CANADIAN GEOSPATIAL DATA INFRASTRUCTURE STOCKTAKING DESK STUDY

BASED ON THE UNITED NATIONS Integrated Geospatial Information Framework (UN-IGIF)

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ACRONYM LIST

Acronym	Definition
AI	Artificial intelligence
BC	British Columbia
BCIT	British Columbia Institute of Technology
CAP	Country-level action plan
CCMEO	Canada Centre for Mapping and Earth Observation
CCOG	Canadian Council on Geomatics
CFI	Canada Foundation for Innovation
CFS	Canadian Forest Service
CGDI	Canadian Geospatial Data Infrastructure
CGS	certified geomatics specialist
CHS	Canadian Hydrographic Service
CICE	Centre for Innovation and Clean Energy
CIG	Canadian Institute of Geomatics
COGS	Centre of Geographic Sciences
CSA	Canadian Space Agency
ECCC	Environment And Climate Change Canada
FAIR	Findable, accessible, interoperable, and reusable
FGP	Federal Geospatial Platform
FHIMP	Flood Hazard Identification and Mapping Program
FIPPA	Freedom of Information and Protection of Privacy Act
FNIGC	First Nations Information Governance Centre
FPT	Federal, provincial, territorial
FSDS	Federal sustainable development strategy
GBA	Gender-based Analysis
GEDS	Government electronic directory services
GIS	Geographical information systems
GISCI	GIS Certification Institute
GISP	GIS Professional
GPS	Global positioning systems
ICT	Information communication technology
IDEaS	Innovation or Defence Excellence and Security
IEC	International Electrotechnical Commission

IPR	Intellectual property rights
IRAP	Industrial Research Assistance Program
ISC	Innovative Solutions Canada
ISO	International Standards Organization
KPIs	Key performance indicators
MES	Master of environmental studies
MRDEM	Medium resolution digital elevation model
NMSO	National master standing offer
NSERC	Natural Sciences and Engineering Research Council of Canada
OCAP	Ownership, control, access, and possession
OGC	Open Geospatial Consortium
PIPEDA	Personal Information Protection and Electronic Documents Act
PSPC	Public Services and Procurement Canada
RCGS	Royal Canadian Geographical Society
RCM	Radarsat Constellation Mission
RSSSA	Remote Sensing Space Systems Act
SAIT	Southern Alberta Institute of Technology
SCC	Standards Council of Canada
SDG	Sustainable development goal
SDI	Spatial data infrastructure
SDOs	Standards development organization
SIF	Strategic innovation fund
SMEs	Small-medium sized enterprise
SP	Strategic pathways
UBF	Universal Broadband Fund
UN	United Nations
UN-IGIF	United Nations Integrated geospatial information framework
UNA	User needs assessment
USA	United States of America
WCS	Web coverage service
WFS	Web feature service
WMS	Web map service
W3C	World Wide Web Consortium

ADVISORY STATEMENT

This desk-based stock taking assessment of the Canadian Geospatial Data Infrastructure (CGDI) provides essential baseline information to the potential development of a whole-of-community geospatial strategy for the CGDI to 2030 and beyond. The objective is to assess the CGDI against the United Nations (UN) Integrated Geospatial Information Framework (UN-IGIF) using UN/World Bank methodologies adapted to the Canadian context.

This stock taking assessment was completed by Hatfield Consultants LLP (Hatfield), contracted to develop this report by Natural Resources Canada (NRCan). This assessment was informed by Hatfield's 30 years of activity providing geospatial services in Canada and internationally. The information presented was collected from publicly available records accessed between July to October 2024. The geospatial landscape in Canada continues to evolve. As such, the research findings represent a moment in time and cannot represent a complete or up-to-date reflection of the full situation across Canada. Further, it does not encompass all public or private actions being taken by the Government of Canada and others in relation to the CGDI. For definitive, up to date information on any initiative or organization encompassed herein, please refer to original sources.

Editorial changes have been made by NRCan to the original version prepared by Hatfield for publication purposes.

1.0 INTRODUCTION

Natural Resources Canada (NRCan) is taking stock of Canada's spatial data infrastructure (SDI), the "Canadian Geospatial Data Infrastructure (CGDI)," to provide essential baseline inputs to the potential development of a whole-of-community geospatial strategy for the CGDI to the year 2030 and beyond, and/or related efforts. The stock-take assesses the CGDI against the United Nations (UN) Integrated Geospatial Information Framework (UN-IGIF) (UN-GGIM 2023) using UN/World Bank methodologies (World Bank Group 2024) adapted to the Canadian context.

The CGDI is the collection of geospatial data, standards, policies, applications, and governance that facilitate the access, use, and integration of spatial data (CCMEO 2024). Historically, the five component areas of the CGDI have included: Collaboration, Data, Operational Policies, Standards and Specifications, and Technology.

The UN-IGIF builds on and expands the concept of an SDI and creates an enabling environment where national governments can coordinate, develop, strengthen, and promote the efficient and effective use and sharing of geospatial information for policy formulation, decision-making, and innovation (UN-GGIM 2023).

The UN-IGIF is a tool that provides guidance on how to extend the scope of an SDI to cover the governance, policy, financial, capacity and engagement processes necessary to collect, maintain, integrate, and share geospatial information, through all levels of government and society. It describes, via nine Strategic Pathways (SP), what is needed to build and maintain the capabilities required to manage and offer geospatial information to users.

Assessment of a country's SDI against these components enables a balanced and comprehensive approach to guide SDI planning and investments to meet future geospatial needs.

Objective

The objective of this document is to compile responses to the UN-IGIF questions and assess the CGDI against associated UN/World Bank criteria (accounting for the Canadian context).

The stock-take is not intended to replace a CGDI Performance Assessment against the CGDI Performance Framework (such as the 2015 assessment), nor is it a formal evaluation. It is intended to support the Identification of strengths and weaknesses, opportunities, and challenges, including from stakeholder/partner perspectives using UN-IGIF as a reference framework.

2.0 METHODOLOGY

This document is one component of a larger stocktaking exercise led by NRCan's Canada Centre for Mapping and Earth Observation (CCMEO). The stock-take includes the following data collection methods: 1) individual/small group interviews with a sample of provincial/territorial and federal government organizations; 2) on-line geospatial data producer and user inventories (surveys) to collect more detailed information from interviewee organizations; 3) this desk study (desktop research); 4) in addition, a third

party environmental scan was undertaken (literature review) to provide an overview of trends in geospatial technologies and strategies relevant to the CGDI.[1]

This document provides the desk study assessment against the UN/World Bank baseline assessment criteria (World Bank Group 2024). Using the UN-IGIF Baseline Diagnostic Tool published by the World Bank as a template, some modification to the approach and structure were completed to account for the Canadian context. The Diagnostic Tool, which provides an assessment of the current position of geospatial information management around the nine SPs, was completed through desktop research and professional opinion and knowledge. The assessment was completed based on a subset of questions from the Diagnostic Tool.

Each component of the stock-take identified above addresses components of various SPs in the UN-IGIF. No component addresses all SPs comprehensively. As such, CCMEO will use the results of the desk study, together with the findings of other instruments and broader engagement with the private sector, academia, Indigenous organizations, and other partners and stakeholders, to generate a more complete picture of the state of the CGDI and to inform the development of a potential strategy and other products, including a country report to the United Nations.

The structure of each SP consists of an assessment of the state of the CGDI against the questions included in the World Bank Diagnostic Tool, with accompanying recommendations for improvement (where/how the CGDI needs to adapt/mature to meet current and future needs).

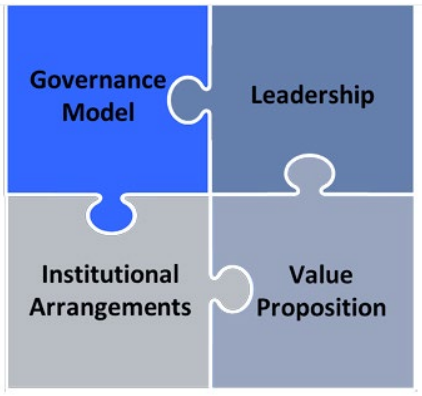
The recommendations are from the perspective of Hatfield, contracted to develop this report, and are informed by Hatfield's 30 years of activity providing geospatial services in Canada and internationally. Formal recommendations for future readiness should be developed collaboratively as part of whole-of-community strategy development activity.

This study and its findings may be shared online as a stand-alone piece of evidence; however, they are intended to be used alongside evidence from the other lines of inquiry to provide a more comprehensive picture of the status of Canada's SDI.

3.0 STRATEGY PATHWAY 1: LEADERSHIP/GOVERNANCE[2]

[1] In this document, SDI and CGDI are used interchangeably.

[2] The most recent version of the UN-IGIF identifies SP1 as "Governance", meanwhile the World Bank derived guide utilized the term "Leadership"



This strategic pathway establishes the leadership, governance model, institutional arrangements, and clear value proposition to strengthen multi-disciplinary and multi-sectoral participation in, and a commitment to, achieving an Integrated Geospatial Information Framework.

The objective is to attain political endorsement, strengthen institutional mandates and build a cooperative data sharing environment through a shared vision and understanding of the value of an Integrated Geospatial Information Framework, and the roles and responsibilities to achieve the vision (World Bank Group 2024).

Stocktaking Questions:

1.1 Leadership: Is there an "advocate" in government that is leading, engaging and promoting the benefits of a National SDI (Spatial Data Infrastructure) across all levels of government organizations, and with the private sector, academia, Indigenous organizations, and the local community?

CCMEO, under NRCan, is the advocate for the CGDI across all levels of government. CCMEO manages the GeoConnections program, which is an ongoing program to co-fund innovative geospatial solutions, (NRCan 2024a) and is also the lead federal agency for the Canadian Council on Geomatics (CCOG) (CCOG 2024). CCMEO, through its leadership in GeoConnections and CCOG, is actively driving change across government with tangible outcomes. Specific funded initiatives through GeoConnections impact the private sector, academia, and the local community (including Indigenous communities).

Other geospatial collaborators influencing the CGDI on the development of data and technology standards, on core geospatial data, and on providing operational policy guidance include, but are not limited to, the CCOG, Arctic Spatial Data Infrastructure (Arctic SDI), and Open Geospatial Consortium (OGC). Together these geospatial collaborators, along with CCMEO, advocate for the CGDI with tangible outcomes.

1.2 Governing Body: Has a Governing Body been established (or part of Digital Transformation governance) to provide leadership, direction, and oversight for National Spatial Data Infrastructure-related activities and projects?

The Governing Body providing leadership, direction, and oversight for CGDI-related activities and projects is understood to be CCOG on the basis of the mandate derived from the Geomatics Accord (2014-2019) (albeit the 2020-2025 version of the Accord is not publicly available) (CCOG 2024). However, CCMEO manages the GeoConnections program (NRCan 2024a) and its role and mandate may be considered a Governing Body. GeoConnections, administered by NRCan's CCMEO, provides federal leadership on geospatial data sources, optimizing the use of geospatial data, and policy development (NRCan 2016).

The CCOG role, its membership, and existence of Geomatics Accord (2014-2019) are clear strengths. However, the lack of clarity on the organization structure and entity that is the Governing Body for the CGDI should be addressed.

1.3 Geospatial Coordination Unit: Has a geospatial Coordination Unit been established to coordinate and be accountable for all National SDI (Spatial Data Infrastructure) related activities?

The geospatial Coordination Unit is understood to be staff at CCMEO who are responsible for the Geoconnnections Program. These staff also play a leadership and coordination role in CCOG. There is a long history of NRCan providing leadership and coordination of the CGDI through GeoConnections. However, there is also a lack of clarity on the organization structure and the entity or group that is responsible for coordination of CGDI activities within CCMEO.

1.4 Establishing Working Groups: Have specialist Working Groups (subject matter experts) been established to provide advice and guidance to the National Governing Body and/or the Coordination Unit?

CCMEO has established working groups and other operational units in priority areas related to the CGDI. Public information is available on the Geographical Names Board of Canada (NRCan 2024b) and the GEO.ca digital platform (CCMEO 2024). NRCan is a principal member of the OGC and has been an active member since 1998. Information on other groups is lacking, although it is understood that several groups exist, e.g. International Organization for Standardization (ISO) Geospatial Standards, and the World Wide Web Consortium (W3C).

The work of the Geographical Names Board of Canada is guided by a five-year strategic plan with four overarching strategic priorities for 2020-2025. The GEO.ca platform provides a description of the platform and plans for the future of GEO.ca.

Despite several topics being presented on the NRCan website that are driven by groups, the organization structure and the groups that are responsible for specific topics are not clearly defined. A clear description of the governance of the CGDI should be provided on the NRCan website.

1.5 Institutional Geospatial Roles: Are there clear and accepted institutional roles and responsibilities across all levels of government for tasks (strategic and operational) associated with all aspects of integrated geospatial information management to create a National SDI (Spatial Data Infrastructure)?

It is understood that CCMEO plays the lead strategic role in the CGDI and a key operational role in managing the GeoConnections program. Members of CCOG play strategic and operational roles.

The Geomatics Accord provides a framework for intergovernmental collaboration by outlining roles and responsibilities and overarching principles for intergovernmental collaboration on geomatics activities in Canada. Roles and responsibilities of the federal government and provincial and territorial governments are defined at a high level. CCOG is well established and has an important strategic role in the CGDI. However, the CCOG website defines its member organizations but does not provide institutional roles and responsibilities. The Geomatics Accord (2014-2019) refers to a CCOG Terms of Reference in Annex 1, but this is not provided.

1.6 Geospatial Strategy: Is there a National SDI (Spatial Data Infrastructure) Strategy that identifies the vision, mission, goals and objectives of the geospatial information management initiative to create a National SDI?

A Pan-Canadian geomatics strategy action and implementation plan. ver. 2.1 published in 2014 is listed on the government website but not available online (NRCan 2014a). The most recent national strategy that identifies the vision, mission, goals and objectives of the CGDI is more than 10 years old (GeoConnections 2012a). At a higher level covering all government data, the Government of Canada has developed and published a 2023–2026 Data Strategy for the Federal Public Service (Government of Canada 2024a). The Canada's Digital Ambition 2022 (Government of Canada 2022a) and Digital Stands Playbook (Government of Canada 2021) are also relevant strategies.

Several provinces and territories have published clear geospatial information management strategies, e.g. British Columbia's strategic summary (GeoBC 2023). Many major municipalities also have a geospatial strategy, e.g. City of Vancouver's Geospatial Strategic Roadmap (City of Vancouver 2024).

Despite the long history of NRCan providing leadership and coordination of the CGDI through GeoConnections, a publicly available national geospatial strategy is lacking and GeoConnections funding opportunities are not clearly linked to a national geospatial strategy.

1.7 Value Proposition Statement: Is there a simple statement that summarizes why stakeholders and partners should engage with and use geospatial information and why the government needs a National SDI (Spatial Data Infrastructure) and how the investment is aligned with the strategic priorities of government?

Several publications communicate the benefits of the CGDI including its components (data, policies, standards, technologies, resources, and collaboration). The Geomatics Accord (2014-2019) includes a statement of the benefits of the accord. In 2020, several communications materials about the CGDI were developed that clearly describe its benefits, including a CGDI Factsheet and Primer (Hatfield Consultants 2020; Natural Resources Canada 2020). The performance of the CGDI (GeoConnections program) and a socio-economic value study were completed in 2015 (GeoConnections 2016; KPMG 2016) providing strong evidence of the impact of the investments in the CGDI and the important of geospatial technologies to the Canadian economy.

The Canadian Space Agency (CSA) annual State of the Canadian Space Sector includes financial and socio-economic data on the sector, including number of organizations active in the sector and their composition by region, the sectors of activity, the Canadian space workforce and its composition, research and development (R&D), and innovation (e.g. Canadian Space Agency 2023).

Historical and recent efforts to quantify and communicate the benefits of the CGDI are positive, but the studies on socio-economic impacts and benefits studies are dated (2015 vintage). A simple value statement is not available or published on a CCMEO website.

1.8 Strategic Alignment: Was the process to formulate the National SDI (Spatial Data Infrastructure) Strategy fully inclusive? And did it involve capturing the requirements of all key stakeholders and partners?

A public CGDI strategy document is lacking. In 2019, NRCan commissioned a user needs assessment of the CGDI that emphasized inclusivity by addressing the needs of all Canadian stakeholders, with special attention to the needs of Indigenous organizations (Hatfield Consultants 2019). The NRCan 2024-25 departmental plan integrates Gender-based Analysis Plus (GBA Plus)(NRCan 2024c). The use of GBA Plus allows NRCan to identify and address potential and existing barriers to accessing and benefitting from the department's programs while facilitating a more inclusive and equitable response to creating opportunities and outcomes for all Canadians. NRCan publishes departmental results reports, which includes GBA Plus statistics (NRCan 2023).

As noted above, NRCan has made laudable efforts to capture needs of stakeholder including underrepresented groups, but a publicly available national geospatial strategy is recommended.

1.10 Monitoring and Evaluation / Success Indicators: Is there a Monitoring and Evaluation Framework and associated set of Key Performance Indicators (KPIs) to regularly monitor progress of the planned deliverables towards attaining the country's National SDI (Spatial Data Infrastructure) goal, and adjusting the Action Plan based on feedback?

A Monitoring and Evaluation Framework and associated set of KPIs for GeoConnections or CCMEO's CGDI activities are not publicly available. The 2015 assessment of the CGDI used an assessment framework and analyzed CGDI measurement data and indicators (KPMG 2016). A small number of KPIs relevant to the CGDI are included in results and targets of the NRCan 2024-25 Departmental plan, e.g. percentage of foundational geospatial data that is current (NRCan 2024c). Within the departmental plan, information is provided on plans to achieve results on topics such the Canadian Geodetic Survey and Core Geospatial Data.

It is positive that CGDI-related KPIs are included in the NRCan Departmental plan. The 2015 assessment of the CGDI (KPMG 2016) suggests that an assessment framework and indicators exist, but there is no evidence that an assessment framework and indicators are updated or used internally.

An evaluation and subsequent report of the GeoConnections Program Phase III (2010 to 2014) was published in 2016 but does not report against a set of comprehensive monitoring and evaluation KPIs that have been agreed by the CCMEO (NRCan 2016).

Recommendations from the perspective of Hatfield:

To improve on the baseline assessment, the following are suggested:

- Identify and provide a clear description of the governance for the CGDI on the NRCan website and define the roles of CCMEO, the GeoConnections program, and the CCOG in Canada's SDI. Provide access to the CCOG terms of reference. Include a visual diagram illustrating the governance structure of the CGDI, similar to the CGDI Factsheet (Natural Resources Canada 2020).
- Geomatics Accord (2020-2025) to be publicly available.

- Identify linkages between the CGDI and other federal digital transformation initiatives.
- Develop and publish a five-year geospatial strategy that identifies the vision, mission, goals, and objectives of the CGDI.
    - Include a clear value proposition based on an updated socio-economic analysis of the CGDI.
    - Ensure the strategy is developed through a fully inclusive process.
    - Integrate an assessment framework and performance indicators.

4.0 STRATEGY PATHWAY 2: POLICY AND LEGAL

This strategic pathway establishes a robust policy and legal framework that is essential for instituting effective, efficient, and secure management and exchange of geospatial information - nationally and sub-nationally.

The objective is to address current policy and legal issues by improving the policies and laws associated with, and having an impact on, geospatial information management. This is achieved by proactively monitoring the policy and legal environment, including mandating responsibility for the production of data, and keeping abreast of issues and challenges arising from the evolving, innovative and creative use of geospatial information and emerging technologies (World Bank Group 2024).

Stocktaking Questions:

2.1 Legal & Policy Working Group: Has a National independent geospatial Policy Working Group (which may be comprised of providers from government, the private sector, academia and civil society) been established?

CCOG is a "consultative inter-governmental forum" for federal, provincial and territorial governments to discuss items including proposed legislation (CCOG 2024). However, CCOG does not include private sector, academia and civil society. CCOG plays an important role in geospatial policy across levels of government. However, an independent working group is not established and CCOG does not include private sector, academia and civil society.

2.2 Legal & Policy Review, Needs Assessment, and Gap Analysis: Has a needs assessment for the policy and legal framework been developed to support the National SDI and have gaps been identified in the existing policy and legal framework to be implemented?

CCMEO and GeoConnections provide a summary of Geospatial Standards and Operational Policies (NRCan 2019a) and produced a factsheet on Geospatial standards and policies for interoperability (NRCan 2014b). A user

needs assessment for the CGDI (Hatfield Consultants 2019) did not explicitly address policy and legal issues. The Geomatics Accord addresses responsibilities and provides an inter-governmental collaboration framework.

While CCMEO provides policy information related to interoperability, a needs assessment on legal and policy and a clear framework is lacking or is not publicly available.

2.3 Non-legally Binding, Informal Agreements: Are there non-binding policies, executive orders, administrative measures, memoranda of understanding, norms and guides that are part of a policy and legal framework for the National SDI?

At the federal level, several Treasury Board policies and guidance are relevant and apply to the CGDI. These include:

- Both a Policy and a Guideline on Service and Digital – an integrated set of rules that articulate how Government of Canada organizations manage service delivery, information and data, information technology, and cyber security in the digital era (Government of Canada 2019; Government of Canada 2024b).
- Directive on Open Government – directive to maximize the release of government information and data of business value to support transparency, accountability, citizen engagement, and socio-economic benefits through reuse, subject to applicable restrictions associated with privacy, confidentiality, and security (Government of Canada 2014).

Collectively, these policies, guidelines, and directives help to ensure consistent approaches to open data and information practices across government. In addition, the Geomatics Accord is part of a policy and legal framework supporting the CGDI.

Federal and provincial/territorial policies and guidelines on open data provide a strong basis for geospatial data management and the concept of a national SDI based on collaboration among levels of government. However, a policy and legal framework for the CGDI is not in the public domain.

2.4 Data Sharing: Are there effective arrangements to ensure that geospatial data sharing is encouraged, promoted and fully enabled?

Canada has well-established arrangements to encourage, promote and enable data sharing. A summary is provided below:

	Geomatics Accord (CCOG 2024)	FPT open data policies & licenses	OCAP™
FPT organizations	✓	✓	
FPT organizations & local governments		✓	
FPT organizations & Indigenous partners			✓
FPT organizations & external stakeholders		✓	

OCAP® = The First Nations principles of **ownership, control, access, and possession.** OCAP® is a registered trademark of the First Nations Information Governance Centre (FNIGC) (see: https://fnigc.ca/ocap-training/).

Multiple arrangements exist to ensure geospatial data sharing is encouraged, promoted and enabled. Sharing also embraces the Findable, Accessible, Interoperable and Reusable (FAIR) paradigm.

2.5 Licensing Geospatial Information: To what extent do government generated data licensing agreements facilitate the sharing of geospatial data?

Canada has well-established arrangements to encourage, promote and enable data sharing (GeoConnections 2012b). However, there are still multiple license data agreements from different government departments e.g., Environment and Climate Change Canada (ECCC) and NRCan, which adds complexity.

What aspects of government generated data licensing enable the sharing (access?) of geospatial data?

Sharing is greatly supported by the Federal Open Government License - Canada (Government of Canada 2022b). Provincial/Territorial licenses, e.g. BC Open Government License (Government of British Columbia 11114).

What aspects of government generated data licensing restrict the sharing (access?) of geospatial data?

RADARSAT-1, RADARSAT-2, and Radarsat Constellation Mission (RCM) satellite images have restricted licenses, or user access is impacted by the Remote Sensing Space Systems Act (RSSSA) (Branch 2007).

What are the limitations to adopting and applying open data licenses practices to facilitate sharing of data?

Restrictions apply when governments obtain data under license from commercial vendors or from organizations that apply restrictive licenses. Indigenous data sovereignty is an important issue and is addressed by government policy (Hackett and Olson 2019).

2.6 Open Data Policy: Is there a government generated policy or legislation that supports the dissemination of geospatial data through "Open Data"?

Data sharing is greatly supported by the Federal Open Government Licence - Canada (Government of Canada 2022b) and Provincial/Territorial licences, e.g. BC Open Government Licence (Government of British Columbia 2024). The Federal Open Government Initiative was launched in 2011, which included an Open Data pilot project. The project aimed to improve the ability of the public to access, use, and share government data. In 2013, as part of an expanded Open Data Portal, the Federal Government introduced the Open Government Licence to enable the use of public data while ensuring that the government remains the original source of the data. The licence is designed to be user-friendly and interoperable with other licensing models, such as the ones used by the United Kingdom and British Columbia. The Open Government Licence has been updated and expanded over time to cover more datasets and to make it easier for individuals and organizations to use government data.

The current version of the Open Government License - Canada 2.0 (Government of Canada 2022b) allows anyone to copy, modify, publish, translate, adapt, distribute, or otherwise use the information in any

medium, mode, or format for any lawful purpose. The only requirements are to acknowledge the source of the information and not to misrepresent the data or its source.

Many other open data licenses in use have certain core concepts that may restrict the use of open data (use for commercial development), such as use restrictions, derivative works restriction, share alike terms, or attribution requirements.

2.7 Are there specific data protection and privacy laws around geospatial data to safeguard the rights of individuals?

Canada has specific data protection and privacy laws that apply to geospatial or locational data, especially when such data can be linked to an identifiable individual. Locational data, which includes information about an individual's movements or whereabouts, is considered personal information if it can be used to identify a person either directly or indirectly.

Well established data protection and privacy legislation in Canada includes Personal Information Protection and Electronic Documents Act (PIPEDA), Privacy Act, and the Freedom of Information and Protection of Privacy Act (FIPPA) in BC. However, the impact of PIPEDA and provincial/territorial legislation on geospatial data collection and management is not being specifically monitored.

Are there data protection and privacy laws that impact geospatial data?

Canadian Federal law includes PIPEDA (Office of the Privacy Commissioner of Canada 2021). Provinces and territories with privacy legislation, e.g. BC Personal Information Protection Act (Office of the Information and Privacy Commissioner for BC 2024). PIPEDA and provincial or territorial legislation can have significant implications for geospatial data that often includes information that can be used to identify an individual, such as their home or work address, their travel patterns, or their location at a specific time. This type of data is considered personal information under PIPEDA.

2.8 Is there a robust policy and legal framework that clarifies intellectual property rights (IPR) in respect to geospatial information for both data providers and data consumers?

The policy and legal framework in Canada provides robust protection for intellectual property rights (IPR) related to geospatial information. IPR in respect to geospatial information in Canada are governed by the Copyright Act (Government of Canada 1985). The Act provides protection for original works of authorship including maps and other geospatial data.

IPR arrangements for geospatial information are covered under the Copyright Act of Canada. However, specific details on the IPR arrangements for geospatial information are not available.

2.9 To what extent do the arrangements within existing policy and legal frameworks protect the liability of providers of geospatial information?

In Canada, the policy and legal frameworks that protect the liability of providers of geospatial information are licensing agreements. These agreements can dictate how the data can be used by the licensee, and can include disclaimers of liability and indemnification clauses to protect the data provider.

In general, liability protection for geospatial information is covered under licensing arrangements. Liability protection specific to geospatial data is not provided.

2.10 Is there a Compliance Strategy that defines how organizations and individuals are encouraged to comply with geospatial policies, laws and regulations and how compliance will be monitored?

Hatfield understands that individual federal departments and agencies develop their own compliance strategies related to policies, laws and regulations that impact data (including geospatial data). The Office of the Privacy Commissioner of Canada has developed several resources to help businesses better understand their obligations and ensure compliance with PIPEDA. Where specific legislation related to geospatial data exists, e.g. RSSSA, it is unclear if there is a government compliance strategy. However, Global Affairs Canada has provided guidance for applications under the RSSSA including a plan for monitoring of compliance (Global Affairs Canada 2023).

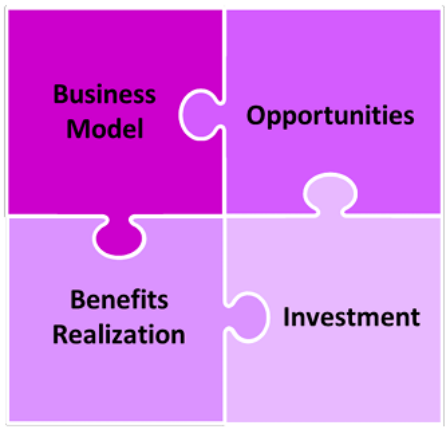
In general, compliance strategies for geospatial data can generally be integrated under strategies for general data, IPR, and copyright legislation. However, this situation reveals a lack of a specific unified compliance strategy for geospatial data.

Recommendations from the perspective of Hatfield:

To improve on the baseline assessment, the following are suggested:

- Establish and maintain a policy and legal framework matrix identifying the relevant policies, laws, regulations, and directives that impact actors producing, disseminating, accessing, and using geospatial data in Canada.
- Complete a gap analysis and plan to strengthen the policy and legal framework.
- Provide guidance to users of the CGDI on the policy and legal framework and how it impacts participants in the CGDI, including compliance.

5.0 STRATEGIC PATHWAY 3: FINANCIAL



This strategic pathway establishes the business model, develops financial partnerships, and identifies the investment needs and means of financing for delivering integrated geospatial information management, as well as recognizing the benefits realization milestones that will achieve and maintain momentum.

The objective is to achieve an understanding of the financial plans required to establish and maintain an integrated geospatial information management, as well as the longer-term investment program that enables government to respond to evolving societal,

environmental and economic demands for geospatial data (World Bank Group 2024).

Stocktaking Questions:

3.1 Is the financial management function from the National Coordinating Body (GeoConnections) supporting the agencies developing the SDI fully staffed, operating effectively and transparently, and has full accountability?

Hatfield understands that the mandate for geospatial information, and geospatial activities, are spread across multiple federal and provincial/territorial bodies. From the federal perspective, the national coordinating body is fully staffed and operates under full transparency and accountability, as demonstrated by the GC InfoBase reporting tool (Government of Canada 2024c). This resource includes supplementary estimates tables with key financial information for the federal government.

To ensure the national coordinating body operates effectively and transparently, audits, reviews, and special studies of federal programs are conducted on a regular basis. An evaluation of Phase III of the GeoConnections program was completed in 2016 (NRCan 2016). GeoConnections is implemented in accordance with the Directive on the Management of Projects and Programmes (Government of Canada 2022c). Information about staffing is largely internal. However, the Government Electronic Directory Services (GEDS) allows for general searching of team and staffing composition, and the Government of Canada Jobs allows for transparency in terms of appointments and promotions.

3.2 Has a sustainable business model for a functional SDI been defined for your organization?

The CGDI operates on a collaborative model, where various stakeholders, including federal, provincial/territorial, and local governments, as well as private sector organizations, academic institutions, and non-profit organizations, contribute data and services. These stakeholders may have their own business models for their individual contributions, which could include government funding, commercial revenue, or other sources of funding.

Business models for CGDI are available and accessible within the federal government (internally) through annual integrated business plans. Additional internal documents, for example an open science action plan (NRCan 2021a), also guides the CGDI business model. Public facing documents are available at the departmental level, for example the most recent Departmental Plan for NRCan (NRCan 2024c). Other federal departments likely have similar approaches in business plans.

The distributed structure of the CGDI means that this business model is collaborative and voluntary with no legislation enforcing it. This makes this business model challenging to define but it has been operating for a long time under the current model. The sustainability of this business model is unclear given the reliance on funding by different levels of government.

3.5 Has a socio-economic impact assessment of the value of investment in the SDI been fully developed by your organization?

The Canadian Geomatics Environmental Scan and Value Study (GeoConnections 2015) is a comprehensive study providing findings from all lines of enquiry related to the economic and noneconomic

benefits associated with geomatics technologies and services in Canada. However, no recent updates to social-economic impact assessment are available.

3.6 Have coherent and sustainable pricing and licensing policies (including open data) for SDI datasets and services been established for your organization?

Government of Canada Open Government License established by Treasury Board (Treasury Board of Canada 2022) provides a coherent licensing policy for data, including geospatial data. Other provincial governments have adopted the similar licences in their jurisdiction.

The Government of Canada policies are designed to promote the use of geospatial data while ensuring that the resources needed to maintain and update these datasets are available. For more detailed information, Canada Open Data Portal or the specific websites managed by federal departments and agencies provide pricing, e.g., Canadian Hydrographic Service (CHS) Nautical Charts. Procurement for satellite imagery by the Government of Canada is through the National Master Standing Offer (NMSO), which is managed by Public Services and Procurement Canada (PSPC). Businesses wishing to provide procurement services to the Government of Canada may contact PSPC for assistance.

Each provincial and territorial jurisdiction has its own approach to data warehousing and pricing models.

3.7 If a socio-economic impact assessment exists, are the benefits of SDI implementation being measured and compared to predicted levels identified in the Socio-Economic Impact Assessment?

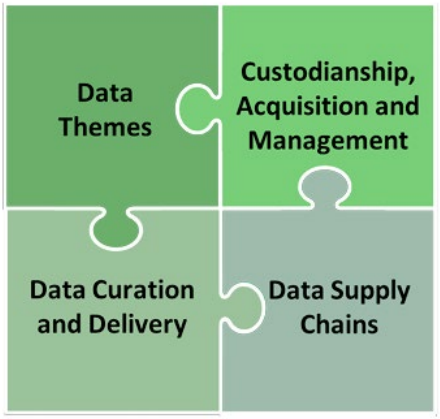
An up-to-date socio-economic impact assessment does not exist, and therefore benefits cannot be measured nor reported and compared against regularly.

Recommendations from the perspective of Hatfield:

To improve upon baseline assessment:

- Clarify the business model and arrangements between the federal government, provinces/territories, and other partners for the sustainable functioning and development of the CGDI.
- Complete a socio-economic impact assessment of the CGDI as it evolves towards a geospatial information ecosystem.

6.0 STRATEGY PATHWAY 4: DATA



This strategic pathway establishes a geospatial data framework and custodianship guidelines for best practice collection and management of integrated geospatial information that is appropriate to cross sector and multidisciplinary collaboration.

The objective is to enable data custodians, those responsible for managing data, to meet their data management, sharing and reuse obligations to government and the user community through the execution of well-defined data supply chains for organizing, planning, acquiring, analyzing, integrating, aggregating, curating, publishing and archiving geospatial information (World Bank Group 2024).

Stocktaking Questions:

4.3 Are there official guidelines for agencies to refer to when sharing/releasing geospatial information?

The Open Government Guidebook (Government of Canada 2023a) - A guide to releasing open government data and information on open.canada.ca. It aims to provide direction, best practices and tools to learn more about open government processes for the Government of Canada. It also outlines implementation guidance for relevant policy instruments including the Policy on Service and Digital (Government of Canada 2019), the Guideline on Service and Digital (Government of Canada 2024b) and the Directive on Open Government (Government of Canada 2014) – all of which help ensure consistent approaches to open data and information practices across government.

4.4 Are data and metadata interoperable with multiple systems and services?

NRCan is involved in multiple groups (e.g., OGC, ISO, W3C) promoting the use of standards for interoperability. The Standard on Geospatial Data (Government of Canada 2017) provides the definition of the standards for federal government to allow departments to share data and maximize utility of existing mapping and related products. The standard applies the North American Profile of ISO 19115:2003 - Geographic Information - Metadata. This supports information and data discovery, sharing, exchange and reuse.

Provincial examples of data and metadata standards include the Province of British Columbia Core Administrative and Descriptive Metadata Standard (BC Gov. 2023) which is based upon the Dublin Core Metadata Element Set defined in ISO 15836. The Government of Alberta Open government metadata application profile: standard guide (Gov. Alberta 2020).

In general, all levels of government apply interoperable metadata standards and utilize standard geospatial data formats that facilitate interoperability.

4.5 Is there special consideration given to the use and sharing of Indigenous data?

Although not a component of the UN-IGIF Baseline Diagnostic Tool, use and sharing of Indigenous data is an important consideration in the Canadian context.

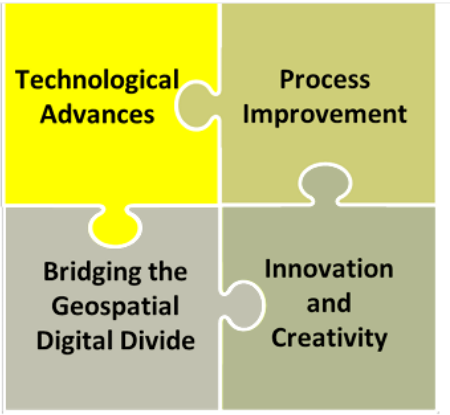
GeoConnections commissioned a report on Dissemination of open geospatial data under the Open Government License-Canada through OCAP principles (Hackett and Olson 2019), which indicates that special consideration is applied in the federal government. Multiple initiatives by NRCan have promoted responsible use and sharing of indigenous data, from establishing interactive Indigenous Place Names Map of Canada (NRCan 2022), developing guidelines and information about Indigenous engagement in relation to the Flood Hazard Identification and Mapping Program (FHIMP) (NRCan 2024d), to appointing an Indigenous Advisor to the Geographical Names Board of Canada (NRCan 2022).

Recommendations from the perspective of Hatfield:

To improve upon baseline assessment:

- Provide further guidance on dissemination of open geospatial data under the Open Government Licence-Canada through OCAP principles.

7.0 STRATEGY PATHWAY 5: INNOVATION



This strategic pathway recognizes that innovation has the potential to stimulate, trigger and respond to rapid change, leapfrog outdated technologies and processes, and to bridge the geospatial digital divide. Technology is continually evolving, creating new opportunities for innovation and creativity.

The objective is to leverage the latest cost-effective technologies, innovations and process improvements so that governments, businesses and academia, no matter their current situation, may leapfrog to modern geospatial information management systems and practices. Since there is no explicit pathway for technology in the UN-IGIF, technology indicators have been integrated in this pathway (World Bank Group 2024).

Stocktaking Questions:

5.1 Is there an active geospatial Innovation Group or similar reporting to the Governing Body?

Numerous federal departments and agencies promote geospatial technology innovation. For example:

- Innovative Solutions Canada (ISC), has three components that provide funding opportunities from early research and development (R&D) to commercialization for small and medium-sized enterprise (SME)innovators (ISC 2023). Not all projects funded by ISC are geospatial in nature.
- Innovation for Defence Excellence and Security (IDEaS) is a National Defence innovation fund that advances innovations for defence and security applications, some of which are geospatial (National Defence 2023).
- GeoConnections funds geospatial innovation and NRCan itself has taken part in Open Geospatial Consortium (OGC) innovation activities (OGC 2024).
- CSA supports innovation activities with government partners, industry, and academia through the smartEarth program which three innovation tracks, Enabler, Accelerator, and Integrator.
- Fisheries and Oceans Canada has multiple collaboration funds in Science and Technology, some of which use remote sensing and geospatial data collection, storage, and analysis.

These groups report to their respective ministries and governing bodies but not to the centralized body coordinating the CGDI.

5.2 Is there a national geospatial innovation strategy to drive transformational change, invigorate the geospatial marketplace, and trigger investment in innovation?

There is no clear public national innovation strategy that focuses on geospatial innovation to drive transformational change, although other measures and guidance are available. There are innovation strategies across the federal government, but these are compartmentalized. Examples include:

- GeoConnections – offers funding, but there is no public “national geospatial innovation strategy to drive transformational change”.
- Other innovation strategies exist across government and private/non-profit accelerators.
- Accelerator organizations, e.g., Foresight, BC Centre for Innovation and Clean Energy (CICE) CICE), and MaRS.

5.3 Is the fundamental information communication technology infrastructure (Internet, electricity and digital geospatial technologies) available, accessible and easily leveraged?

The Innovation, Science and Economic Development Canada (ISED) “High-Speed Access for All: Canada's Connectivity Strategy” (ISED Canada 2019) outlines the commitment to “connect every Canadian to affordable, high-speed Internet no matter where they live, and to improve mobile cellular access from coast to coast to coast.” Significant gaps exist in connectivity for rural and remote communities due to challenges in accessing affordable, high-speed Internet.

The federal government along with the provinces, have invested $3.225 billion for the Universal Broadband Fund (UBF), with the aim of providing access to high-speed Internet to 98% of Canadian households by

2026 and 100% by 2030. Notable efforts demonstrating increased information communication technology infrastructure include:

- The High-Speed Internet Access Dashboard (Government of Canada 2024d) allows Canadians to view national progress and government funding by province and territory.
- The National Broadband Internet Service Availability Map (Government of Canada 2023b) is an interactive tool that allows Canadians to find Internet service providers as well as connectivity projects under way in their area.
- An example of progress is in Port-Menier, Quebec, recent upgrades and access to high-speed Internet has enhanced the village's tourism industry (ISED Canada 2023).

However, a comprehensive assessment of the availability and accessibility of information communication technology (ICT) on digital geospatial technology is not available.

Can you name a few fundamental ICT infrastructure (Internet, electricity and digital geospatial technologies)?

- High-speed fiber optic cable.
- Satellite-based internet – Starlink.

Can you identify any barriers or gaps in availability or access?

Improving connectivity globally and to rural communities in Canada is an important trend that impacts the future of CGDI development and benefits. There is an opportunity to assess the impact and benefits on CGDI engagement of improvement in connectivity in rural and northern regions and for specific communities.

5.4 Are geospatial technologies being used to deliver new services and insights to the broader community of users (beyond specialist/expert users)?

Geospatial services and tools and application are widely available and used across Canada from a broad community of users. These tools and applications span sectors such as but not limited to, public health, urban planning, environmental monitoring, real estate, and even citizen science. Geospatial technology in Canada is being used to deliver services and insights.

Are geospatial technologies linking to areas of strategic needs as catalysts for innovation?

Geospatial technologies touch many areas strategic need in Canada, for example:

- Environmental Monitoring: Geospatial technologies are used to provide real-time updates on environmental conditions, such as air quality, water quality, flood and wildfire tracking. These updates can be accessed by the public through websites and mobile apps.
- Precision farming: integration of global positioning systems (GPS), geographical information systems (GIS), and remote sensing technologies to support variable rate technology and yield monitoring.

- Health Services: Geospatial technologies are used to map health services, such as hospital locations and areas of disease outbreak. This can help individuals find the nearest health services and understand health risks in their area.
- Real Estate: Real estate websites and apps use geospatial technologies to provide property listings with detailed location information, including proximity to schools, public transit, and other amenities.
- Transportation and Delivery Services: Ride-hailing and food delivery services use geospatial technologies to connect drivers, customers, and businesses. Users can track their ride or delivery in real time on a map.
- Outdoor Recreation: Apps use geospatial technologies to provide trail maps and navigation tools for hikers and bikers. Users can also use these apps to share their own trails and experiences with others.

5.5 Are geospatial technologies and state-of-the-art methods, such as machine-learning and the latest GIS software, being used widely for data creation?

There are many examples of geospatial technologies and machine learning methods used for data creation and widespread adoption of geospatial technology in the public and private sector. The Canadian Forest Service (CFS) uses machine learning to analyze geospatial data to help monitor forest health, track deforestation, and predict forest fire risks. CCMEO uses machine learning methods to create national land cover maps of Canada from satellite data (NRCan 2019b). In the private sector, BlueDot provides infectious disease intelligence and uses machine learning to analyze spatial data from various sources to provide early warnings about potential outbreaks, helping public health agencies respond more effectively.

Widespread adoption of geospatial technology and advanced methods are also used to generate data; for example, the CCMEO GeoAI initiative that focuses on creating foundational geospatial data using artificial intelligence (AI).

Identify the state-of-the-art methods and/or GIS software.

- GIS software usage includes standard commercial and open source, (e.g. Esri, QGIS, Catalyst Earth, and ENVI).
- Open-source data science libraries (e.g., Python or R).
- Digital Earth Canada – Cloud-based geospatial data science platform.
- Methods include but not limited to machine learning, neural networks, object-based image analysis, and agent-based modeling.

5.6 Is there an SDI (Spatial Data Infrastructure) enabling infrastructure and geoportal in operation that supports sharing, viewing, accessing and using geospatial information?

The government of Canada operates GEO.ca (Government of Canada 2024e). Within the federal government, the Federal Geospatial Platform (FGP) contains a collection of data that can be discovered and viewed. The public Open Maps leverages the FGP to provide access to geospatial data to all

Canadians. The Open Science and Data Platform also provides access to federated data (spatial and non-spatial), publications and information across the country to support better understanding of cumulative effects from human activities (NRCan 2024e).

5.7 Does national government actively engage in geospatial-related quality improvement processes, and are the academic and private sectors involved?

NRCan has developed a departmental indicator and target related to update of foundational geospatial data: (**Erreur! Source du renvoi introuvable.**) *Percentage of foundational geospatial data that is current* (NRCan 2024c). The GeoAI initiative from CCMEO / Geobase, is a collaboration between federal, provincial and territorial geospatial data providers to improve processes to created geospatial data using AI (Government of Canada 2024f).

To test out the systems, validate the results, develop the dataset structure, and highlight use cases, various pilot projects were carried out under the leadership of CCOG. Following the completion of these pilot projects, the series was formally approved by the CCOG as a GeoBase Initiative data series.

The National Elevation Data Strategy, led by NRCan, uses state-of-the-art technologies (e.g., lidar and satellite imagery) to increase availability and coverage of accurate high-resolution elevation data to support Government of Canada objectives. There has been considerable effort to improve the quality of the geospatial data set, for example recent release of the Medium Resolution Digital Elevation Model (MRDEM) - CanElevation Series (NRCan 2024f).

What about other levels of government?

All provinces and territories have a geospatial data infrastructure program with data improvement projects. Some examples are:

- GeoBC LidarBC program (BC Gov. 2021).
- Alberta Base Hydrography Update (Government of Alberta 2022).

5.8 Does the national government have an organization responsible for innovation?

Multiple organizations are involved in innovation at the federal level, notably, NRCan through GeoConnections, ISC, CSA through smartEarth, and National Defense through IDEaS.

Is geospatial data and technology included in the government's innovation efforts?

Geospatial data and technology are the core focus of NRCan's GeoConnections and CSA's smartEarth funding. In other cases, geospatial technologies may be part of the funding, e.g. ISC funded projects included High-resolution Forest Mapping (with NRCan) and Earth Observation Images Processing and Management System (with Public Health Agency of Canada) (ISC 2023).

What about at other levels of government?

Examples include BC CICE and Alberta Innovates and Alberta Data Partnerships.

Please list and describe any geospatial data and technology included in government innovation efforts.

- Wildfire management – airborne and terrestrial lidar, drones, satellite imagery, WildFireSat.
- Forest ecosystem disturbance and restoration – airborne and terrestrial lidar, drones, satellite imagery.
- Infrastructure monitoring – InSAR.
- Big data management – Digital Earth Canada.
- Canadian Drought Monitor – Agriculture and Agri-Food Canada.

5.9 Are there investment programs for geospatial information and technology innovation?

There are multiple investments programs spread across different federal departments, For example, GeoConnections, Innovative Solutions Canada, smartEarth, and IDEaS. In Alberta, the government established Tecterra, a geomatics technology innovation non-profit organization.

List and describe any known investment program for geospatial information and technology innovation

- GeoConnections: co-funds the development of innovative solutions and further development of Canada's SDI.
- ISC: designed to stimulate technology research, development, and commercialization of Canadian innovation. The program's Challenge Stream and Testing Stream helps startups and small/medium-sized businesses (SMEs) overcome technology testing and development hurdles so that they can produce globally-demanded products and services, while also improving government operations.
- smartEarth: a funding initiative related to Earth observation applications development. It fosters a smart use of satellite data to develop solutions to key challenges on Earth. Funding opportunities are provided through three different tracks: the Accelerator, the Integrator, and the Enabler.

5.10 Are individual geospatial data systems interrelated using integrative technologies?

Integrative technologies allow for the seamless sharing, processing, and analysis of geospatial data across different systems and platforms, enhancing the utility and applicability of the data for various purposes. Federal and provincial/territorial agencies are using technologies such as:

- OGC standards (e.g., WMS, WFS, WCS)
- Application Programming Interfaces

There are many examples of geospatial data systems using integrative technologies to promote data sharing, for example:

- Open Maps of the FGP - Web Services (NRCan 2021b)
- GeoBC Web mapping services (BC Gov. 2024)

Recommendations from the perspective of Hatfield:

To improve upon baseline assessment:

- Review the mandate of GeoConnections and aim to develop a nationally coordinated geospatial Innovation Group that can support innovation. The actions could include providing direction on priorities for geospatial information that can be integrated by geospatial innovation actors.
- Review the availability and accessibility of ICT infrastructure on digital geospatial technology uptake and awareness.

8.0 STRATEGY PATHWAY 6: STANDARDS

This strategic pathway establishes and ensures the adoption of best practice standards and compliance mechanisms for enabling data and technology interoperability to deliver integrated geospatial information and location-based knowledge creation.

The objective is to enable an efficient and consistent approach for different information systems to be able to discover, manage, communicate, exchange and apply geospatial information for a multitude of uses, improved understanding and decision-making (World Bank Group 2024).

Stocktaking Questions:

6.1 Is there standards leadership embedded in a Canadian Governing Body and a Working Group on standards established and operational? Identify the governing body and working group.

Standards leadership embedded in GeoConnections, which supports the integration and use of the CGDI, and provides leadership and coordination for the use of geospatial data, and with key stakeholders, leads strategic geomatics policy development. CCOG works to advance geomatics activities, including standards, between federal, provincial and territorial governments.

6.2 Has the national need assessment for geospatial information management standards been undertaken, priorities agreed, and an on-going review process established?

There is a broad national user needs assessment conducted in 2019 (Hatfield Consultants 2019). The OGC Canada Forum was restarted in 2024 to provide a forum to foster collaboration across stakeholders to tackle Canada's geospatial needs, including standards. There is generally a high degree of awareness for the need for a national assessment of needs. However, implementation has been broad and has not been focused on geospatial information management standards.

6.3 Is there a National Standards Strategy and a process to review/develop (as necessary), and endorse a common framework of national data and technology standards?

The CGDI relies on the collaboration of partners through committees and working groups to develop data and technology standards, core geospatial data, and to provide geospatial standards and operational policies guidance (NRCan 2019a). Coordinating efforts at the federal, provincial, territorial level, occur through CCOG.

If applicable, can you name the National Standards Strategy and process?

The Standard on Geospatial Data (Government of Canada 2017) is a foundational standard. The NRCan Geospatial Standards and Operational Policies webpage provides a summary of geospatial standards and Canada's approach. In addition, the Geographical Names Board of Canada national coordinating body outlines its strategy and process.

6.4 Is there an active awareness program that raises, advocates, and promotes the principles, values, needs and benefits of geospatial data and technology standards?

There is awareness amongst major CGDI stakeholders, particularly members of CCOG. Through NRCan's membership, the OGC Canada Forum was restarted in June 2024 providing a forum for expert stakeholders and users to discuss, promote, and raise awareness of geospatial data and technology standards. However, a dedicated and active data and standards awareness program is not in place for public/private sector stakeholder and is not actively promoted.

Can you name any specific programs that raise, advocate, and promote the principles, values, needs and benefits of geospatial data and technology standards?

- GeoConnections
- CCOG
- OGC Canada Forum

6.5 Have technology and data standards been endorsed / mandated to support interoperability and enable different systems and diverse data types to work together seamlessly?

Standards are endorsed in the Standard on Geospatial Data (Government of Canada 2017) and there is widespread adoption at the federal, provincial, territorial level. Although implementation is more advanced in some jurisdictions than others.

6.6 Is there national representation on the international Standards Development Organizations (SDOs)?

The Standards Council of Canada (SCC) is a Crown corporation established to foster and promote voluntary standardization in Canada. It operates independently of government although it is financed partially by Parliamentary appropriation. SCC represents Canada at both the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

NRCan, ECCC, and Fisheries and Oceans Canada are members of OGC. NRCan is member of the ISO's Technical Committee 211 and leads the Working Group 6 – Imagery, focused on standardized aspects of remote sensing and Earth observation sensors including geo-positioning of the sensors, calibration and validation of the sensors and validation of the remote sensing data production stream from information capture to data encoding (ISO 2024). There is little information publicly available to determine the membership level of national representatives within these SDOs.

6.7 Are there policies, incentives, and/or guidance to ensure that organizations are correctly implementing nationally or internationally endorsed standards?

Standards are provided via the Standard on Geospatial Data (Government of Canada 2017), Guideline of Service and Digital (Government of Canada 2024b) and other guidance provided by GeoConnections. Through funding arrangements, GeoConnections provides incentives for the adoption of endorsed standards.

6.8 Has a community of practice been established to share skills, knowledge, and experiences about the implementation of standards?

CCOG is an intergovernmental community of practice. However, this does not include academia, civil society, Indigenous organizations or the private sector. The Arctic SDI is an example of regional and international cooperation.

Recommendations from the perspective of Hatfield:

To improve upon baseline assessment, the following is recommended:

- Conduct a needs assessment that focuses on geospatial information management standards.
- Develop a clear and agreed on dedicated and active awareness program related to standards.
- Establish incentives for the implementation of endorsed standards.

9.0 STRATEGY PATHWAY 7: PARTNERSHIPS

This strategic pathway establishes cross-sector and interdisciplinary cooperation, coordination and collaboration with all levels of government, the geospatial industry, private sector, academia, and the international community, as an important premise to developing and sustaining an enduring nationally integrated geospatial information framework.

The objective is to create and sustain the value of geospatial information through a culture based on inclusion, trusted partnerships and strategic alliances that recognize common needs, aspirations and goals, towards achieving national priorities and outcomes (World Bank Group 2024).

Stocktaking Questions:

7.1 Are the national SDI stakeholders and partners across the city / region / country aware of the benefits of partnering?

CCOG exemplifies the benefits of federal and provincial/territorial partnership in the context of developing the CGDI. The Arctic SDI also shows the benefits of regional partnership. Canada and the United States of America (USA) have partnerships related to several shared watersheds, including geospatial data management.

What kinds of opportunities for collaboration / partnering are you aware of?

Stimulation of partnership among government, academia, civil society, Indigenous organizations, and the private sector, e.g. through GeoConnections, smartEarth, or ISC.

7.2 Are the SDI stakeholders and partners across the city / region / country moving towards a culture based on inclusion, trusted partnerships and strategic alliances that recognize common needs, aspirations and goals, towards achieving national priorities and outcomes?

In general, federal and provincial funding is being designed to stimulate partnerships to achieve strategic goals, e.g. United Nations Sustainable Development Goals (UN SDGs). Funding of these goal-oriented collaborations include the Canadian Superclusters, smartEarth Integrator projects, and ISC. The Digital Earth Canada initiative represents a good example of partnership for developing the big Earth observation data analytics infrastructure required by multiple partners.

The FHIMP helps Canadians better plan and prepare for future floods. The program promotes the collaboration amongst public sector institutions (provincial, territorial, and municipal) but promotes collaboration with private sector bodies, Indigenous communities, and civil society organizations.

7.3 Is a cross-sector culture of interdisciplinary collaboration being implemented across public sector institutions to reduce duplication of work or to implement complex programs where multiple areas of expertise are required?

Cross-sector interdisciplinary collaboration is a challenge, but notable examples of collaboration across public sector institutions include Digital Earth Canada for developing the big Earth observation data analytics infrastructure required by multiple partners, and the National Elevation Data Strategy.

Please identify who is involved in these collaborations?

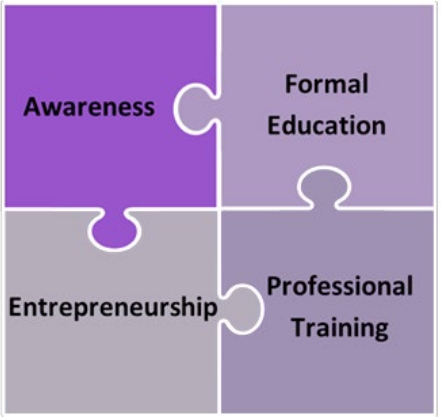
Digital Earth Canada initiative is led by the Canadian Space Agency in partnership other government departments, notably ECCC, NRCan, and Shared Services Canada.

Recommendations from the perspective of Hatfield:

To improve upon baseline assessment, the following is recommended:

- Develop a clear strategy for partnerships, including stimulating partnership with funding. Integrate this into the proposed five-year geospatial strategy.

10.0 STRATEGIC PATHWAY 8: CAPACITY AND EDUCATION



This strategic pathway establishes enduring capacity development and education programs so that the value and benefits of integrated geospatial information management is sustained for the longer term.

The objective is to raise awareness, build and strengthen knowledge, competencies, skills, instincts, processes, resources, and innovative entrepreneurship that organizations, communities and individuals require to utilize geospatial information for evidence based decision-making and effective service delivery (World Bank Group 2024).

Stocktaking Questions:

8.1 Are there mechanisms for reporting on Capacity and Education to governing bodies/to levels of government?

"Mechanisms" refers to working groups, units, departments, functions, etc. at any and all levels of government (federal, provincial, territorial, municipal, Indigenous).

Hatfield is unaware of how working groups, units, departments, functions that are reporting on geospatial capacity and education status and progress to GeoConnections and/or CCOG.

8.2 Has an assessment been conducted to understand the priority areas for geospatial capacity development?

The 2019 User Needs Assessment (UNA) of the CGDI and Arctic SDI (Hatfield Consultants 2019) included identification of interests for capacity building and training to address stakeholders' expressed gaps in knowledge, skills, and capacity. Following the UNA, some limited activities were implemented to address knowledge gaps, such as the CGDI Primer (Hatfield Consultants 2020) and evaluation of the concept of CGDI Analysis Ready Data Starter Kits (Natural Resources Canada 2021). Beyond these positive actions, Hatfield is unaware if priority areas for capacity building are identified, and it is not clear if there is coordination with educational institutions and other government departments and agencies, e.g. CSA, Natural Sciences and Engineering Research Council of Canada (NSERC), and across levels of government, given education is a provincial responsibility.

8.3 Is there a Capacity Development and Education Strategy and associated action plan?

Hatfield's understanding is that there is no Capacity Development and Education Strategy and associated action plan and is unaware if a strategy is under consideration or has been discussed within CCOG. Under the Canadian Constitution, provincial governments have exclusive responsibility for all levels of education. Canada's three territorial governments also assume this responsibility. However, notably several federal departments do provide educational resources as part of their strategy to raise understanding and awareness of specific topics, e.g. CSA related to space and Earth observation and ECCC related to climate change.

Does the action plan set out how capacity development and education programs will support the strengthening of integrated geospatial information management?

N/A

8.4 Are post-secondary institutions offering sound foundations in topics important to understanding concepts of geography and geographic science? Are post-secondary institutions offering education to develop competencies and skills in geospatial information management and its application?

Universities and colleges across Canada have geography and GIS programs. Notable university programs include:

- Masters of Geomatics for Environmental Management, Faculty of Forestry, University of British Columbia.
- Institute for Geospatial Inquiry, Instruction, and Innovation (i4Geo), University of Lethbridge, Alberta.
- Master of Environmental Studies (MES) in Geography with a specialization in Geomatics, University of Waterloo.
- Bachelor and Master in Geomatics Engineering, University of Calgary.
- Master of Science in Geomatics Engineering, York University.

- Maîtrise en sciences géomatiques - géomatique appliquée, Université Laval.

Examples of Advanced Diploma in GIS or geomatics include:

1. Geomatics Technician Program (military) and GIS, Algonquin College.
2. Geomatics Engineering Technology, British Columbia Institute of Technology (BCIT).
3. GIS and Geomatics Engineering Technology, Centre of Geographic Sciences (COGS), Nova Scotia Community College.
4. Geomatics Engineering Technology and Bachelor of Applied Technology Geographic Information Systems, Southern Alberta Institute of Technology (SAIT).
5. Canadian Institute of Geomatics offers a range of voluntary Certification in geomatics fields.

8.5 Are there professional training, lifelong learning, internship opportunities and / or continual technical and professional development available to the workforce to sustain geospatial information management capabilities?

In Canada, there are numerous professional trainings, lifelong learning, internship opportunities, and continual technical and professional development opportunities available to sustain and enhance geospatial information management capabilities. Examples include:

- Canadian Institute of Geomatics – offers various courses, workshops, and certification programs in geomatics and geospatial information management.
- Esri Canada – provides extensive in-person and online training programs on GIS, focusing on Esri software.

Many Canadian universities and colleges offer undergraduate and graduate programs in geomatics, geography, and geospatial sciences, which support lifelong learning. Online platforms like Coursera, edX, and LinkedIn Learning offer courses in GIS, remote sensing, and other geospatial technologies. Some of these courses are provided by Canadian institutions like the University of Toronto and McMaster University. Professional development programs can include certification such as the GIS Professional (GISP) Certification offered by the GIS Certification Institute (GISCI) and Certified Geomatics Specialist (CGS) offered by the Canadian Institute of Geomatics (CIG).

Government agencies in Canada provide internship opportunities and co-ops co-op for students and recent graduates in the field of geomatics and geospatial information management, including NRCan and provincial ministries. Many private sector companies, including Esri Canada, engineering firms, and environmental firms offer internship programs that provide hands-on experience in geospatial technologies and project management.

Canada has numerous conferences, workshops, and online events that are accessible such as the GeoIgnite Conference, Esri Canada User Conferences, and the Canadian Symposium on Remote Sensing. Webinars and online workshops are also prevalent – a notable example is a series of webinars from government, industry, and non-profit speaker on remote sensing applications organized by the CSA.

8.6 Is government supporting and stimulating entrepreneurship to grow the capability of the business sector to develop products and services underpinned by geospatial information?

The federal government supports and stimulates entrepreneurship in the geospatial information sector through a variety of initiatives, programs, and policies aimed at fostering innovation, providing funding, and facilitating collaboration. Notable examples are:

- GeoConnections, with funding opportunities for innovation for the private sector.
- CSA's smartEarth initiative, which specifically addresses the private sector and stimulates collaboration with Innovation, Science and Economic Development Canada (ISED), which has the:
    - Strategic Innovation Fund (SIF) to support large-scale, transformative, and collaborative projects in various sectors, including geospatial technologies; and
    - Innovative Solutions Canada (ISC), which provides funding to small businesses and has included several geospatial technology challenges.
- NSERC, with funding available for research and development innovation that can include geospatial technology.
- Scientific Research and Experimental Development (SR&ED) tax incentives that intended to encourage businesses to conduct research and development in Canada, which can include geospatial technologies.
- Industrial Research Assistance Program (IRAP), which offers advisory services and funding to help businesses develop and commercialize innovative technologies, including geospatial solutions.
- Mitacs, which provides research internships and funding to connect businesses with academic researchers, which can include innovation in geospatial technologies.
- The Canadian Superclusters, a set of industry-led innovation hubs designed to foster collaboration between businesses, academic institutions, and non-profits to drive economic growth and technological advancement in key sectors. These superclusters supported several geospatial technologies related projects.

What about entrepreneurship programs funded and led outside of government?

Examples of entrepreneurship programs funded and led outside of the federal government are:

- Tecterra, offered support for the advancement of the geospatial technology sector in Canada through a distinctive funding portfolio, however, is no longer receiving funding from government sources. Tecterra now focuses on entrepreneurship by supporting geomatics graduates to commercialize technologies within Alberta universities and institutes.
- Canada Foundation for Innovation (CFI), provides funding to support research infrastructure, which can include geospatial data and technologies

8.7 Is geospatial literacy, including access to geospatial technologies, being integrated into primary and secondary education systems?

In Canada, provincial/territorial governments have exclusive responsibility for all levels of education. Therefore, integration of geospatial literacy varies across the country. However, some notable examples include:

- Canadian Geographic Education (Can Geo Education), formerly the Canadian Council for Geographic Education, is the educational branch of The Royal Canadian Geographical Society (RCGS). Can Geo Education is one of the largest non-profit educational organizations in Canada, with the goal to foster geographic engagement among Canadians.
- Esri Canada GIS in Schools Program, which offers free access to ArcGIS Online for K-12 schools across Canada. This program includes resources, lesson plans, and training for teachers to integrate GIS into their classrooms.
- GIS Day, an annual event celebrating GIS based technologies. The event first took place in 1999 and was initiated by Esri.

Recommendations from the perspective of Hatfield:

To improve upon baseline assessment the following area recommended:

- As part of a proposed five-year geospatial strategy, identify the gaps and opportunities for GeoConnections to contribute to geospatial capacity and education in Canada, accounting for the mandate of the federal government in education.

11.0 STRATEGY PATHWAY 9: COMMUNICATION AND ENGAGEMENT

This strategic pathway recognizes that stakeholder identification, user engagement and strategic communication are essential to successfully deliver integrated geospatial information management arrangements nationally and sub-nationally for sustainable social, economic and environmental development.

The objective is to ensure effective communication and engagement to enhance and deepen participation and contributions from all stakeholders and at all levels. Commitment, mutual understanding, collaboration, cooperation and communication are essential to successfully implement the Integrated Geospatial Information Framework within organizations and with stakeholders (World Bank Group 2024).

Stocktaking Questions:

9.1 How completely has the National Governing Body identified the full range of current and potential stakeholders, partners, and users?

NRCan completed a comprehensive UNA for the CGDI and Arctic SDI addressing all Canadians, with special attention on needs of Indigenous Canadians (Hatfield Consultants 2019). However, a database of stakeholders and partners was not an intended output.

9.2 Are there existing agreed upon national strategies for all types of stakeholders and partners at Federal and P/T government levels?

Following the UNA for the CGDI (Hatfield Consultants 2019) several communications materials were developed to address knowledge and capacity gaps of various stakeholders related to the CGDI, e.g. a CGDI Factsheet and Primer (Hatfield Consultants 2020; Natural Resources Canada 2020). These materials were designed to address the broadest possible types of stakeholders; however, they were not based upon a national strategy (communications or otherwise). The most recent national strategy of the CGDI is more than 10 years old (GeoConnections 2012a). GeoConnections provides funding opportunities, recently targeting support at Indigenous organizations, however it is not clear if this is related to a formal strategy.

9.3 Is a dedicated team to support communications within the engagement strategy formed, fully resourced, and operational?

Hatfield understands that communications related to CGDI falls under the mandate of communications from NRCan. A dedicated team is not in place, however the need for resources for communication is recognized.

9.4 Have the messages that convey the economic and societal value of SDI been agreed upon?

The communications materials developed following the UNA for the CGDI, e.g. CGDI Factsheet and Primer (Hatfield Consultants 2020; Natural Resources Canada 2020), included messaging related to the economic and societal value of the CGDI. This messaging likely remains valid but has not been reviewed with wider stakeholders/partners nor adopted at the national level. The most recent national strategy of the CGDI contains relevant messaging but is more than 10 years old (GeoConnections 2012a).

9.5 Are there defined and followed methods of communications for stakeholders and partners?

Hatfield does not have any information on a draft communication plan or methods nor any discussions occurring at national level towards a national plan. CCOG and the Geomatics Accord represent defined methods for communication among federal and provincial/territorial partners. There are some defined and followed methods of communication for focused areas, such as the Indigenous engagement guidelines for flood mapping under the FHIMP (NRCan 2024d). Broad level consultation on methods and communication at the national level however is not publicly available.

9.6 Is active and ongoing engagement with key stakeholders and partners implemented, being reviewed and working effectively?

Important national and provincial/territorial stakeholders/partners are involved in CCOG based on the institutional roles and responsibility in the Geomatics Accord. While the most recent Geomatics Accord (2020-2025) is not publicly available on the CCOG website, Hatfield understands the engagement process is active and regular.

9.7 Are there case studies that show the use of geospatial information in society (government, private sector, citizens)?

Short case studies on the value of the CGDI were included in the CGDI Primer (Hatfield Consultants 2020). More recently, the GeoAI blog is an example of compelling cases studies of the important of innovation within an National Mapping Agency (NRCan 2024g). The CSA promotes users of Radarsat Constellation Mission (RCM) and their specific case studies (CSA 2019). A consolidated database of case studies, however, has not been created nor is available.

9.8 Is there is a fully established link between the National SDI (Spatial Data Infrastructure) and the UN Sustainable Development goals in engagement and communication materials?

The Federal Sustainable Development Strategy (FSDS) (Federal sustainable development strategy - Canada.ca) is the government's plan and vision for a more sustainable Canada. It outlines goals and actions to promote clean growth, ensure healthy ecosystems and build safe, secure and sustainable communities. The CGDI and the UN SDGs are linked through their shared focus on sustainable development and the use of geospatial data to achieve these goals. The link between the two comes in the use of geospatial data to monitor, evaluate, and achieve the UN SDGs. For instance, geospatial data can help track changes in land use, monitor the effects of climate change, manage natural resources, and plan sustainable cities, all of which are crucial for achieving the SDGs. However, the link between the CGDI and the UN SDGs is not explicit in communication materials and Hatfield is unaware if the need to link the CGDI to the SDGs is identified.

Recommendations from the perspective of Hatfield:

To improve upon baseline assessment the following is recommended:

- Develop a communication plan as a component of the proposed five-year geospatial strategy that identifies the vision, mission, goals, and objectives of the CGDI. The communications plan includes resources, type and frequency of outputs, and engagement activities with stakeholders.

12.0 SUMMARY OF RESULTS

Hatfield has completed a desk study of Canada's baseline against the nine SPs of the UN-IGIF, which provides an independent assessment of the current position of geospatial information management. This was completed through desktop research and professional opinion and knowledge, which may be limited by a lack of publicly disclosed information. The information used to guide the assessment was collected from publicly available records accessed between July to November 2024.The geospatial landscape in Canada continues to evolve. As such, the findings represent a moment in time and cannot represent a complete or up-to-date reflection of the full situation across Canada. Further, it does not encompass all public or private actions being taken by the Government of Canada in relation to the CGDI.

The stock-take was based on a sub-set of questions taken from the UN-IGIF Diagnostic Tool and this should be considered in the context of the outcomes for subsequent interview and inventory activities. This assessment is a partial assessment and will contribute to a full stock-take of Canada's SDI against the nine SPs.

For each SP, Hatfield provided an assessment of Canada's current status on the SP along with recommendations. The results show the areas that could be a focus of future efforts to improve Canada's operationalization of the UN-IGIF. This study illustrates that Canada is relatively strong in standards, innovation, and data. Financial and policy and legal are strategic pathways where advancement is desirable. Additional work and improvement is required in partnerships, capacity and education, and leadership strategic pathways. Considerable attention is required on the communication and engagement strategy pathway. However, NRCan will have access to additional information that could influence the assessment baseline.

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