfoundland), Galdos Systems Inc. and PCI Geomatics (Ontario), won contracts to work on the Multi-Hazards Mapping Initiative and clearly demonstrated their technical leadership. GeoConnections is committed to working in partnership with Canadian companies participating in the OGC.

ESS Provides Expertise to Develop Geomatics Program in Tunisia

ESS is working with the Government of Tunisia to establish a national geomatics program, providing expertise and technology transfer supporting the design of a national geomatics infrastructure (GÉONAT). Fourteen Tunisian government departments are working together with ESS and some Canadian companies to develop a common geospatial infrastructure. The $4.3-million GÉONAT project, funded by CIDA, will contribute to the sustainable development of Tunisia.

Geospatial Expertise Helps De-Mining Actions in Mozambique

The Sector is committed to CIDA's five-year, $10.5-million Mine Action Program to rid Mozambique of land mines. ESS is managing a $1.25-million geospatial information project to help in planning the removal of these mines. It involves the acquisition and transfer of equipment and software to Mozambique, along with the transfer of technical know-how. ESS is working in partnership with the Canadian geomatics industry and Mozambique's national mapping agency.

The raster geospatial information and the digital toponymic database collected will be of immediate benefit to the de-mining community. Users will be able to integrate existing digital data to the new raster maps. The integrated product will provide a clearer image of the lay of the land, which will greatly help in prioritizing and estimating the cost and time required to clear mined areas. In the future, the Mozambican National Mapping Agency will be able to update and improve these databases, and provide its government with a powerful tool that can be used in planning the development of projects in support of its sustainable development strategy.

Collaborating on Canadian Arctic Research

PCSP manages the Canadian Arctic–Antarctic Exchange Program, which is designed to encourage scientific collaborations among Canadian Arctic research scientists and their Antarctic colleagues. The program receives some funding from the Department of Foreign Affairs and International Trade (DFAIT).

In 2001, PCSP supported three programs in the Arctic through the exchange program. The first was a study into the mass balance of the Agassiz Ice Cap, which involved a British research scientist; the second, a climate change-related research program, involving a University of Madrid researcher; and the third was a collaborative program that compared marine organisms, involving a New Zealand scientist.

The Antarctic research scientists sponsor their Canadian colleagues' research in Antarctica in exchange for PCSP's support for their Arctic programs.

Trade and Investment

Canada's Earth sciences industry is a major contributor to the Canadian economy and a key player in the global economy. Year after year, it continues to demonstrate its comparative advantage by competitively exporting products and services, both in geomatics and geosciences. The Sector's trade and investment program concentrates on the development and promotion of Canada's private sector and its exports, with due consideration to the sustainable development of developing countries. The program is delivered in cooperation and coordination with its stakeholders — in business, governments and educational institutions — in Canada and abroad.

ESS Part of NRCan Mission to Mexico

The Sector played an active role in the NRCan mission to Mexico in September 2001. The NRCan delegation, which included five Earth sciences companies and 20 energy companies, was well received and the Mexicans were very interested in building good relations with Canada.

The mission provided an opportunity to acquire a better understanding of the Mexican market by both the Canadian government and the private sector, including how to do business in Mexico. The excellent contacts made by the Canadian business participants should lead to increased business for Canada in Mexico. The mission also provided opportunities to explore government-to-government cooperation and to inform the Mexicans of Canadian business capabilities.

Calibrating Weights Using the Canadian Spatial Reference System

The national standard of reference for spatial positions has proven its usefulness in a whole new area: calibrating weights. Measurement Canada began providing its Weights and Measures inspectors, and their clients, with access to gravity information from ESS's gravity database.

Gravity is used to establish the elevation component of positions in Canada. Now, a Web-based calculator provides a calibration factor for a weight scale as it is moved to any location in the country that has a Gravity Standardization Network station. Accurate, uniform measures ensure confidence in the marketplace and contribute to fair and competitive domestic and international trade.

Gravity measurements were first performed in Canada in 1902 by the National Gravity Program, which was then under the Dominion Observatory. Today, the program is managed by the Geodetic Survey Division of NRCan.

Expansion of Landsat-7 Distributor Network

RADARSAT International Inc. (RSI) of Richmond, B.C., announced in June 2001 that it had become the largest commercial distributor of Landsat-7 imagery. RSI has been distributing Landsat data products under sub-licence from ESS since late 1999 and other Landsat data since the early 1990s.

In September 2001, Resource GIS and Imaging Ltd. (RGI) of Vancouver was added to the ESS Landsat-7 data distributor network under sub-licence from ESS. This resulted in the expansion of RGI's existing satellite image-processing business, providing the user community with a competitive and wider choice of products and value-added products and services.

RADARSAT-2 Ground Segment Development

The RADARSAT-2 ground segment is well under way. It is being developed as a flexible modular system that can support RADARSAT-2 and other missions through a short development cycle and cost-effective upgrades. The system is being developed by CCRS in conjunction with MacDonald, Dettwiler and Associates (MDA) of Richmond, B.C., the owner and operator of RADARSAT-2. CCRS is responsible for testing and accepting the system, which is funded by the Canadian Space Agency.

ENVISAT Ground Segment Development

The European Space Agency launched ENVISAT on March 1, 2002. The ESS ENVISAT ground segment was ahead of schedule and is ready to receive data from the Advanced Synthetic Aperture Radar (ASAR). ASAR data will be used as a complementary data source to RADARSAT-1 and will serve as contingency should RADARSAT-1 be unavailable. The Canadian Space Agency funded this ground segment.

New CEOSAM and DAF Control Systems for RADARSAT-2

On behalf of CCRS, the federal government contracting authority awarded MDA two contracts for information systems. The first is to build a planning and scheduling system for satellite data acquisition and reception at ESS facilities in Saskatchewan and Québec, including a new capability to support RADARSAT-2. The second contract is to build the system that controls satellite data reception at both facilities. Work is well under way on these upgrades.

With the advent of RADARSAT-2, ESS will be entering a new era in Earth observation. Both the CEOSAM and DAF control systems will allow ESS to meet its clients' needs, and the Sector will occupy a leadership role in bringing remote sensing information to the Earth-observation community.

As part of its modernization program, ESS requires a modular system that can support existing missions, as well as the upcoming RADARSAT-2 mission, and can be easily expanded to support future satellite missions. The new planning and scheduling system, CEOSAM, will provide a Web-based client interface to support user ordering, in addition to all of the current functionality. The DAF Control System is an upgrade that will coordinate satellite data reception at the Gatineau and Prince Albert ground stations. It will also support the reception and archiving of data from RADARSAT-2, ENVISAT, Landsat and SPOT.

A New Application for GPS Elevations

Did you know that the heights determined by GPS are meaningless numbers for most people until converted to elevations referenced to the mean sea level, or geoid? In late 2001, ESS made these conversions easier with the latest CGG2000 Canadian gravimetric geoid model.

Based mostly on gravity observations obtained throughout Canada and globally, the conversion is available in the "GPS-H Package" application. ESS developed the gravimetric geoid model, considered to be a basic tool for sustainable development, with the help of provincial government elevation models and through collaboration with geodesy experts in Canadian universities and foreign agencies.

Glossary of Acronyms

ACLS	Association of Canada Lands Surveyors
ASAR	Advanced Synthetic Aperture Radar
CCAF–PARC	Climate Change Action Fund–Prairie Adaptation Research Collaboration
CCOG	Canadian Council on Geomatics
CCRS	Canada Centre for Remote Sensing
CEPAE	Centre sur l'environnement de la Péninsule acadienne et ses environs
CGDI	Canadian Geospatial Data Infrastructure
CIDA	Canadian International Development Agency
CLS	Canada Lands Survey system
CLSR	Canada Lands Survey Records
CPRM	Geological Survey of Brazil
CTI	Centre for Topographic Information
DCS	Digital Census Subdivision
DFAIT	Department of Foreign Affairs and International Trade
ESIC	Earth Sciences Information Centre
ESS	Earth Sciences Sector
ESSIM	Eastern Scotian Shelf Integrated Management
GC	Geomatics Canada
GÉONAT	National Geomatics Infrastructure for Tunisia
GIS	Geographic Information Systems
GPS	Global Positioning System
GSC	Geological Survey of Canada
GSD	Geodetic Survey Division
GSDI	Global Spatial Data Infrastructure
IAC	Innovation Acceleration Centre
IACG	Inter-Agency Committee on Geomatics
IBC	International Boundary Commission
IDRC	International Development Research Centre
ILS	Instrument Landing Systems
INAC	Indian and Northern Affairs Canada
INRS	Institut national de la recherche scientifique
IRS	Indian Remote Sensing
ISSMAP	In Situ Sensor Measurement Assimilation Program
LIDAR	LIght Detection And Ranging
LOMA	Large Ocean Management Area Plan
LSD	Legal Surveys Division

MAP	Multinational Andean Project
MDA	MacDonald, Dettwiler and Associates
MITE	Metals in The Environment Program
MVI	Mapping for the Visually Impaired
NASA	U.S. National Aeronautics and Space Administration
NATMAP	National Geoscience Mapping Program
NRCan	Natural Resources Canada
NTS	National Topographic Series
OCIPEP	Office of Critical Infrastructure Protection and Emergency Preparedness
OGC	Open GIS Consortium
PCSP	Polar Continental Shelf Project
PERD	Program for Energy Research and Development
PROASNE	Northeastern Brazil Groundwater Project
QGC	Québec Geoscience Centre
R&D	Research and Development
RGI	Resource GIS and Imaging Ltd.
RSI	RADARSAT International Inc.
S&T	Science and Technology
SAR	Synthetic Aperture Radar
SCI	Sustainable Communities Initiative
SDI	Spatial Data Infrastructures
TAP	GeoConnections Technology Advisory Panel
TGI	Targeted Geoscience Initiative
USGS	U.S. Geological Survey

Earth Sciences Sector Funding

Appropriation Funding by Major Category of Expenditures

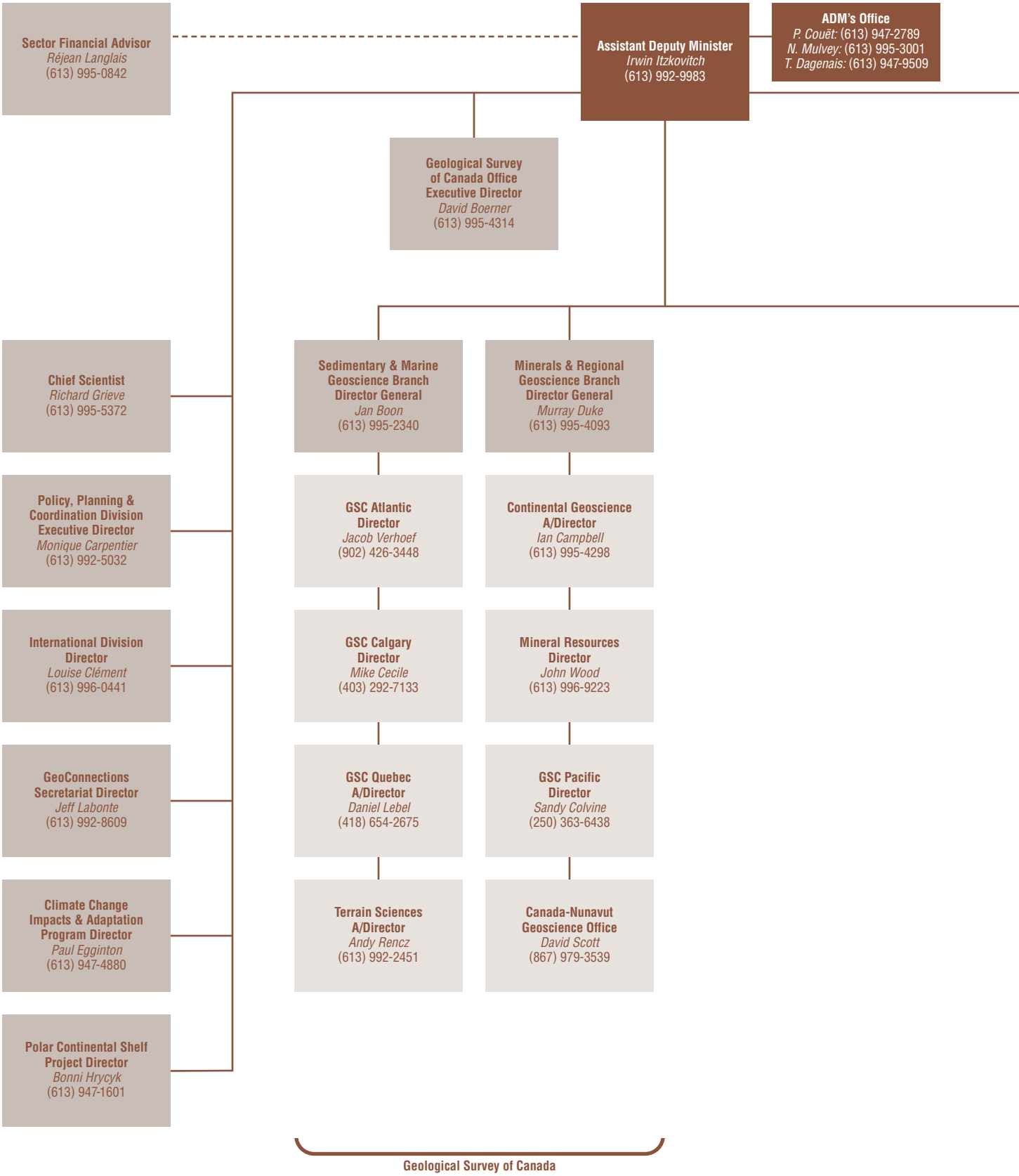
	FY 2001/02 ($000)
Salaries (1414 Full Time Equivalent Employees)	88 237
Employee Benefit Plan	17 388
Operating and capital expenditures	74 871
Grant and Contribution	6 153
TOTAL	**186 649**

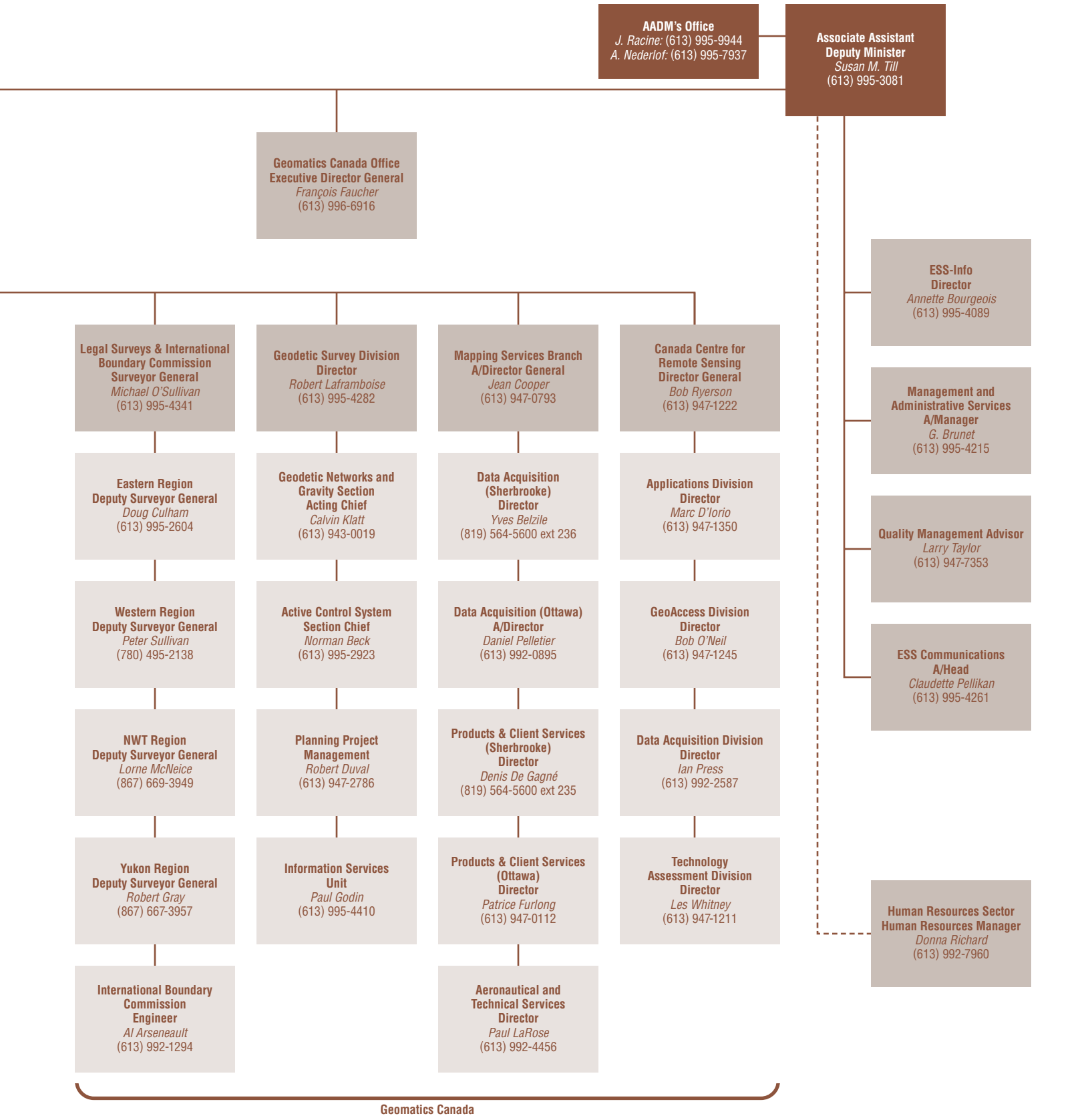
Funding by Major Component

		FY 2001/02 ($000)
Geomatics Canada		78 620
Salaries	35 822	
Employee Benefit Plan	7 087	
Operating and capital expenditures	32 478	
Grant and Contribution	3 233	
Geological Survey of Canada		81 521
Salaries	39 863	
Employee Benefit Plan	7 800	
Operating and capital expenditures	31 077	
Grant and Contribution	2 781	
Polar Continental Shelf Project		3 902
Salaries	674	
Employee Benefit Plan	135	
Operating and capital expenditures	3 085	
Grant and Contribution	8	
ESS Corporate Services		22 606
Salaries	11 878	
Employee Benefit Plan	2 366	
Operating and capital expenditures	8 231	
Grant and Contribution	131	
TOTAL		**186 649**

Earth Sciences Sector Across Canada

Earth Sciences Sector — Organization Chart

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Notes

Notes

Earth Sciences Sector

Vision

ESS will be, and be recognized to be, a leader in the development, deployment and integration of science and technology into policy and decision-making by NRCan, the federal and provincial governments, and other stakeholders.

Strategy

- Have and maintain a highly motivated innovative and focused staff;
- Have a balanced S&T portfolio;
- Do the right S&T and do it at the right time;
- Own only what you must; influence all you can; and
- Use the best resources wherever they exist through the use of internal and external networks, partnerships, and alliances.

Implementation

ESS will be a high performance, issues, outputs and outcomes driven organization, aligned with government priorities, linked with other parts of Canada's innovation system, and known for excellence in everything it does, making it the employer of choice.