

UNITED NATIONS

STATISTICS DIVISION

Country Report of

Canada 

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Country Report Overview

The following report outlines Canada’s past, present, and future efforts to develop its geospatial capacity, and provides insight into federal, provincial and territorial government activities that together contribute to the development of the Canadian Geospatial Data Infrastructure (CGDI). The report is organized as follows:

Section I “Introduction: Canada’s Political Landscape and Policy Priorities” provides an overview of how Canada’s federated political structure and how its extensive territory have influenced the development of its geospatial capacity and distributed spatial data infrastructure (SDI) that relies on horizontal collaboration and data integration. Section I highlights Canada’s vast wealth in natural resources which both requires and enables rigorous systems for data sharing. The section also demonstrates how Canada’s SDI addresses national policy priorities.

Section II “Canada’s International Responsibilities and Activities in Geomatics” contains a list of selected international engagements. The section provides an understanding of the diverse ways in which Canada seizes opportunities both to share and to harness international expertise, fostering global capacity for development.

Section III “Canadian Spatial Data Infrastructure” provides an overview of the distributed system that makes up the CGDI, highlighting findings from a value study and performance assessment of the CGDI. Core elements include governance mechanisms, operational policies, tools and standards that support interoperability and horizontal collaboration across the range of jurisdictions and other contributors to the CGDI.

Section IV “Collaborative SDI Initiatives” describes the national and international level collaborations that comprise the CGDI data ecosystem and contribute to a global data ecosystem.

Section V “Federal Government Department and Agency Responsibilities and Activities” outlines the mandates and roles of specific federal departments that form part of the CGDI.

Section VI “Provincial and Territorial Government Department and Agency Responsibilities and Activities” outlines provincial and territorial mandates and roles in geomatics, equally contributing to and constituting the CGDI.

I. Introduction: Canada's Political Landscape and Policy Priorities

As a northern nation, Canada covers nearly 10 million square kilometres, stretching from 41°N to the North Pole. Because the effects of Climate Change are greatly magnified in the polar regions, Canada is faced with additional challenges of permafrost loss, extreme coastal erosion, evolving wildlife habitat or loss of habitat and species at risk, food security in remote areas, extreme fire and flooding events.

A large proportion of Canada's 36.3 million people inhabit the southern part of the country while a low population density is found in the north. Canada's population distribution and natural resources wealth have come to shape its regional diversity.

Canada is politically divided into 10 provinces and 3 territories. Starting in the early 1600's and prior to the Confederation of Canada, the British Crown entered into a series of treaties with Indigenous nations. Post-Confederation, the Government of Canada has continued to negotiate treaties (refer to Appendix 2 for larger jurisdictional maps).

These physical, political and social realities explain why Canada adopted horizontal collaboration and data integration as its strategic geospatial focus and strength.



Figure 1 Political Map of Canada
Source: Natural Resources Canada 2006



Figure 2 Canada with historic treaties
Source: Indigenous and Northern Affairs Canada 2016

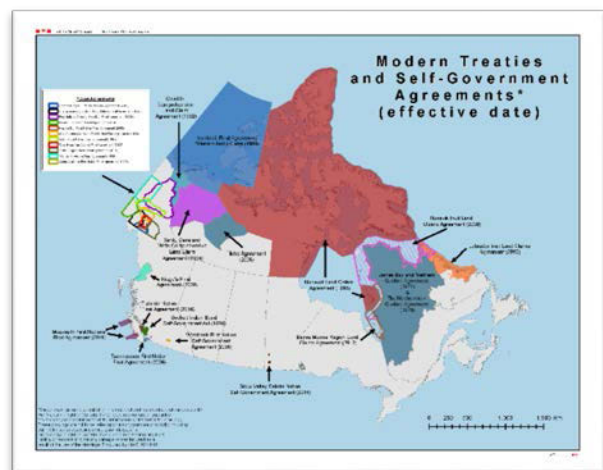


Figure 3 Canada with modern treaties
Source: Indigenous and Northern Affairs Canada 2016

Managing Canada's Wealth of Natural Resources

Interoperable systems for data sharing are necessary to analyze and manage Canada's vast wealth in natural resources. With huge reserves of energy; massive tracts of forest; lakes, rivers, and access to three oceans; and an abundance of minerals, metals and aquatic wealth, natural resources and oceans management play a significant part in the nation's economy and livelihood. As the work associated with geomatics and Earth observation is critical to sustain these resources, the Geological Survey of Canada was established in 1842, prior to Canada becoming a nation in 1867. In 1970, Canada invented the first Geographic Information System (GIS) system¹. The technology was shared freely and now forms the foundation for all geographic information globally².

Shared Governance

The country's political structure reflects its vast size and history: Canada is a federal state governed as a parliamentary democracy, created to balance the country's interests as a whole with the interests of individual regions. From the outset, multi-jurisdictional governance and collaboration have been the norm for this system of cooperative federalism. The provinces and territories' respective mandates³ are based on responsibilities set out in the *Constitution Act, 1867*. Federal and provincial governments have shared jurisdiction over natural resources, whereas navigable waters are a federal responsibility, and cadastre is a provincial and territorial responsibility except federal lands.

Comprehensive Land Claims Agreements and Self-Government Agreements form government-to-government relationships. Self-Government Agreements set out arrangements for Indigenous groups to govern their internal affairs and assume greater control and law-making authority over a comprehensive range of jurisdictions, including governance, social and economic development, education, health, lands and more.

Shared jurisdiction across levels of government—federal, provincial, territorial, municipal and Indigenous—means that each level produces, uses and distributes geospatial data and

information to support decision-making. Horizontal collaboration through national and federal governance structures, and data sharing via spatial data infrastructure (SDI) principles, policies and architecture, align with multilateral international collaborations.

Interoperability of Data to Address National Priorities

Geospatial information management requires cooperation between governments, industry, academia, the public and international jurisdictions. As a result, strong partnerships and collaboration are key to facilitate the management of geospatial information, where government is decentralized and no legislation for the Canadian Geospatial Data Infrastructure (CGDI) and related institutional arrangements exist. This infrastructure provides the interoperability that allows a diverse community to access and share information from authoritative sources.

Through the CGDI, shared governance, common standards, tools, operational policies and accessible framework data layers converge. This results in interoperability of federal, provincial, territorial and regional SDIs, creating an online system of information, data, services and applications.

Emerging collaborations and initiatives include:

- **Marine-land SDI linkages**—The national Marine SDI (MSDI) is the integrated management and dissemination of marine geospatial data, led by the Canadian Hydrographic Service of the Department of Fisheries and Oceans (DFO). The MSDI, jointly with the Canadian Federal Geospatial Platform (FGP), the CGDI and the Arctic SDI, make authoritative and accurate datasets and applications accessible and open. The MSDI forms a critical element of the national level CGDI, as well as the international level Arctic SDI and MSDI led by the International Hydrographic Organization (IHO). Arctic SDI is co-developing an Arctic MSDI with the IHO, the National Geospatial-Intelligence Agency (NGA) of the USA, and the FGP.
- **Integration with statistical data**—Since 1906 Canadian mapping and statistical organizations have collaborated to produce publications on the Canadian land mass, its infrastructure, and its population. An example of new data integration possibilities: Statistics Canada published statistical information on “Human Activity and the Environment” on the FGP in March 2017.

- **Open geospatial data/Open Government facilitate governance and data integration**—To drive innovation and economic opportunities for everyone, the government of Canada has committed to making government ‘open’ by making available its holdings of geospatial information. Open data—enabled via the Canadian Geospatial Data Infrastructure (CGDI), and published through the Federal Geospatial Platform (FGP) and OpenMaps—is accessible and freely available to all Canadians.

**Open geospatial data contributed
at least \$695 million (0.04%) to
Canada’s Gross Domestic Product in 2013.**

(Canadian Geomatics Environmental Scan and Value Study, 2015)

Interoperability of data enables the government to address its current national priorities in an integrative way:

- **Innovation in the knowledge economy**—The GeoConnections Program, a national initiative led by Natural Resources Canada (NRCan) that is mandated to lead the CGDI, is supporting Canadian organizations to realize projects that leverage governance mechanisms, standards, tools and operational policies to share and integrate data. One example is innovation in sensors’ solutions and policies.
- **Inclusion**—Open data equalizes access; meanwhile, growing geomatics capacity and awareness among women and Indigenous communities enables greater participation in decision-making, supporting inclusive growth and reconciliation. Sharing ethically open data that recognizes the rights of knowledge holders is one way that Canada delivers on its commitment to fully support the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).

- Sustainable development—Open data, standards, and integrating statistical data are key in supporting the UN Sustainable Development Goals (SDGs). The Canadian Geospatial Data Infrastructure (CGDI) is a data ecosystem that helps Canada achieve the SDGs on a national basis, is a model for other nation's efforts to do so, and further contributes to a global data ecosystem.

On the international stage, Canada has been actively engaging on sustainable development goals and communicating progress on the UN Declaration - Harnessing the Data Revolution for Sustainable Development and Climate Risk Resilience.

- Climate change—In 2016 Canada ratified the Paris Agreement on climate change. The CGDI provides the capability to meet Canada's commitment to protect, monitor and manage its land, freshwater, marine and coastal areas, including the Arctic. By integrating marine and land SDIs, as well as integrating geospatial and statistical data into Canada's data ecosystem, Canada can better plan for extreme events and natural disasters. SDIs enable data exchange across jurisdictions for large-scale responses to climate change.

As a member of the Arctic Spatial Data Infrastructure (Arctic SDI) initiative, Canada voluntarily cooperates with the seven national mapping agencies of Arctic countries. The Arctic SDI serves local and global stakeholders and ensures that they can access, combine and use data to conduct research, make informed decisions, and respond to issues in the Arctic, an area on the planet that is warming quickly and, consequently, undergoing dramatic changes.

For more information:

- Canadian Departmental mandate letters: <http://pm.gc.ca/eng/mandate-letters>.

The scope of this report is federal, provincial and territorial government activities that involve coordination with the wide range of partners that together contribute to the CGDI.

II. Canada's International Responsibilities and Activities in Geomatics

Participating in international fora and initiatives gives Canada the opportunity to not only share expertise and experience to facilitate capacity development and sustainable development in other countries, but to harness international expertise, standards, and science and technology. To this end, Canada participates in and contributes to numerous geospatial information management and related organizations, in many cases alongside our G7 partners. The following is a partial list of key engagements:

- Arctic Council—Member (Global Affairs Canada and contributing Departments)
- Arctic Spatial Data Infrastructure (Arctic SDI)—Member (Natural Resources Canada)
- Commission on Environmental Cooperation (CEC)—Member (Environment and Climate Change Canada)
- Committee on Earth Observing Satellites (CEOS)—Member (Canadian Space Agency)
- Defence Geospatial Information Working Group (DGIWG)—Member (Department of National Defence/Canadian Armed Forces)
- Global Spatial Data Infrastructure Association (GSDI)—Member (Natural Resources Canada)
- Group on Earth Observations (GEO)—Member of the Executive Committee (Environment and Climate Change Canada)
- Intergovernmental Oceanographic Commission—Member (Fisheries and Oceans Canada)
- International Hydrographic Organization—Member (Fisheries and Oceans Canada)
- International Organization for Standardization - Technical Committee 211 (ISO/TC 211)
– Member (Standards Council of Canada) with subject matter expertise drawn from Federal Departments
- International Maritime Organization—Member (Fisheries and Oceans Canada)
- Open Geospatial Consortium (OGC)—Strategic Member (Natural Resources Canada)
Associate Member (Environment and Climate Change Canada)

- United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM)—Member (Natural Resources Canada)
- United Nations Committee on Global Geospatial Information Management: Americas (UN-GGIM: Americas)—Executive Board Member, North American Vocal (Natural Resources Canada)
- United Nations Committee on the Peaceful Uses of Outer Space (UN-COPUOUS)—Member (Canadian Space Agency)
- United Nations Group of Experts on Geographical Names (UNGEGN)—Member; past-Chair (2007-12) (Natural Resources Canada)
- United States Geological Survey (USGS) Landsat Program—International Cooperator (Natural Resources Canada)
- World Meteorological Organization (WMO)—President (Environment and Climate Change Canada)

Canada also works closely with the United States Federal Geographic Data Committee (FGDC), Geoscience Australia, the Infrastructure for Spatial Information in the European Community (INSPIRE), and is a cooperating state of the European Space Agency (ESA).

III. Canadian Spatial Data Infrastructure

In 2013, the use of geospatial information contributed \$20.7 billion—or 1.1 per cent—to the national Gross Domestic Product (GDP), \$19 billion to Real Income, and generated approximately 19,000 jobs in the Canadian economy. The uptake of “open” geospatial data (data available at minimal or no cost and for use without restrictions) provided an estimated additional \$695 million to the GDP and \$635 million to Real Income also in 2013 (Source: Canadian Geomatics Environmental Scan and Value Study, 2015, 2016). The *Canadian Geomatics Environmental Scan and Value Study* represents the most comprehensive assessment of geomatics and geospatial information in Canada to date, including details about the contributions of geospatial information usage to Canada’s economy and society.

For more information:

- Canadian Geomatics Environmental Scan and Economic Value Study:
<http://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/cgdi-initiatives/canadian-geomatics>
- Canadian Geomatics Environmental Scan Findings Report:
<http://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/fulle.web&search1=R=297709>

The Government of Canada recognizes the importance of a national spatial data infrastructure (SDI) in spurring innovation, contributing to economic growth and facilitating decision-making by governments, industry and the public.

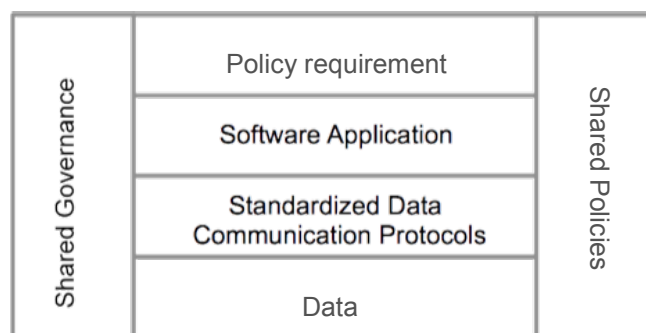


Figure 4 Spatial Data Infrastructure Components

The Canadian Geospatial Data Infrastructure (CGDI) is a convergence of common standards, tools, operational policies and accessible framework and thematic data that result in the interoperability of federal-provincial-territorial and regional SDIs. This convergence creates a navigable online system of information, data, services and applications that improves the sharing, access and use of Canadian geospatial information. Development of the CGDI is based

on a cooperative approach between interested organizations and different levels of government. The CGDI governance model reflects Canada's governance structure, where decision-making and the information needed to support it are distributed across a federated structure.

SDIs are composed of highly distributed components that allow data integration based on international standards, industry consortia, operational policies, governance mechanisms and application development.

The CGDI is best described as a system of systems. Standards and governance enable catalogues, data and processes to be shared between the following entities, among others:

- Federal Committee on Geomatics and Earth Observation (FCGEO) for federal inter-departmental co-ordination; and the Federal Geospatial Platform (FGP) for sharing of federal data;
- Canadian Council on Geomatics (CCOG) for Canadian inter-jurisdictional co-ordination and sharing of provincial and territorial data;
- Arctic Spatial Data Infrastructure (Arctic SDI) and liaison with the Arctic Council for a Canadian and Pan-Arctic view and analysis of data; and
- Marine Spatial Data Infrastructure (MSDI) for Canada and the World (International Hydrographic Organization).

For more information:

- Canadian Spatial Data Infrastructure: <http://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/10783>
- CGDI Resource Centre provides access to operational policies and SDI assessments: <http://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/8904>
- CGDI maintains a weekly list of Canadian Geospatial web Services. As of March 31, 2018 Canadian data providers have 2339 web services online that contain a total of 54,900 data layers. <http://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/19359>

A 2015 Performance Assessment was undertaken to measure the continued progress of development, use, success and state of the CGDI. The assessment involved reviewing and updating the 2012 CGDI Assessment Framework and analyzing CGDI measurement data and indicators against a revised CGDI Assessment Framework. The Assessment Framework consists of Collaboration, Framework Data, Operational Policies, Standards and Specifications, and Technology. Increased maturity or stable performance was noted across all assessment areas with some gaps identified in monitoring and reporting, communication, and policy development. In addition to providing a comprehensive overview of the key features of Canada's SDI, this assessment demonstrates a methodology for evaluating SDIs. The Assessment Framework developed for the CGDI was primarily based on the INSPIRE State of Play model (European SDI, 2010/2011).

For more information:

- 2015 Assessment of Canadian Geospatial Data Infrastructure:
<http://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/fulle.web&search1=R=297880>
- Additional CGDI publications and services are available via the CGDI Resource Centre:
<http://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/8904>

IV. Collaborative SDI Initiatives:

Arctic Spatial Data Infrastructure

The Arctic Spatial Data Infrastructure (Arctic SDI) consists of the Canadian and International regionalized components of the CGDI and Global Spatial Data Infrastructure, respectively. Canada's domestic Arctic SDI contributes to development in the North by providing a geographic reference foundation to help inform sound decision-making and policy development related to responsible resource development, emergency management, and environmental issues.

The national mapping agencies (NMAs) of Canada, Kingdom of Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States of America support the development of an international Arctic SDI. The SDI, in turn, is backed by a Memorandum of Understanding signed by all member countries, and is endorsed by the Arctic Council. The Arctic SDI aims to provide politicians, governments, policy makers, scientists, private enterprises and citizens in the Arctic with access to geographically related Arctic data, digital maps and tools to facilitate monitoring and decision-making.

The Arctic Council—the intergovernmental forum for Arctic governments and peoples—leverages Arctic SDI through the Conservation of Arctic Flora and Fauna (CAFF) Working Group as a common information management methodology for the Council. Arctic SDI and the Arctic Council work together to publish and share interoperable data through standards. This includes topographic, marine, biodiversity, elevation and Earth observation data.

In 2015, a strategic plan was written to expand the scope of Arctic SDI to improve sharing, access and use of other location-based information spanning the Arctic. In 2016 Canada led, with contributions from the other Arctic NMAs, the development of an *SDI Manual for the Arctic* and an authoritative circumpolar *Glossary of Terms* to provide guidance and information management good practices on commonly accepted SDI operational policies and standards.

An evaluation of the Arctic SDI was undertaken by Canada in 2016, and is available in the CGDI Resource Centre.

For more information:

- Arctic Spatial Data Infrastructure (International): <http://arctic-sdi.org/>
- Arctic Spatial Data Infrastructure Strategic Plan 2015-2020: http://arctic-sdi.org/wp-content/uploads/2014/08/20151119-Arctic-SDI-Strategic-Plan-2015-2020_FINAL.pdf
- Arctic Council: <http://www.arctic-council.org/index.php/en/>
- Introduction to Arctic SDI video :
<https://www.youtube.com/channel/UCn1vg2HcsIdxv1p3DqKHMpQ>
- *SDI Manual for the Arctic and Glossary of Terms*:
<http://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/fulle.web&search1=R=305329>
- Evaluation of the Arctic SDI :
<https://arctic-sdi.org/wp-content/uploads/2017/.../Arctic-SDI-Evaluation-Report.docx>
<https://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/fulle.web&search1=R=305895>
- CGDI Resource Centre: <http://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/8904>

The Arctic Spatial Data Pilot Project was managed by the Open Geospatial Consortium (OGC), and co-sponsored by Natural Resources Canada (NRCan) and the United States Geological Survey (USGS). It sought to demonstrate the diversity, richness and value of providing geospatial data using International standards to support spatial data infrastructures. The Pilot's participants presented world-class standards implementation on climate change scenarios by showcasing applications, tested geospatial data feeds, and technologies in an Arctic context. The project focused on food security for Northerners and Indigenous communities while analyzing the impact of climate change on migration routes (e.g. polar bears, caribou, geese, and whales) and increasing ship traffic.

For more information:

- Arctic Spatial Data Pilot overview:
<http://www.opengeospatial.org/projects/initiatives/arcticsdp>
- Arctic Spatial Data Pilot with Open Geospatial Consortium Video and Engineering Report: <http://www.opengeospatial.org/projects/initiatives/arcticsdp>

Regarding a Marine SDI for the Arctic, the Arctic Regional Marine Spatial Data Infrastructure Working Group (ARMSDIWG), under the Arctic Regional Hydrographic Commission of the International Hydrographic Organization (IHO), is the key coordinating body delivering marine

geospatial data from Arctic Hydrographic Offices to a broader user base. The ARMSDIWG coordinates with the Arctic SDI, and works with other relevant Regional Hydrographic Commissions and groups within the IHO. The ARMSDIWG also works closely with the Open Geospatial Consortium (OGC) through the Marine Domain Working Group to monitor relevant open geospatial standards and activities to be applied to Marine SDI best practices. A concept development study to provide engineering recommendations is in the planning stages.

For more information:

- Arctic Regional Hydrographic Commission (ARHC):
https://www.iho.int/srv1/index.php?option=com_content&view=article&id=435&Itemid=690&lang=en

Marine Spatial Data Infrastructure

The Department of Fisheries and Oceans (DFO)—Science, Canadian Hydrographic Service (CHS) represents Canada as a Member State of the International Hydrographic Organization (IHO). The Canadian Hydrographic Service is the National Hydrographic Charting Authority in Canada. IHO Member States systematically collect, produce and disseminate information to support maritime navigation safety, marine environment preservation, defence and exploitation of marine resources. Building on policies and governance, information systems, and technical standards, the development of a national Marine Spatial Data Infrastructure (MSDI) is a natural extension into the integrated management and dissemination of marine geospatial data.

Hydrography provides fundamental data and information covering the maritime domain.

Hydrographic Offices of the IHO Member States are mandated to produce official charts and publications in digital and paper format for the safety and efficiency of navigation within their respective waterways. Their respective mandate is usually embedded within their national legislation and regulation frameworks. The IHO considers the establishment of MSDIs the solution for discoverability, accessibility, and interoperability of marine geospatial data and the future roles of Hydrographic Offices in the world. To support this approach, the IHO has established an MSDI Working Group, and an Arctic MSDI Working Group under the Arctic Regional Hydrographic Commission.

The Canadian MSDI is led by the Canadian Hydrographic Service (CHS), Department of Fisheries and Oceans (DFO), in conjunction with the Federal Geospatial Platform (FGP), the

Canadian Geospatial Data Infrastructure (CGDI) and the Arctic SDI; to make authoritative and accurate datasets and applications accessible and open. Canada's MSDI development is catalyzed by the Oceans Protection Plan (OPP), and is expected to become CHS's core data-centric infrastructure. To facilitate the population of the ISO-compliant metadata, CHS will coordinate and offer access to metadata training for data owners. This MSDI will form a critical marine element of the CGDI.

In coordination with the Canada Centre for Mapping and Earth Observation (CCMEO), a functional MSDI prototype has been developed within the Government of Canada by adapting existing Geographic Information System (GIS) tools and applications. This work builds on the International MSDI Study developed by Canada for the IHO-Marine Spatial Data Infrastructure Working Group (MSDIWG), and on the Government of Canada's investment in the Oceans Protection Plan (OPP) for the next five years. Implementation will target diverse application fields such as Regional Response Planning, Hydrographic Dynamic Products, Ports, Near-shore bathymetry and Arctic waters, and will provide targeted data layers responding to marine-based issues and needs. Furthermore, to improve the MSDI functionality and usability, multiple thematic approaches will be implemented to support different use cases such as IHO-MSDI Themes, ISO Data Classification Themes, Government of Canada Regulations and Acts, and DFO Themes.

To better support the marine domain, the MSDI will be built on the implementation of the suite of IHO's S-100 standards such as the S-121 standard for the management of Maritime Limits and Boundaries (MLBs), where Australia and Canada (CHS) are the main leads. The S-121 standard aims to standardize how MLBs are deposited to the United Nations Division for Ocean Affairs and the Law of the Sea (UN-DOALOS) and provide support for administering and legally describing marine geospatial content through integrating the ISO-19152 Land Administration Data Model.

For more information:

- MSDI Working Group:
http://www.iho.int/srv1/index.php?option=com_content&view=article&id=483&Itemid=370&lang=en

- Arctic Regional Hydrographic Commission:
http://www.iho.int/srv1/index.php?option=com_content&view=article&id=435&Itemid=690&lang=en
- Arctic Regional Marine Spatial Data Infrastructures Working Group White paper:
https://www.iho.int/mtg_docs/rhc/ArHC/ArHC_Special_IHOA1/ARMSDIWG_WhitePaper_V1_1.pdf
- International MSDI Study made by Canada for the IHO-MSDIWG:
https://www.iho.int/mtg_docs/com_wg/MSDIWG/MSDIWG7/MSDIWG7-1.8A-MSDI_Comparative_Study.docx

Spatial Data Infrastructure Manual for the Americas

A Spatial Data Infrastructure (SDI) Manual for the Americas was led by Canada for UN-GGIM: Americas to guide officials and stakeholders in the Americas in planning, developing and implementing SDI initiatives. It has been structured to cover all the topics that those considering implementing an SDI will encounter, generally in the order in which they will need to be considered.

For more information:

- Spatial Data Infrastructure (SDI) manual for the Americas:
<http://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/fulle.web&search1=R=292897>

Open Geospatial Consortium

The Open Geospatial Consortium (OGC) offers a variety of initiatives that Canada leverages. These range from governance methods, to standards implementation to standards development based on an open consortium model. Canada is a Strategic member of the OGC.

The OGC has regional forums to bring together stakeholders with similar interests. Canada has developed in 2018 a Canadian Forum on Geospatial Standards. The Forum is open to all Canadian stakeholders and partners, and it is expected will draw from industry, all levels of government, Indigenous nations and academia. Given Canada's complex division of powers the Forum will empower a common space for standards implementation.

For standards and specifications development a variety of Canadian members are active in both Standards Working Groups and Domain Working Groups. In general, there is an emphasis on

Quality of Service, GeoSemantics, Point Cloud, Cloud and Big Data, Sensors and all water related specifications ranging from groundwater, to surface water and marine.

The OGC Innovation Program has two key components: Testbeds to test emerging specifications and Pilots to implement them for a particular issue (e.g. a disaster scenario). Testbeds—activities conducted through the OGC Innovation Program—define, design, develop and test standards-based specifications. OGC managed Pilot and Testbed activities provide a platform for both technology users and providers to work together to define globally important spatial interoperability requirements that can be met through industry agreements on open standards and best practices.

NRCan and the United States Geological Survey co-sponsored an Arctic Spatial Data Pilot on climate change scenarios for Northerners. The Pilot was explained on page 12.

For more information:

- Arctic SDI Pilot video: <http://www.opengeospatial.org/pub/ArcticSDP/blog-arcticSDP.html>

NRCan has sponsored two initiatives under OGC Testbed 13: 1) to further develop Map Markup Language (ML) and 2) to develop a prototype solution for Earth observation (EO) data processing in a Cloud Environment (EOC). Through these Testbed activities, NRCan is leveraging the effort and expertise from OGC member sponsors and solution providers. Specifically, NRCan's sponsorship to further Map ML development will lower the barriers of using spatial information on the web. NRCan is collaborating with the European Space Agency (ESA) and its solution providers to enhance NRCan Earth observation (EO) data processing capability based on open standards.

NRCan is collaborating with Canadian and international OGC members through OGC Testbed 14, that marks OGC's 100th Innovation Program initiative. Areas of investment include: Web Mapping Services Quality and Usability, Map HTML Markup Language, Point Cloud data management systems, and use of Web Processing Services over federated Clouds for EO data processing.

Canadian Council on Geomatics

The Canadian Council on Geomatics (CCOG) is a federal-provincial-territorial government body that advances geomatics activities of common interest, and facilitates data collection, interoperability and integration between jurisdictions. CCOG develops and endorses national data and data exchange standards that enable information-sharing and technical expertise between governments, and advocates for the use of geospatial data and information in improving policy and decision-making. Through its support, the CCOG has helped to successfully advance CGDI standards-based access mechanisms and the GeoBase collection of framework data.

For more information:

- Canadian Council on Geomatics: <http://www.ccog-cocg.ca/>

GeoBase

CCOG oversees GeoBase, a federal-provincial-territorial government initiative to ensure the provision of, and access to, a common, up-to-date and maintained base of geospatial data for all of Canada. The initiative provides no-cost access to quality geospatial information under the Government of Canada Open Data License. GeoBase datasets are available to the public according to the Open Government initiatives (i.e., Open Data and Open Maps) and within Canadian federal departments through the Federal Geospatial Platform (FGP).

Challenges remain for governments to collectively maintain and provide the core Authoritative, Accurate, and Accessible (triple-A) geospatial framework data that meets user expectations for currency and interoperability in a world increasingly defined by integrated data and information services.

Some opportunities that are currently being further investigated and tested include applying Artificial Intelligence and Deep Learning technology to data extraction and classification, Data Cubes, Lidar Point Cloud data management and generation of Digital Elevation/Surface Models, Linked-Open-Data for Hydrographic Data Management, include Crowdsourcing and Volunteered Geographic Information (VGI) initiatives. New research is considering dynamic solutions to address anticipated need of Linked Data, Web Sensors or Near Real-Time applications.

For more information:

- GeoBase Products: <https://www.nrcan.gc.ca/earth-sciences/geography/topographic-information>

Geographical Names Board of Canada

The Geographical Names Board of Canada (GNBC) is the national coordinating body responsible for standards and policies for geographical names in Canada. The Board is established under a federal Order in Council, and comprises members from federal, provincial and territorial government departments and agencies, each with specific responsibilities for their respective jurisdictions and mandates. Working together as a multi-jurisdictional national body, GNBC members ensure that geographical names are consistently managed in Canada. The GNBC was initially established as the Geographic Board of Canada in 1897, and celebrated its 120th anniversary in 2017.

Since 2013, the GNBC has focused on developing, refining, and now implementing an ambitious, forward-looking five-year strategic plan. The Strategic Plan includes several key objectives: enhanced effectiveness of the Board through renewed governance; improved functionality of the national geographical names database through interoperability; improved Indigenous naming policies and partnerships; a renewed national policy for undersea and maritime feature naming; and increased awareness of the importance of authoritative geographical names. Since adopting the Strategic Plan, several GNBC working groups have been meeting regularly to implement the Plan's objectives.

The GNBC naming authorities have a long-standing interest in researching, documenting and approving place names that have traditional Indigenous origin. A recent survey by the GNBC indicates that nearly 30,000 official place names in Canada have confirmed or assumed Indigenous roots in over 50 languages or dialects. The GNBC has identified increased engagement with Indigenous communities a strategic goal, with the intention of accurately recording, storing and disseminating Indigenous place names in the national database.

Notable recent examples of adopting traditional Indigenous geographical names have occurred in several jurisdictions:

- In 2015, the Northwest Territories approved five names for the Mackenzie River in the languages of the peoples who live along Canada's longest river system: *Dehcho* (South Slave language), *Deho* (North Slave), *Grande Rivière* (Michif), *Kuukpak* (Inuvialuktun), and *Nagwichoonjik* (Gwich'in).
- In 2016, Manitoba approved an Indigenous name for Lake Winnipeg, *Weenipagamiksaguygun*, the traditional Anishinabe name used by the Poplar River First Nation.
- In 2017, Nunavut approved over 600 names for geographical features in the Cape Dorset area in the Inuktitut language, for example: ᐱᕈᐱᐱᐱᐱᐱᐱ or *Aupallaavik*.

For more information:

- About the GNBC: <https://www.nrcan.gc.ca/earth-sciences/geography/place-names/about-geographical-names-board-canada/11084>
- Canadian Geographical Names Data Base: <https://www.nrcan.gc.ca/earth-sciences/geography/place-names/about-geographical-names-board-canada/9180>

Natural Resources Sector Governance

Canada's governments coordinate their geomatics-related efforts in the natural resources sector through organizations such as the Energy and Mines Ministers Conference (EMMC) and Canadian Council of Forest Ministers (CCFM). Geomatics and Earth observations relate to initiatives stemming from meetings with these organizations, including environmental protection, mineral development and exploration, development of economic clusters, clean technology, energy transmission, and oil and gas.

The EMMC provides venues for sharing information and best practices on energy and mineral exploration, sustainable development and emergency preparedness and response. Further, governments in Canada have recognized that developing natural resources and related infrastructure must always comply with the highest standards for public safety and environmental protection. Geomatics and Earth observations can play a role in providing critical information to inform decision-making. One priority identified at the 2016 EMMC by federal, provincial and territorial governments was to collaborate and expand the availability of public

geoscience data information sharing to help facilitate grassroots exploration by the junior mining sector.

For more information:

- <http://www.scics.ca/en/product-produit/news-release-federal-provincial-and-territorial-energy-and-mines-ministers-agree-to-collaborate-on-priorities-for-the-upcoming-year/>
- <http://www.nrcan.gc.ca/publications/11102>

The National Forest Information System (NFIS), under the authority of the CCFM, a federal-provincial-territorial government body, provides leadership on forestry related matters. The NFIS is a national system that monitors, integrates and reports on Canada's forests and changes to the forest resource over time. The Canadian Forest Service of NRCan, along with provincial and territorial government agencies, develops and maintains the system. It serves as a platform for interoperable data sharing and provides a suite of geospatial and socio-economic data services and forest reporting applications to serve the Canadian forest sector. Among these are the National Forestry Database and National Forest Inventory, which are federal-provincial-territorial government programs that Canada uses to monitor and report nationally and internationally on the state of its forests.

For more information:

- NFIS: nfis.org
- https://opendata.nfis.org/mapserver/nfis-change_eng.html
- https://opendata.nfis.org/mapserver/nfis-change_fra.html

Federal Geospatial Platform and Open Maps

Twenty-one federal departments and agencies worked together to develop the Federal Geospatial Platform (FGP). The platform is a collaborative online environment where a collection of the government's most relevant geospatial information can be found easily and viewed on maps to support evidence-based decision-making, foster innovation, and provide better service for Canadians. The FGP shares tools and best practices through Open Data and open platforms and applications.

For managing emergencies the Federal Geospatial Platform has committed to making available Canadian landmass and marine information and geospatial data required to reduce disaster risk.

The FGP's open access version is Open Maps—part of the broader Open Government initiative to make information more readily available to

Canadians. It was demonstrated at a side meeting of the United Nations General Assembly in September 2016, where Canada also endorsed a Joint Declaration on Harnessing the Data Revolution for Climate Resilience—an initiative to integrate government data and make it publicly available.

Since 1999, **GeoGratis** has provided free access to a wide collection of NRCan geospatial data, maps, remote sensing imagery, and publications in different popular formats, under the Government of Canada Open Data License. The geospatial data discovery of GeoGratis is being migrated to the Canadian Government's Open Data/Open Maps to provide a 'single-search and discovery' to the Government's entire Open Data holdings. Other services offered by the GeoGratis portal (Application Programming Interfaces (API) and services, data extraction services, interactive mapping applications) will remain available for the foreseeable future.

For more information:

- FGP: <http://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/geospatial-communities/federal>
- Open Maps: <http://open.canada.ca/en/open-maps>
- Open Government License - Canada: <https://open.canada.ca/en/open-government-licence-canada>

Federal Committee on Geomatics and Earth Observation

The Federal Committee on Geomatics and Earth Observation (FCGEO) promotes the use of geospatial and Earth observation information as fundamental to integrated, sound, and fact-based decision-making within the Government of Canada, and governs the Federal Geospatial Platform. The Committee provides proactive, whole-of-government leadership in establishing priorities for geomatics and Earth observations and their application to support government priorities, decision-making, and Canada's competitive advantage. The FCGEO also seeks to collectively improve the responsiveness, efficiency and sustainability of the federal geomatics and Earth observation infrastructure.

The FCGEO is comprised of Assistant Deputy Ministers (ADMs) representing departments across the federal government. In addition to this ADM committee, the FCGEO governance model includes a Director General Shadow Committee and ad-hoc Director-level working groups.

For more information:

- FGP and FCGEO site: <http://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/geospatial-communities/federal>

V. Federal Government Department and Agency Responsibilities and Activities

Behind the scenes of the CGDI and other collaborative SDI initiatives, federal, provincial and territorial players carry out their respective mandates and roles in geomatics. Collaborating across shared areas of jurisdiction, they each make respective contributions to an integrated system of systems.

This section outlines the mandates and contributions of selected federal departments while the last section details provincial and territorial roles and responsibilities.

Department	Natural Resources Canada
Core geospatial roles and mandate	<ul style="list-style-type: none">• National Mapping Agency (NMA)• Satellite ground station receiving network• Earth Observation or remote sensing research and development• Spatial Data Infrastructure• Emergency geomatics support• Federal Cadastre• Geodesy• Energy and mining geological mapping• Natural hazards monitoring• Forest monitoring

The Canada Centre for Mapping and Earth Observation (CCMEO) at Natural Resources Canada (NRCan) fulfills the role of Canada's national mapping agency. CCMEO's responsibilities encompass a range of activities along the geospatial information value chain, including; Earth observation and geomatics research and development; data acquisition and archives; management of geospatial and Earth materials collections; provision of services (e.g. GeoAnalytics); a geomatics and Earth observation strategy; and domestic and international partnerships.

Since 1999, Canada has funded the GeoConnections Program, a national initiative led by NRCan, which is mandated to lead the Canadian Geospatial Data Infrastructure (CGDI) through

governance mechanisms, standards-based technologies and operational policies for data sharing and integration. The GeoConnections program addresses all components of a Spatial Data Infrastructure in a country with highly distributed governance. As such, substantial effort is placed into collaborative governance and standards processes. Many of the projects described in this report were developed or co-ordinated via the GeoConnections Program. These include OGC membership, Testbed and Pilot development, Canada Forum on Standards, User Needs Requirements, Spatial Data Infrastructure Assessments, Framework data, Arctic Council liaison, funding opportunities and an evergreen catalogue of Canadian web services. The web service catalogue is published every week and lists all OGC Web and ESRI REST services that are accessed via a Canadian domain (i.e. CA). While the counts vary week-to-week, there are approximately 2,600 web services in Canada containing a total of 62,000 map layers.

Canada uses leading-edge satellite systems technology to provide real-time scientific information on its land mass, to address various topics that are important to Canadians, like environmental monitoring, stewardship, resource exploration and development, emergency response, navigation, sovereignty and security.

For more information:

- Canadian catalogue of web services: <http://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/19359>

The Government of Canada has recently completed the revitalization of NRCan's satellite ground stations with the installation of four antennas: two in Prince Albert, Saskatchewan; one in Gatineau, Quebec; and one in Inuvik, Northwest Territories. These three satellite station facilities are strategically located across Canada to provide excellent reception coverage from polar orbiting satellites. The revitalization also includes a data management system to house and safeguard satellite information and to ensure the data received by these facilities are accessible to users. The data management system was completed in 2017.

The Inuvik Satellite Station Facility (ISSF) infrastructure is leveraged to introduce geomatics skills to youth in Inuvik to increase their opportunities related to geospatial data and applications. CCMEQ's Women and Indigenous Inclusion in science, technology, engineering and math

(STEM) initiative, for example, has supported the following Inuvik area projects: an ArcGIS Online Story Map of the Inuvik region using Geographic Information System (GIS) tools and a Minecraft World application of the satellite facility using Open GIS data; and an Inuvik RADARSAT Capacity Building Project that provides introductory training and skill development in the interpretation and analysis of RADARSAT Constellation Mission (RCM) data that will be available following the 2018 RCM launch. A series of other projects have also been selected to help further women and Indigenous peoples' leadership experience and help with their careers, on the topics of northern geographical place naming, flood risk management, flood plain mapping, and collaborative mapping for adaption to climate change, among others. The initiative involves partnerships with provincial and territorial governments and community-based organizations.

For more information:

- Satellite Facilities: <http://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/satellite-facilities/10816>
- ArcGIS Online Story map and Minecraft World: <http://maps.canada.ca/journal/content-en.html?lang=en&appid=4568fa91f9ca46ed972598d7c4b07884&appidalt=0e9f6ce110664fe1abae05ced43bd61e>

The Earth Observation Data Management System (EODMS) is a fully integrated archive and access system of Earth observation (EO) data for EODMS authorized users, including the Government of Canada, provinces and territories, municipal governments, academia, commercial organizations and the general public. Users can discover and access EO imagery data (raw data, products, EO derived products and aerial photography) from CCMEQ's National Multi-mission EO data holdings, archive and make available future datasets. The EODMS supports the ingestion and management of datasets as it relates to archiving and cataloguing, processing, end-user license management, and the packaging of products for dissemination. The EODMS will provide various web services including a front-end portal, and various machine-to-machine interfaces. These web services are managed via complex user profiles and access controls.

CCMEQ also supports federal flood mapping initiatives, including providing technical advice to the National Disaster Mitigation Program (administered by Public Safety Canada), chairing the

Federal Flood Mapping Committee, and conducting research and mapping exercises to support flood mapping and flood risk initiatives in other government departments. Currently, CCMEQ is developing the Federal Flood Mapping Guidelines Series, which advance flood mapping practices through stakeholder engagement and data sharing, including consultation with Indigenous communities.

Emergency Geomatics Service (EGS) supports the Government Operations Centre (GOC) by providing subject matter expertise and satellite-derived products and services for emergency situations requiring federal level coordination and response under Canada's Federal Emergency Response Plan. EGS becomes activated during certain emergency situations, such as floods, earthquakes and wild land fires.

EGS provides near real-time products derived from the best available optical or radar data from Canadian and international satellites (e.g., Landsat, RADARSAT-2, TerraSar-X, and Sentinel-1). While EGS has responded primarily to flood events (with open water and flooded vegetation extent polygons) its capabilities have expanded to include products for ice jams and wild land/urban interface fires. Products for earthquakes and damage assessment based on multi-sensor technologies are being developed. EGS is actively working to develop seamless processes from mitigation, to preparedness, to response and recovery for each of these types of emergencies. EGS is authorized to draw on many parts of the Government to provide Earth observation, spatial data and analysis, and cartography to support emergency response.

For more information:

- Natural Hazards – Emergency Geomatics Services: <https://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/applications-development/natural-hazards/10981>

The Surveyor General Branch (SGB) ensures boundary certainty through properly maintaining the Canada-United States international boundary for law enforcement, land administration, customs and immigration, and transboundary resource management; effective boundary surveys of Aboriginal settlement lands to meet Canada's obligations under land claim settlement legislation and treaties; and statutory registration of legal surveys on Canada Lands (the North, Canada's offshore area, Aboriginal lands and national parks), essential to create property parcels. The SGB includes the Geodetic Survey Division, which is responsible for maintaining the

Canadian Spatial Reference System (CSRS). The CSRS provides fundamental reference values for latitude, longitude, height and gravity, including Earth's orientation parameters and rotation rate in space, as the foundation for the nation's evolving positioning and navigation activities. Key priorities include modernizing legislation governing surveys on Canada Lands; supporting Canada's Indigenous communities through capacity building; and modernizing Canada's satellite-based positioning, navigation and timing systems.

The Geo-mapping for Energy and Minerals Program (GEM) is creating and making publicly available modern geological datasets, maps and other knowledge products for Canada's North. The program includes an extensive series of research activities exploring the structure and evolution of Canada's northern geology and the region's mineral and energy resource potential. NRCan scientists lead these activities, which may involve experts from Canadian leading research institutions and geological surveys, both in conducting the fieldwork and in subsequent laboratory analysis and data integration. This fills the critical information gap in the geoscience knowledge base to inform land use decisions and facilitate exploration investment by industry in Canada's North. GEM is conducted with provinces and territories and benefits from an advisory group of Northerners, including representatives from territorial governments, the private sector and Indigenous socio-economic development organizations.

For more information:

- GEM: <http://www.nrcan.gc.ca/earth-sciences/resources/federal-programs/geomapping-energy-minerals/18215>

NRCan's Canadian Forest Service (CFS) conducts research and development of new remote sensing applications. One example is the **National Terrestrial Ecosystem Monitoring System** project being pursued with the University of British Columbia and the Canadian Space Agency to produce more timely and detailed national monitoring technologies for Canada. The System uses the United States Geological Survey (USGS) Landsat image archive and advanced Big Data computing.

The **Canadian Wildland Fire Information System** (CWFIS) is a geospatial computer-based fire management information system that provides data and maps on current and forecasted wildland fire conditions across Canada, including daily maps of fire locations, fire weather and fire behavior. CWFIS data and mapping services are produced through strong collaborations

with provincial and territorial wildland fire management agencies. The CWFIS supports wildland fire operations and emergency management across Canada.

For more information:

- Satellite Forest Monitoring in Canada: <http://forests.foundryspatial.com/>
- Canadian Wildland Fire Information System: <http://cwfis.cfs.nrcan.gc.ca/home>

Agency	Canadian Space Agency
Core geospatial roles and mandate	<ul style="list-style-type: none">• Peaceful use and development of space• Space exploration• Space science

Established in March 1989, the Canadian Space Agency (CSA) was created through an Act of Parliament, proclaimed in December 1990. The Canadian Space Agency is mandated to promote the peaceful use and development of space, to advance the knowledge of space through science, and to ensure that space science and technology provide social and economic benefits for Canadians.

Earth observation is a key priority of the Canadian Space Program, and the RADARSAT program is the core element. The first satellite, RADARSAT-1, operating from 1995 until March 2013, provided information for use in environmental monitoring and natural resource management, particularly over Canada's North. Its successor, RADARSAT-2, was launched in 2007. RADARSAT-2 provides a high resolution, enhanced repeat imaging capacity, shortened programming and processing-delivery timelines, superior data storage and more precise measurements than its predecessor. RADARSAT uses RADAR sensors and provides imagery regardless of cloud cover or lighting conditions. This is extremely important during Canadian winters as the number of daylight, cloud-free hours is low or nil.

The third generation of the RADARSAT program, the RADARSAT Constellation Mission (RCM), is currently being developed in Canada and satellite launches are scheduled for 2018. Comprised of three small satellites, the RCM will offer complete global coverage capacity and

frequent revisits of Canada's vast territory and coastal approaches of all three oceans. RCM will improve Canada's capability to effectively carry out maritime surveillance, ecosystem monitoring, and respond to emergencies and natural disasters. More importantly, RCM will continue to provide critical EO data to support long-term decision-making and daily government operations and services, and to contribute to international EO datasets.

Together with the international community, the Canadian Space Agency actively makes the case for the use of geospatial data and space-based Earth observations to advance the 2030 Agenda for Sustainable Development. Whether with the international EO community led by the Group on Earth Observations (GEO) or with the space community in the Committee on Earth Observation Satellites (CEOS), the Canadian Space Agency is contributing to the global effort to integrate geospatial information and data with statistical information.

Over the last 20 years, RADARSAT-1 and RADARSAT-2 have collected more than 500TB of data over Canada. RCM is expected to collect approximately the same volume of data annually. RCM data are and will be freely available to users in federal departments. Aligned with the spirit of Open Government and the global trends in Earth Observation, access to non-sensitive RCM data will be provided (subject to Canadian legislation) to a variety of Canadian users, including the industry, government and academic users. This opportunity will enable the development of the downstream industry (and related applications) and support the broader use of Canadian space-based EO technologies in more non-space sectors.

The CSA is also active in making space-based information useful for disaster management. As a founding member of the International Charter on Space and Major Disasters, the CSA supports capacity building and provides data to countries in need. The CSA is also chairing the CEOS Working Group on Disasters. The group aims to define a global satellite observation strategy for disaster risk management and to ensure the appropriate inclusion of satellite Earth observations in the "Sendai Framework for Disaster Risk Reduction 2015-2030."

For more information:

- GEO: https://www.earthobservations.org/geo_sdgs.php
- CEOS: <http://ceos.org/ourwork/ad-hoc-teams/sustainable-development-goals/>
Working Group: <http://ceos.org/ourwork/workinggroups/disasters/>
- International Charter on Space and Major Disasters:
<https://www.disasterscharter.org/web/guest/home;jsessionid=951BF053393A8A46EA7300E9166CD1B3.jvm1>

Department	Fisheries and Oceans Canada
Core geospatial roles and mandate	<ul style="list-style-type: none">• National hydrographic authority• Nautical charting• Marine cadastre• Marine SDI• Oceanography, Fisheries Science, and Hydrography• Coast Guard

Fisheries and Oceans Canada (DFO) scientific research deals with large volumes of mainly geospatial data. The three main marine domains where these data are collected include Oceanography, Fisheries Science, and Hydrography. The volume of scientific and geospatial data acquired amounts to about 90 terabytes per year. The geospatial portion of these data are being made accessible via the Canadian Federal Geospatial Platform (FGP).

In oceanography, Canada participates in joint international monitoring projects where the datasets extend beyond its sovereign waters. Remote sensing data and autonomous drifting buoys produce large volumes of geospatial data that become part of temporal series monitoring the dynamic ocean environment. Ship-board, shore-based and stationary buoy measurements provide geospatial data on currents, waves, tides, temperature, salinity, and density. Observation and measurement data is collected within the three bordering oceans, maritime zones or navigational waters under federal jurisdiction: Atlantic, Pacific, Arctic, internal and Arctic waters and the Great Lakes.

Since the seafloor of the oceans is predominantly unmapped, increasing the bathymetric coverage to increase our scientific knowledge, safety of navigation and marine management

capacity is a priority. By investing in new geospatial data collection technology such as LiDAR, Autonomous Surface Vehicles (ASV), Earth observation, Satellite-Derived Bathymetry, use of gliders, and installing multibeam echo sounders on the fleet of Coast Guard Arctic icebreakers for opportunistic hydrographic data collection in the North, this priority is being addressed.

Fisheries science collects biological and tracking information on migratory species, invasive species, and species at risk, and conducts a stock assessment of economic species. By mapping the different marine habitats, better knowledge of their preservation is obtained, which leads to the creation of Marine Protected Areas or zones of fisheries closure.

Another aspect of DFO's activities relates to establishing regulated zones of fisheries. These zones are part of the fishing permits that are mandatory to fish in Canadian waters and protect the fish resources. The delineation of other maritime zones and limits such as the territorial sea baseline, the territorial sea and the Exclusive Economic Zone (EEZ) is also part of DFO's mandate under the *Oceans Act* with the guidance of Global Affairs Canada.

As a key science department, DFO plays a key role in ensuring the sharing of its scientific evidence base and maintaining transparency concerning policy and program decision-making for sustainable resource management, maritime safety and security and economic prosperity of ocean-related activities.

A number of key datasets include information from the annual DFO survey of more than 150 major fish stocks, and Pacific salmon escapement data, which supports ecosystem and fishery management decisions.

The Department of Fisheries and Oceans continues to strengthen its efforts towards the vision of having DFO Science Data “Open by Default.” In 2016-17, the Department saw a significant increase in the number of datasets available for dissemination through Open Data and Open Maps.

For more information:

- DFO Science and Research: <http://www.dfo-mpo.gc.ca/science/index-eng.htm>
- DFO Science/Canadian Hydrographic Service (CHS): Nautical Charts and Services; <http://charts.gc.ca/index-eng.asp>
- Open Data: <http://open.canada.ca/en>

- Open Maps: <http://open.canada.ca/en/open-maps>

Department	Agriculture and Agri-Food Canada
Core geospatial roles and mandate	<ul style="list-style-type: none"> • Climate related impact monitoring for agriculture (e.g., drought monitoring) • Soil science • Crop inventories, crop yield forecasting and sustainable crop metrics

The Centre for AgroClimate, Geomatics and Earth Observations (ACGEO) is a centre of excellence and innovation at Agriculture and Agri-Food Canada (AAFC). ACGEO is the authoritative source for agroclimate, Earth observation-based agricultural land use management, and soils information in Canada. The centre provides foundational information (near real-time monitoring and forecasting of these resources) for innovative science, proactive policies and effective programs that support market access and a sustainable, competitive agriculture sector in Canada.

The ACGEO provides:

- an authoritative source for land use, land management, soils and agroclimate data, information and applications;
- research in climate indices—drought, excess moisture and extreme weather;
- an official lead for federal drought monitoring;
- climate, Earth observation, soils and geospatial analyses;
- web mapping applications development and maintenance and support for the Federal Geospatial Platform;
- a self-service mapping platform (User Mapping Application Platform);
- leadership in an international agricultural monitoring network, a contribution to the G-20 Group on Earth Observations (GEO) Global Agricultural Monitoring initiative (GEOGLAM); and
- management, maintenance, and dissemination of AAFC geospatial data assets through the Government of Canada's Open Data platform (<http://open.canada.ca/en>) and the FGP.

Open Data: Enabling Access to Agricultural Geospatial Data

The Data Warehouse includes 1,053 registered datasets (30 Terabytes of geospatial data); serves 285 registered Geographic Information users at AAFC; and is accessible to AAFC and Canadian Food Inspection Agency staff, and to the public by request through the Internet. This is AAFC's greatest contribution to the Government of Canada's Open Data initiative (data.gc.ca).

The ACGEO provides foundational data, information and technologies that support agricultural producers, agribusiness and commodity groups; multiple levels of government (federal, provincial and municipal); universities; and non-government organizations. Strategic priorities include:

- National Agro-Climate Information Service (NAIS)—is an authoritative source for agroclimate information in Canada. It provides timely and proactive data, information and tools to support weather and climate related production risk and opportunity assessments. NAIS also conducts applied research to improve the monitoring of agroclimate variables, the assessment of drought and other extreme events.
- Canadian Soils information Service (CanSIS)—is the authoritative source for soil data and expertise (100 years of soil data). Current research is directed towards predictive soil interpretations that translate legacy data to formats that can be readily used in land resource assessments and agri-environmental modelling applications.
- Earth Observation Service (EOS)—is the authoritative source for operational satellite based data development and expert assessment of agricultural land use, management practices and near real-time crop conditions. Key operational products include the Annual Crop Inventory of Canada and near real-time, weekly crop condition assessments.
- Agri-Geomatics Service (AGS)— provides Geospatial data management, analysis and applications. It ensures data is openly available, and ACGEO's datasets, web services,

and applications are timely, authoritative and accurate. AGS also provides analytical capabilities to geo-enable AAFC science, policy and programs.

Major research, development and transfer accomplishments include:

- The national **Annual Space-Based Crop Inventory** generates annual field scale crop type maps of Canada that support the next generation of agri-environmental modelling and provide information on the state and changes in the agricultural landscape.
- **Global Agriculture Monitoring Leadership** leads the Joint Experiments for Crop Assessment and Monitoring (JECAM), a global network of research sites that develop monitoring and reporting protocols and best practices to support a global system for agricultural monitoring. It also co-leads the research component of the GEO Global Agricultural Monitoring Initiative (GEOGLAM), an initiative of the G-20 Agriculture Ministers' action plan to address concerns with food price volatility.
- **Climate Related Production Risk Monitoring for Agriculture** leads the National Climate Related Production Risk Committee (CRPRC), a federal committee that reports bi-weekly on crop condition and assesses national weather and climate impacts on production. Reports help inform a number of activities including: Livestock Tax Deferral assessments due to excessive moisture or drought conditions; Agri-Recovery assessments (e.g., due to hail, frost and drought conditions); and GEOGLAM national assessments.
- **Crop Yield Forecasting and Sustainable Crop Metrics** leads the development of the Canadian Crop Yield Forecasting, a statistical model that uses remote sensing and climatic factors to predict crop yields through the growing season. It also leads the development of indicators of crop yield and production characteristics in near real-time, and the development of metrics to help producers address market access sustainability criteria.
- **Drought Monitoring** leads the Canadian Drought Monitor and is the Canadian lead for the North American Drought Monitor—monthly assessments of the extent and intensity of drought conditions across Canada and North America respectively.

- **Agroclimate Impact Monitoring** leads the online reporting and assessment of the impacts of weather on agricultural operations through a network of volunteer on-the-ground reporters. The online tool, the Agroclimate Impact Reporter (AIR) is currently active in Western Canada, and is being expanded nationally. AIR was Agriculture and Agri-Food Canada's (AAFC) first effort to integrate "crowd sourced" information to produce valuable information for the sector.

For more information:

- AAFC's geospatial products: <http://www.agr.gc.ca/eng/?id=1343066456961>
- AAFC geospatial data assets: <http://open.canada.ca/en>

Department	Department of National Defence/Canadian Armed Forces
Core geospatial roles and mandate	<ul style="list-style-type: none"> • Military and humanitarian operations

Within the Department of National Defence (DND), the Mapping and Charting Establishment (MCE) is the Canadian Armed Forces (CAF) unit that provides authoritative geospatial information and geospatial engineering support to the sea, land and air elements of the DND/CAF. MCE produces data and products in-house and leverages national and international partnerships in addition to purchasing commercial satellite imagery to meet the geospatial information demands of the DND/CAF. The department is mandated to ensure that geospatial, hydrographic and aeronautical data, information and products are available to support all CAF operations at home in Canada and overseas on international missions.

In June 2017, the Government of Canada released its new defence policy review: *Strong, Secure, Engaged*. This policy commits Canada to promote the peaceful use of space and to provide leadership in shaping international norms for responsible behaviour in space. The policy

reiterates that surveillance satellites are vital to the Canadian Armed Forces' ability to monitor and control Canada's maritime approaches.

Canada, represented by DND/CAF, is a member of the Defence Geospatial Information Working Group (DGIWG), a multi-national body responsible for developing geospatial standards for the defence organizations of member nations. DGIWG has been established under a memorandum of understanding between member nations, and addresses the requirements for these nations to

have access to compatible geospatial information for joint military and humanitarian operations. It supports the requirements of NATO and the other alliances in which its member nations participate, including United Nations sanctioned peace keeping.

For more information:

- Canada's Defence Policy: <http://dgpaapp.forces.gc.ca/en/canada-defence-policy/index.asp>

In addition to the launch of the RADARSAT Constellation Mission in 2018, Canada commits to invest in and employ a range of space capabilities, including space situational awareness, space-based Earth observation and maritime domain awareness, and satellite communications that achieve global coverage, including in the Arctic.

Department	Environment and Climate Change Canada
Core geospatial roles and mandate	<ul style="list-style-type: none">• Weather and environmental predictions• Air quality monitoring• Greenhouse gas and aerosols monitoring• Nature conservation

Environment and Climate Change Canada (ECCC) is primarily responsible for weather and environmental predictions. This program provides reliable, accurate and timely forecasts and warnings, as well as weather and environmental intelligence to anticipate, manage and adapt to the risks and opportunities of changing weather, water, air quality and climate conditions. It

involves monitoring, research, prediction and service delivery based on sound science to help Canadians make informed decisions in order to protect their health, safety, security and economic prosperity. Because a global effort is needed to monitor, understand and predict constantly changing weather, water, air quality, sea ice, and climate conditions, the program works with various collaborators around the world. Global collaborators include other national meteorological services, such as the U.S. National Oceanic and Atmospheric Administration and Météo France, as well as international organization such as the United Nations World Meteorological Organization and the Intergovernmental Panel on Climate Change. Data of radiances and derived products from more than 30 sensors, such as hyperspectral infrared and microwave sounders, geostationary imagers, GPS radio-occultation, a Synthetic Aperture Radar (e.g., RADARSAT), and scatterometers is continuously assimilated. Imagery and derived products are delivered to regional forecast offices and media and support is provided to nowcasting (short-range forecasting).

In terms of air quality monitoring, data of stratospheric ozone observations from numerous sensors are continuously assimilated to deliver the UV index and improve weather and air quality forecasts. Chemicals related to air quality and human and ecosystem health are monitored. Satellite products (i.e., Nitrogen dioxide (NO₂), Sulphur dioxide (SO₂), Carbon monoxide (CO), and particulates) are evaluated. Additionally, both Greenhouse gases (GHGs) / aerosols and industrial air pollutant emissions are monitored.

ECCC also strives to monitor and understand vegetation changes, sea ice coverage, snow, surface albedo, and soil moisture through numerous science initiatives including ecosystem mapping and anthropogenic disturbance mapping.

ECCC also contributes to emergency response activities linked to fires, accidents involving chemical products or radioactivity, and flooding. Improvements made to its Global Ice-Ocean Prediction System (GIOPS), enhance the Department's ability to support safe navigation along Canadian coastal areas. The GIOPS is a strong marine environmental prediction tool used across federal departments and agencies. It has the capacity to provide information needed to respond to environmental emergencies (such as oil spills, search and rescue missions). The recently upgraded GIOPS better supports the work of ECCC's Canadian Ice Service, and the mariners

and Arctic communities that rely on ice information and prediction for the seasonal resupplies, ice travel, and hunting and fishing on ice.

ECCC participates with the Canadian Space Agency (CSA) and international space agencies on preparing future satellite missions of interest to the Department, and is the lead federal Canadian department for participation on envisioning future space-based systems and requirements with the World Meteorological Organization. ECCC continuously aims to strengthen partnerships with other government departments and agencies (including CSA) and international space agencies.

Currently, ECCC operates satellite receiving stations in Canada to receive process and operationally distribute Geostationary Operational Environmental Satellite (GOES) data and imagery to ECCC's weather forecasting programs. Numerous atmospheric and surface derived products are assimilated daily from GOES, as well as several polar orbiting satellites. ECCC is preparing for new satellite earth observing missions on a continuous basis, including for the upcoming RADARSAT Constellation Mission (key applications: sea ice mapping, oil pollution monitoring, soil moisture, ocean surface winds, coastal erosion and wetland monitoring). Partnering with CSA, ECCC is working on developing new satellite mission concepts for terrestrial snow monitoring and GHG monitoring.

ECCC's Meteorological Service of Canada (MSC) operates GeoMet which provides access to the MSC's open data, including raw numerical weather prediction (NWP) model data layers and the weather radar mosaic, via Open Geospatial Consortium (OGC) standards. Meteorological layers are served dynamically through the Web Map Service (WMS) standard to enable end-users to display meteorological data within their own tools, on interactive web maps and in mobile apps.

For more information:

- ECCC: <https://www.canada.ca/en/environment-climate-change.html>
- GeoMet public documentation: <https://www.canada.ca/en/environment-climate-change/services/weather-general-tools-resources/weather-tools-specialized-data/geospatial-web-services.html>

Agency	Statistics Canada
Core geospatial roles and mandate	<ul style="list-style-type: none"> • Official statistics—census, survey, and statistical program frames support

Statistics Canada produces data that help Canadians better understand their country—its population, resources, economy, society and culture. Its mission is to serve Canada with high-quality statistical information that matters. The agency promotes the quality and coherence of Canada’s statistics by collaborating with international organizations, federal departments and agencies, and the provinces and territories. As a member of the United Nations Statistical Commission, the agency endorses the fundamental principles of official statistics, which help define what constitutes a good system of official statistics and what role that system should play in national governments.

Statistics Canada has three main programs: one for economic and environmental statistics; one for socio-economic statistics; and one for the census. These are complemented by a statistical infrastructure program that includes geographic and geospatial activities and related support to the other programs.

The Statistical Registers and Geography Division (SRGD) maintains and develops geospatial activities. Its main role has been to support the census frame, its collection, and processing and dissemination activities. It is also the anchor for all survey and statistical program frames. Geography and geospatial activities are not exclusive to SRGD. They are encouraged and taking place in many programs. For example, remote sensing has been used in the Agriculture Crop yield survey program.

Statistics Canada has embraced a modernization agenda that will: strengthen its alignment to users and enhance their experience; use more modern tools and approaches; be a stronger enabler in data uses; and transform its partnership model with its collaborators and stakeholders. The increased use of geospatial information is a natural component of this modernization effort.

With the Open Government Implementation Plan (OGIP), the Government of Canada is working to ensure transparency on federal operations. In this project, the Treasury Board of Canada Secretariat engaged Statistics Canada to build and maintain

a new version of the Open portal. In parallel, statistical information on Human Activity and the Environment was published on the Federal Geospatial Platform in March 2017, opening up new data integration possibilities.

For more information:

- Open Government Implementation Plan: Statistics Canada: <http://open.canada.ca/en/content/open-government-implementation-plan-statistics-canada>
- Statistics Canada (2017). *About us – What we do, our data, administrative data*. Statistics Canada's web site, www.statcan.gc.ca/eng/about/about?MM=as.

Department	Transport Canada
Core geospatial roles and mandate	<ul style="list-style-type: none"> • Transportation safety, management and analysis support for four modes: air, marine, road and rail

Transport Canada's mission is to serve the public interest by promoting a safe and secure, efficient and environmentally responsible transportation system in Canada. Geospatial data and analytical tools are increasingly used to inform policy-making, enhance safety, manage assets, and facilitate socio-economic research across the four modes of transportation—air, marine, road and rail. Illustrative examples include:

- collecting on-road vehicle activity data using plug-in data loggers;
- tracking marine vessels;

- analyzing traffic flows on road and railway networks;
- assessing modal network accessibility, especially in northern and remote areas;
- analyzing supply chain fluidity and performance, especially at border crossings and marine ports;
- estimating shipping container transit and dwell times;
- analyzing traffic network resiliency, including bridges and other structures;
- identifying transport bottlenecks and other sources of traffic congestion;
- regulating the transport of dangerous goods and providing emergency response services through the Canadian Transport Emergency Centre (CANUTEC); and
- managing buildings and other real property owned and operated by Transport Canada.

For more information:

- About Transport Canada: <http://www.tc.gc.ca/eng/aboutus-whatwedo.htm>

Department	Public Safety Canada
Core geospatial roles and mandate	<ul style="list-style-type: none"> • All-hazards integrated federal emergency response support • Flood mapping for disaster mitigation

Public Safety Canada's Government Operations Centre (GOC) provides an all-hazards integrated federal emergency response to events (potential or actual, natural or human-induced, accidental or intentional) of national interest. It provides 24/7 monitoring and reporting, national level situational awareness, warning products and integrated risk assessments, as well as national level planning and whole-of-government response management. During periods of heightened response, the GOC is augmented by staff from other government departments/agencies and non-governmental organizations.

The GOC produces geomatics products with information and analysis, which serve to enhance the GOC capabilities in providing strategic coordination and advice, or in managing current and upcoming events that have the potential to affect national interests. The GOC's Geomatics

section is an authorized government user of satellite imagery during declared emergencies. It coordinates all RADARSAT requests that deal with national emergency management issues.

Some of the current geospatial activities for the GOC are:

- coordinating RADARSAT-2 data to analyze ice along rivers in several provinces, to help monitor ice jams and spring floods;
- planning and acquiring RADARSAT-2 data jointly with the Canada Centre for Mapping and Earth Observation's (CCMEOS) Emergency Geomatics Service (EGS) to extract flood extents during recent flooding in Canada;
- working with partners to map forest fires, forecast fire behaviour and analyze smoke to help with the federal response and decision-making;
- activating the International Charter on Space and Major Disasters when required during emergencies; and
- delivering online tools to share aerial imagery.

Ongoing work also includes development of the Federal Flood Mapping Guidelines Series, which advances flood mapping practices through stakeholder engagement and data sharing, including consultation with Indigenous communities. The publication of these documents will contribute to improved risk management of flooding – Canada's costliest recurring natural hazard – by strengthening flood mapping across the country. The Guidelines Series includes nine evergreen documents:

1. Federal Flood Mapping Framework
2. Flood Hazard Identification and Priority Setting
3. Federal Hydrologic and Hydraulic Procedures for Flood Hazard Delineation
4. Federal Airborne LiDAR Data Acquisition Guideline
5. Case Studies on Climate Change in Floodplain Mapping
6. Federal Geomatics Guidelines for Flood Mapping
7. Federal Flood Risk Assessment Guidelines
8. Risk-Based Land Use Guide
9. Bibliography of Best Practices and References for Flood Mitigation.

For more information:

- Government Operations Centre: <https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/rspndng-mrgnc-vnts/gvrnmnt-prtns-cntr-en.aspx>
- Federal Floodplain Mapping Guidelines Series: <https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/dsstr-prvntn-mtgn/ndmp/fldpln-mppng-en.aspx>

VI. Provincial and Territorial Government Responsibilities and Activities

With the exception of federal lands and maintaining Canada's international boundaries, cadastre is a provincial and territorial responsibility. Most provinces and territories also have geospatial agencies or functions that make maps, geospatial information and expertise available to other government departments/agencies, as well as provide public access to core geospatial information.

Key trends across jurisdictions include a move toward Open Data; increasing geospatial capacity and capacity development activities across departments, including using geospatial data and enterprise solutions, integration, and customizing geospatial information; integration of IM/IT services across departments; growing acquisition of imagery (including an increase in LiDAR acquisition); and growing deployment of Unmanned Aerial Vehicles (UAVs) and Unmanned Aerial Systems (UASs). Additionally, collaborating on and adopting standards within and across jurisdictions is growing.



Government of Alberta: GeoDiscover Alberta

GeoDiscover Alberta, Alberta's Geospatial Data Authority, is a provincially-led program designed to provide quality and authoritative mapping data to citizens. Alberta's geospatial data is brought together in one searchable catalogue and can be viewed with an easy-to-use online mapping tool.

For more information:

- Three-Year Strategy: <https://geodiscover.alberta.ca/geoportal/catalog/docs/GDA-Strategy-2016.pdf>
- GeoDiscover Alberta: <https://geodiscover.alberta.ca>

**Government of British Columbia: The Ministry of Forests, Lands,
Natural Resource Operations and Rural Development, GeoBC**



GeoBC creates and manages geospatial information and products to help the Province manage and protect its natural, economic and social resources and its infrastructure assets. GeoBC provides leadership to advance the geospatial business vision for the province through custom services and solutions to resource business issues including emergency response and natural hazard mitigation; through Crown land and resource expertise to support to other government agencies; and through acquisition, creation and maintenance services for standard base spatial data and imagery with the goal that they are open and accessible.

Leadership in information development and provision is accomplished by working closely with partner provincial agencies. The Natural Resource Ministries' IM/IT Division is responsible for all IM/IT in the ministries. It provides corporate expertise, services and tools that enable innovation, provides the strategy and vision and architecture for geospatial information management and infrastructure, and leads business system development for the natural resource ministries. DataBC is a central agency that provides the provincial government with data management, access, hosting and distribution services that enable the sharing of provincial government data across government, with business and with the public for a range of applications and uses that improve services for citizens and create economic opportunities. In particular, DataBC leads the government's Open Data initiative promoting and providing free public data, and provides and develops a range of map and location based applications by hosting and managing the province's spatial data infrastructure.

For more information:

- Ministry of Forests, Lands, Natural Resource Operations and Rural Development: <https://www2.gov.bc.ca/gov/content/governments/organizational-structure/ministries-organizations/ministries/forests-lands-natural-resource-operations-and-rural-development>
- GeoBC: <https://www2.gov.bc.ca/gov/content/data/about-data-management/geobc>
- DataBC: <https://data.gov.bc.ca/>



Government of Manitoba: GeoManitoba

GeoManitoba is responsible for geospatial technology and information assets in the province. In addition to providing surveying, remote sensing, topographic and cadastral mapping services and sales, GeoManitoba supports the government's intentions to develop corporate-wide GIS capacity to provide a revitalized approach to support delivery, acquisition and management of geospatial information for all Manitoba government departments. This includes providing leadership in the Province's use of GIS technology and specialized geomatics capabilities, stewardship for corporate GIS datasets and centrally coordinating the development of GIS capacity for the Province, including:

- centralized geospatial data storage, management and dissemination (spatial data infrastructure);
- enterprise GIS software licensing;
- corporate data acquisition such as digital ortho imagery; and
- improved human resource capacity for GIS.

GeoManitoba encourages and facilitates sharing of geographic and spatially linked business data between departments to enhance decision-making and to add value across government.

GeoManitoba also assists government departments to evolve the use of GIS and spatial management technologies to support program objectives.

Since 2001 the Manitoba Land Initiative (MLI) web site has been the source for geospatial information from the Government of Manitoba. This web site allows free on-line access and downloading of Manitoba's geospatial data and information.

For more information:

- GeoManitoba: <http://gov.mb.ca/sd/geomanitoba/index.html>
- Manitoba Land Initiative: <http://mli2.gov.mb.ca/>

Government of New Brunswick: Land Information

Infrastructure Secretariat and GeoNB



GeoNB is the Province of New Brunswick's gateway to geographic information and related value-added applications. The main goals of GeoNB are to:

- provide all users with easy access to geographic data, value-added applications and maps;
- reduce duplication and costs through collaborating and sharing geographic data and infrastructure; and
- promoting and increasing the use of geographic data and maps.

For more information:

- GeoNB: <http://www.snb.ca/geonb1/e/index-E.asp>
- Land Information Infrastructure Secretariat: http://www2.gnb.ca/content/gnb/en/contacts/dept_renderer.173.1784.201824.html



Government of Newfoundland and Labrador: GIS and Mapping Division

The GIS and Mapping Division is responsible for planning, developing and supporting the geographic information systems (GIS), mapping and spatial analysis for the four branches of the Department of Fisheries and Land Resources. This includes compiling and maintaining GIS datasets designed for all land resources including agriculture, forestry, wildlife, fisheries, Crown lands and land management.

For more information:

- GIS and Mapping Division: <http://www.flr.gov.nl.ca/gis/index.html>



Government of Northwest Territories: Centre for Geomatics

The Northwest Territories Centre for Geomatics was established primarily to provide geomatics and geographic information systems (GIS) services to the departments of the Government of the Northwest Territories (GNWT). The Centre conducts geomatics projects, provides access to geomatics and geographic information, and promotes the application of geomatics and GIS in all departments by providing training, resources and advice. Centre staff have a wide range of skills in geomatics, GIS, remote sensing, field applications and computer systems. The Centre provides various online services and supports web mapping portals for GNWT clients and the public.

For more information:

- GNWT: <http://www.geomatics.gov.nt.ca/>



Government of Nova Scotia: GeoNOVA

GeoNOVA is the Province of Nova Scotia's provincial mapping agency responsible for coordinating geomatics activities. These activities are varied and include:

- developing, supporting, and enhancing geographic information through common policies, procedures, guidelines and standards for the province;
- acquiring provincial geographic data such as aerial photography and LiDAR;
- administering the provincial Spatial Data Infrastructure;
- maintaining the base mapping database for the province; and
- providing geomatics services to provincial departments or agencies that do not have the capacity.

For more information:

- GeoNOVA: <https://geonova.novascotia.ca/>

For more information:

- Government of Ontario: Ontario Ministry
of Natural Resources and Forestry**

The Ministry's Mapping and Information Resources Branch is an essential partner in managing Ontario's natural resources, enabling decisions supported by the best possible data and information, and by demonstrated leadership in surveying, geomatics and information management. The Land Information Ontario Program develops partnerships and policies to ensure critical geographic data is created, maintained and accessible to stakeholders, partners and residents of Ontario. Land Information Ontario receives cross-government oversight and direction on projects and operations.

For more information:

- Land Information Ontario: <https://www.ontario.ca/page/land-information-ontario>
- Ministry of Natural Resources and Forestry : <https://www.ontario.ca/page/ministry-natural-resources-and-forestry>

Government of Prince Edward Island

Prince Edward Island (PEI) does not have a central service geomatics organization; however, government departments collaborate to provide access to geographic data, value-added applications and maps for public and private sector use. PEI's Treasury Board is responsible for Geographic Information System (GIS) policy.

For more information:

- Department of Finance, Taxation and Property Records (Geographic Information Systems) <https://www.princeedwardisland.ca/en/information/finance/geographic-information-systems>



Government of Quebec: Department of Energy and Natural Resources

The Department of Energy and Natural Resources (MERN), Lands Sector, Geospatial Information Branch, is responsible for managing and supporting the development of land, energy and mineral resources in Quebec, with a view to achieving sustainable development. The Geospatial Information Branch contributes to MERN's mandate by establishing geographic reference data for Quebec and by promoting the use of government geospatial information. It establishes and manages the cartographic and official geodetic networks of Quebec and provides specialized services in aerial survey, cartography, geodesy and remote sensing. It is also responsible for research, development and marketing of new value-added products in government geographic information.

For more information:

- MERN: <http://mern.gouv.qc.ca/ministere>
- Le Québec géographique : <http://www.quebecgeographique.gouv.qc.ca/>
- Géoboutique Québec : <http://geoboutique.mern.gouv.qc.ca/>



Government of Saskatchewan: Provincial Office of Geomatics Coordination

The Provincial Office of Geomatics Coordination (POGC) coordinates, promotes and facilitates the development, effective use, and sharing of geographic information across government. The office works with government and non-government organizations to gather, store and present geographic information.

For more information:

- GIS Saskatchewan: <http://gis.saskatchewan.ca>



Government of Yukon: Geomatics Yukon

Geomatics Yukon functions as the corporate geomatics unit for the Yukon Government.

Geomatics Yukon's mandate is to provide the official single source for Yukon government geospatial datasets that are comprehensive, current, useful, and widely accessible. Geomatics Yukon manages an integrated enterprise system that is inter-departmental, centralized, and coordinated.

GeoYukon, an application developed by Geomatics Yukon, allows users to search, display and download the Yukon government's most authoritative and recent spatial data.

For more information:

- Geomatics Yukon: <http://www.geomaticsyukon.ca/>
- GeoYukon: <http://mapservices.gov.yk.ca/>

¹ <http://www.science.ca/scientists/scientistprofile.php?PID=420>

² For an overview see: https://www.nfb.ca/film/data_for_decision/

³ In 1982, section 92A was added to the *Constitution Act, 1867* to clarify provincial control for natural resources. This clarification confirms provincial responsibility to make laws about exploration, development, conservation and use of natural resources, including laws about the rates of primary production. This section of the *Constitution Act* does not affect federal responsibility for interprovincial and international trade; for resource-based science and technology; or for resource management in the frontier regions, including the offshore areas. In addition, the definition of primary production excludes value-added products and matters relating to international standards and global trade and commerce.

Appendix 1: Acronyms

AAFC: Agriculture and Agri-food Canada
ACGEO: AgroClimate, Geomatics and Earth Observations
Arctic SDI: Arctic Spatial Data Infrastructure
ARHC: Arctic Regional Hydrographic Commission (IHO)
ARMSDIWG: Arctic Regional Marine Spatial Data Infrastructures Working Group (IHO)
CAFF: Conservation of Arctic Flora and Fauna (Arctic Council)
CCFM: Canadian Council of Forest Ministers
CCMEO: Canada Centre for Mapping and Earth Observation (NRCan)
CCOG: Canadian Council on Geomatics
CEOS: Committee on Earth Observation Satellites
CFIA: Canadian Food Inspection Agency
CGDI: Canadian Geospatial Data Infrastructure
CHS: Canadian Hydrographic Service (DFO)
CSA: Canadian Space Agency
DFO: Department of Fisheries and Oceans (Fisheries and Oceans Canada)
DND/CAF: Department of National Defence/Canadian Armed Forces
ECCC: Environment and Climate Change Canada
EGS: Emergency Geomatics Service (NRCan)
EMMC: Energy and Mines Ministers Conference
EODMS: Earth Observation Data Management System
FCGEO: Federal Committee on Geomatics and Earth Observation
FGDC: Federal Geospatial Data Committee (United States)
FGP: Federal Geospatial Platform (Government of Canada)
GEM: Geo-mapping for Energy and Minerals program (NRCan)
GEO: Group on Earth Observations
GNBC: Geographical Names Board of Canada
GOC: Government Operations Centre (Public Safety Canada)
GSDI: Global Geospatial Data Infrastructure
IHO: International Hydrographic Organization

ISO: International Organization for Standardization

MLB: Maritime Limits and Boundaries

MSDI: Marine Spatial Data Infrastructure

NMA: National Mapping Agency

NRCan: Natural Resources Canada

OGC: Open Geospatial Consortium

SDI: Spatial Data Infrastructure

SGB: Surveyor General Branch (NRCan)

TC: Transport Canada

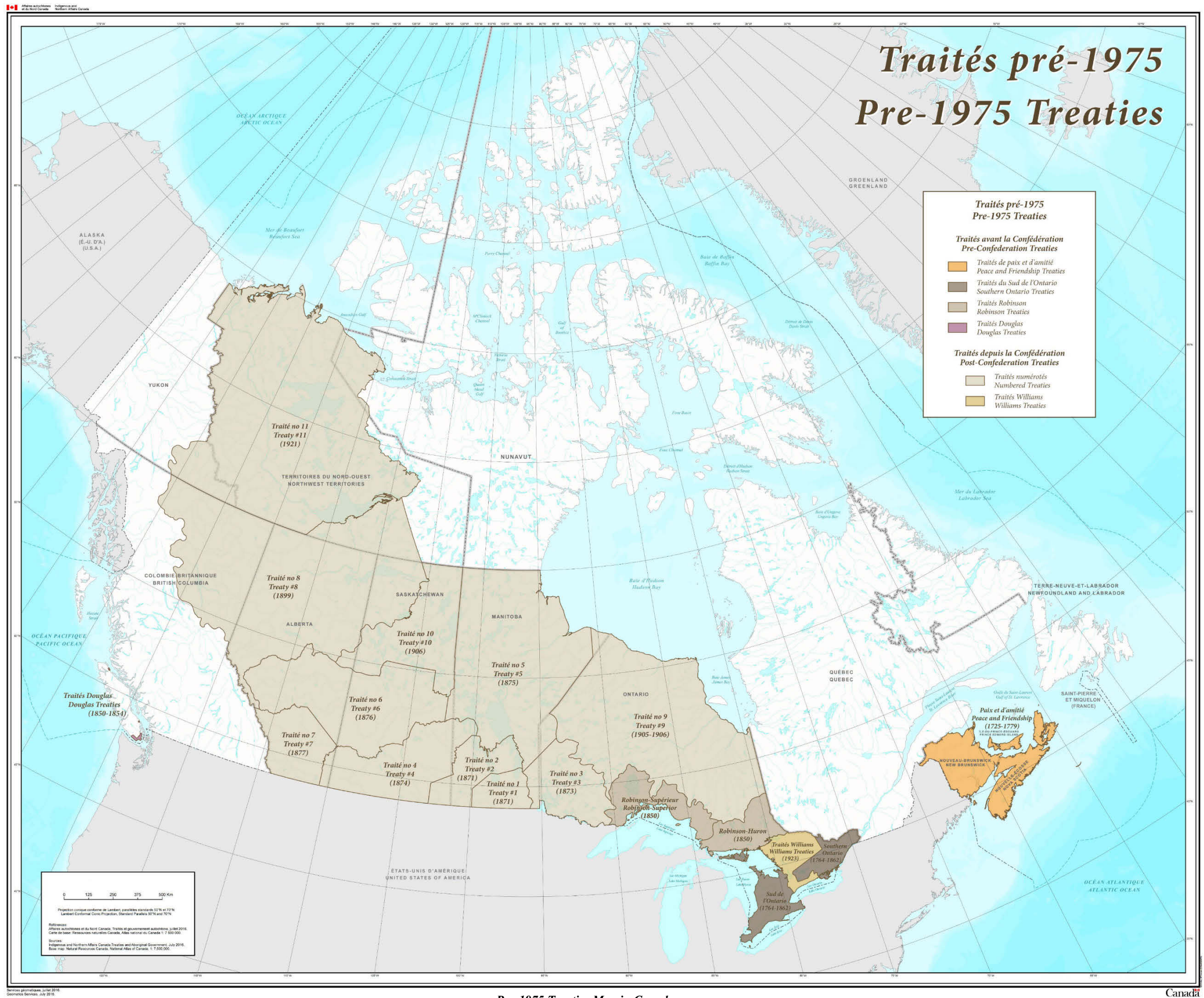
USGS: United States Geological Survey

Appendix 2: Maps

Natural Resources Canada, 2006. <https://open.canada.ca/data/en/dataset/5a4bed82-1f5d-532f-adf0-980c212c9cd1>

Indigenous and Northern Affairs Canada, 2016. PDF Version of the Pre-1975 Treaties Map in Canada (5.32 Mb, 1 Page) https://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-HQ-AI/STAGING/texte-text/mprm_treaties_th-ht_canada_1371839430039_eng.pdf

Indigenous and Northern Affairs Canada, 2016. PDF Version of the Modern Treaties - Comprehensive Land Claims and Self-Government agreements (7.1 mb, 1 Page) https://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-HQ-AI/STAGING/texte-text/mprm_pdf_modrn-treaty_1383144351646_eng.pdf

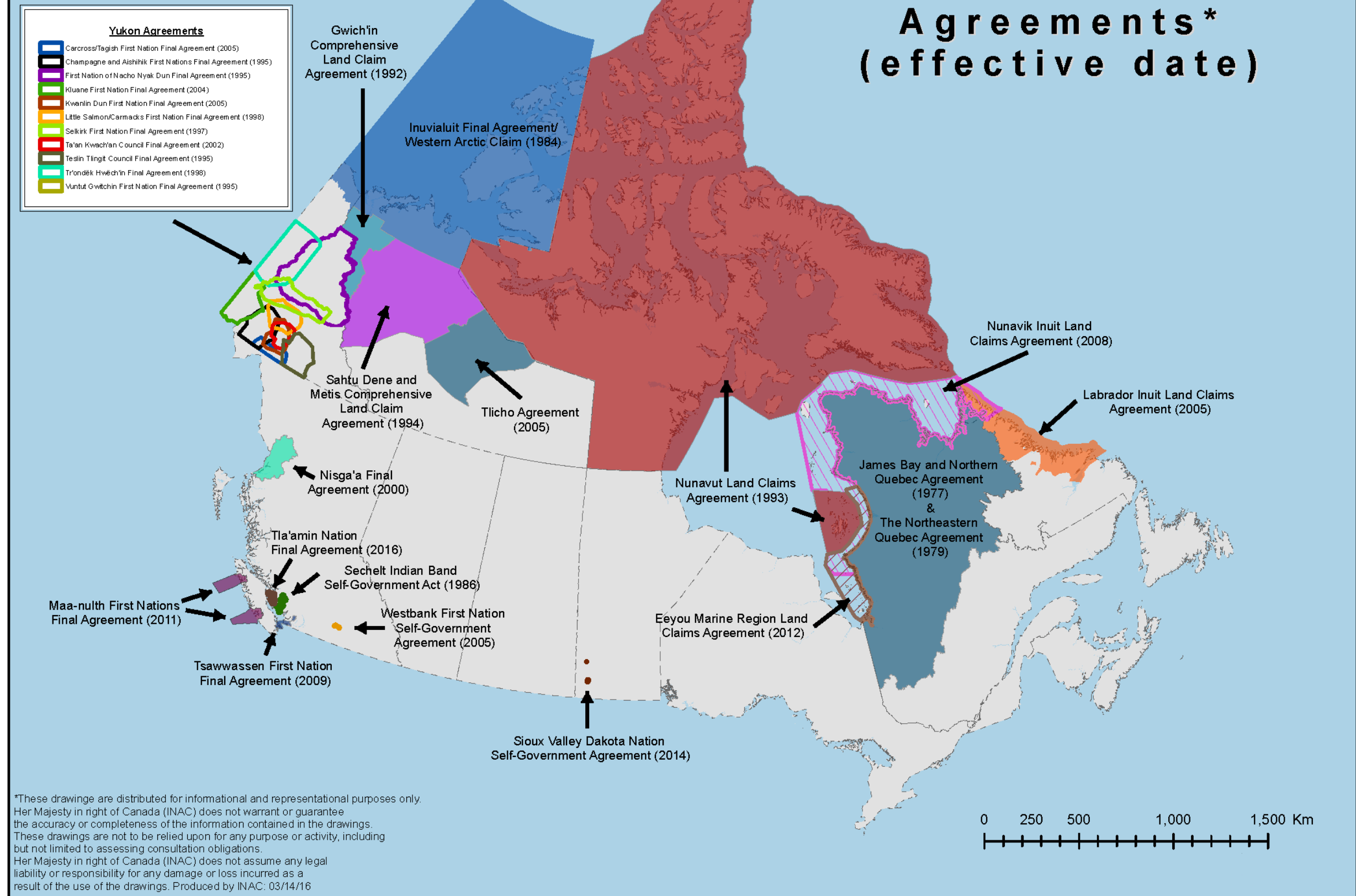


Pre-1975 Treaties Map in Canada

Source: Indigenous and Northern Affairs Canada 2016.

[For intended scale printing please visit and download at <https://www.aadnc-aandc.gc.ca/eng/1290453474688/1290453673970#modern/>]

Modern Treaties and Self-Government Agreements* (effective date)



Modern Treaties and Self-Government Agreements

Source: Indigenous and Northern Affairs Canada 2016 . Please note that the map was released on July 2016, and therefore does not include the Déline Final Self-Government Agreement, which came into effect in September 2016.
 [For intended scale printing please visit and download at <https://www.aadnc-aandc.gc.ca/eng/1290453474688/1290453673970#modern>]