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2015 Assessment of the Canadian Geospatial Data Infrastructure

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2015 Assessment of the Canadian Geospatial Data Infrastructure

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Executive Summary

Overview of Assessment Objectives and Methodology

In accordance with the multi-phase Canadian Geospatial Data Infrastructure (CGDI) Performance Project, the 2015 Performance Assessment was undertaken to measure the continued progress of development, use, success and state of Canada's CGDI. The 2015 assessment involved reviewing and updating the CGDI Assessment Framework and analyzing CGDI measurement data and indicators against a revised CGDI Assessment Framework. The Assessment Framework covers five component areas of: Collaboration, Framework Data, Operational Policies, Standards and Specifications, and Technology.

To address the 2015 Performance Assessment, a mix of qualitative and quantitative sources of information were used. Two principal methods were employed during the assessment: document review; and, the development of two case studies. The 2015 assessment was restricted to the employed methods as a result of project timing as well as resource availability. A comparison of assessment ratings to the results of the 2012 CGDI Performance Assessment was also performed. The comparison is presented graphically to show declining investment, progressive movement or sustained performance against the qualitative scorecard. The results have been identified by the following symbols:

2	—	Reflecting no movement or sustained performance from the 2012 levels – based on the rating applied at that time.
Vertical arrows		Reflecting an increase or decrease in the qualitative rating from the 2012 levels.

Although every effort was made to assess the incremental changes for each indicator since the 2012 Assessment, the 2015 Assessment primarily relied on a review of documentation made available by GeoConnections, or retrieved through Internet searches. The case studies component provided some specific examples of CGDI at work; however, they represent only a limited amount of evidence. The Assessment was methodologically limited in that interviews were not conducted to obtain further elaboration on the presentation of information from documents. As such, there was an inability to acquire additional context in some places, to better understand the depth and breadth of the incremental changes identified throughout this report.

Overview of CGDI Objectives and Goals

Since 1999, the Canadian federal government has invested in the coordination of a national effort to build the CGDI through the establishment of a special program area supported by three phases of funding.   The GeoConnections program was established within Natural Resources Canada (NRCan) to drive and deliver CGDI efforts. The federal government has invested $150M in targeted funding to support GeoConnections to the end of March 2015.

During its first five years (Phase 1, 1999-2005), GeoConnections partners and stakeholders laid the foundation for the CGDI. The concept focused on the use of the internet as a platform for sharing geospatial data, and creating a distributed network where each data provider could retain control of and update their own information. Phase 1 also focused on developing strong partnerships, an inclusive governance structure, and promoting the development and adoption of standards that would enable interoperability – the ability to share and compare different data sets.

Phase 2 (2005-2010) focused on the expansion of partnerships in order to facilitate and improve access to Canadian geospatial data. Phase 2 focused on enhancing capacity for user communities (e.g., municipalities, resource-based communities) to harness the CGDI to support integrated decision making in key areas of federal priority: public health, public safety and security, sustainable development and the environment, and matters of importance to Aboriginal peoples.

The goal of Phase 3 (2010-2015) was to provide "federal leadership to optimize the use of geospatial data for decision-making and lead strategic geomatics policy development." Moving beyond 2015, the GeoConnections program will continue to maintain its core federal leadership and coordination role to support the evolution and maintenance of the CGDI.

Summary of 2015 Performance Assessment Results

The CGDI continues to develop in its maturity and has implemented mechanisms to fully meet almost 80% of the criteria upon which it is being assessed. Increased maturity or stable performance was noted across all assessment areas with some gaps identified in monitoring and reporting, communication, and policy development.

A graphical summary (matrix of ratings) by component, indicator and criteria is provided for each of the assessed component areas following the discussion of each component area's assessment result. The summary illustrates the rating for each criteria assessed both during this assessment as well as the 2012 Assessment to illustrate the change between the two time periods.

2015 Assessment Results

Overall, the Collaboration component indicators have largely been met, demonstrating increased performance since 2012. The leaders and coordinating bodies continue to evolve and drive the CGDI at a number of levels in Canada across public, private and academic sectors through the commitment of both in-kind and financial resources to the CGDI. A Pan-Canadian Geomatics Strategy has been developed that presents an updated vision and mission for the geomatics sector, defines future roles and responsibilities of stakeholders, and is aligned with stakeholder priorities. Formalized networks and communications and outreach activities continue to engage direct CGDI stakeholders allowing inclusive contributions to CGDI development and sustainability as well as the use of CGDI to facilitate decision-making. Canada has continued to participate in numerous international geospatial data-related organizations and has continued its commitment to exchanging and sharing experiences internationally. Progress and status of the Collaboration components is identified in Exhibit EX-1 below.

Exhibit EX-1
Results of CGDI Collaboration Component
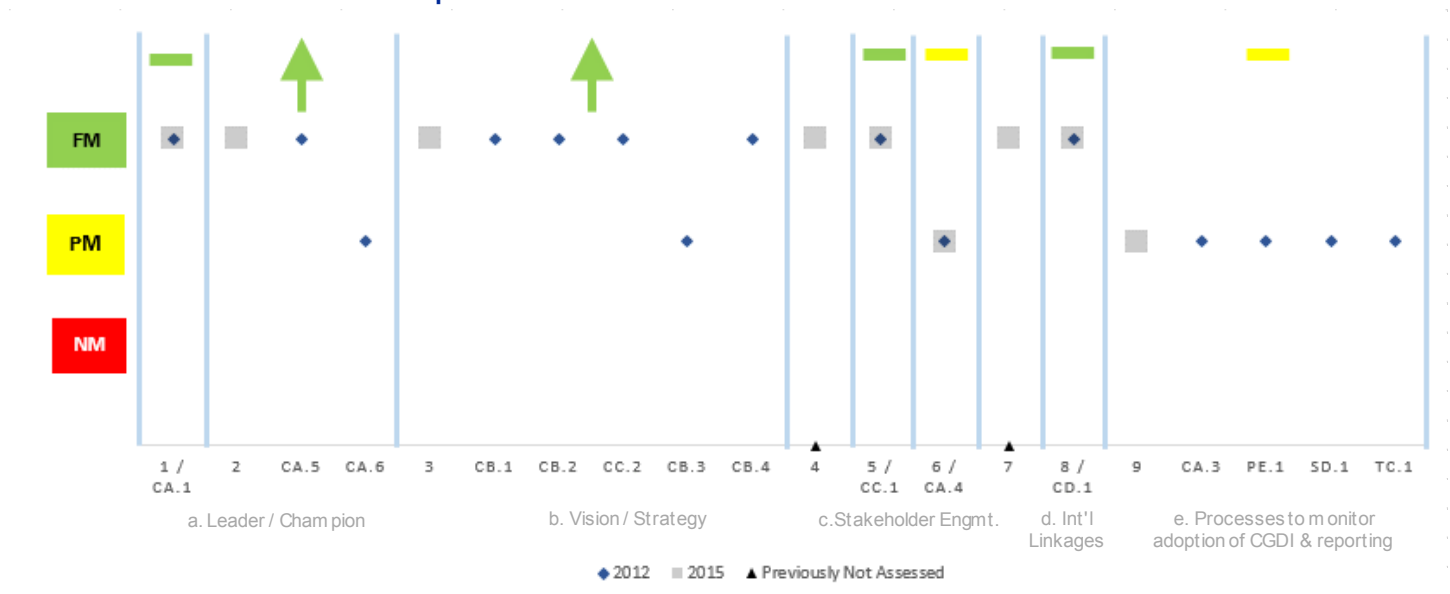
Framework Data component indicators have been fully met demonstrating stable performance. There is availability of data across data themes and continuous contributions are being made by federal and provincial governments. Formal agreements for the sharing of data between Canadian federal and provincial/territorial jurisdictions continue to be in place that include mechanisms to coordinate data collection, quality control, and maintenance. Additionally, agreements to support data sharing at the international level have been established and maintained. Efforts in this component area are allowing for the integration of geospatial information by data users. Progress and status of the Framework Data components is identified in Exhibit EX-2 below.

Exhibit EX-2
Results of CGDI Framework Data Component
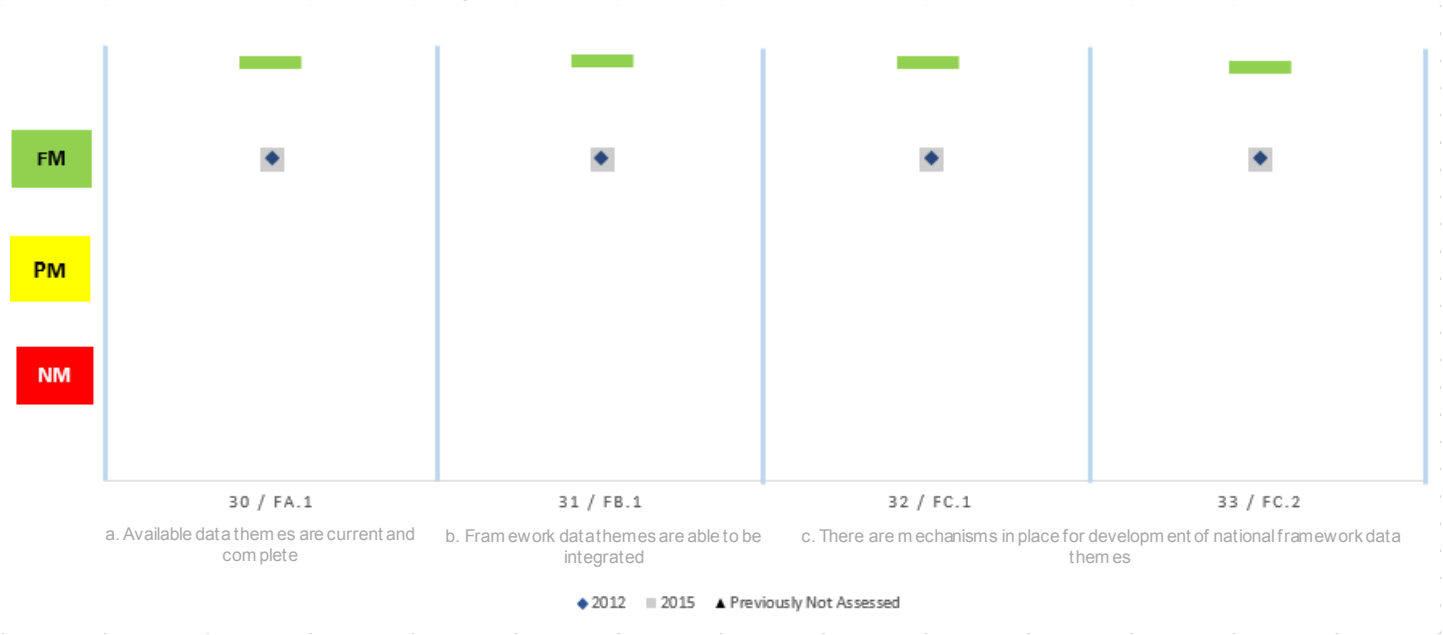
| | 30 / FA.1 | 31 / FB.1 | 32 / FC.1 | 33 / FC.2 |
| | a. Available data themes are current and complete | b. Framework data themes are able to be integrated | c. There are mechanisms in place for development of national framework data themes | |

◆ 2012   ■ 2015   ▲ Previously Not Assessed

The Operational Policies component indicators demonstrate stable and improved performance. Policy development addressing previously identified user needs and policy gaps has been initiated through a formalized plan and subsequent development of policy guidance, as well as the development of resources to assist with developing organizational capacity on operational policies has been completed. There have been efforts to promote policy development, policy adoption, and policy implementation and outreach, consultation and awareness activities have been undertaken. However, policy gaps still exist regarding data stewardship and data integration. Progress and status of the Operational Policies components is identified in Exhibit EX-3 below.
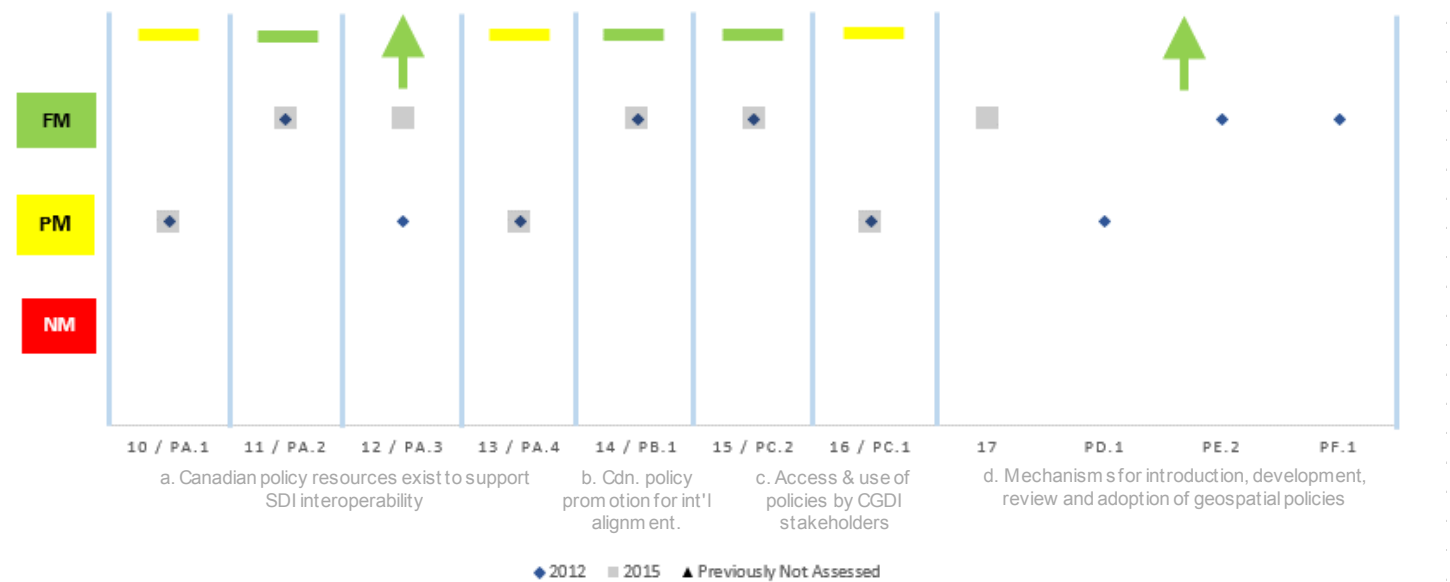
10 / PA.1   11 / PA.2   12 / PA.3   13 / PA.4   14 / PB.1   15 / PC.2   16 / PC.1   17   PD.1   PE.2   PF.1

a. Canadian policy resources exist to support SDI interoperability

b. Cdn. policy promotion for int'l alignment.

c. Access & use of policies by CGDI stakeholders

d. Mechanisms for introduction, development, review and adoption of geospatial policies

◆ 2012   ■ 2015   ▲ Previously Not Assessed

Additionally, an increasing number of governments in Canada have adopted open data policies, including the federal government's development of the Open Government Directive, Open Government License and creation of the new www.open.canada.ca website. There is also evidence of continued alignment with international operational policy. However, there is limited information readily available regarding data sharing agreements other than open data or the international, federal and provincial/territorial data sharing agreements. In addition, there are no formal mechanisms to monitor the implementation/adoption of CGDI operational policies.

The Standards and Specifications component indicators also demonstrate improved performance since 2012. Presently there are many standards either adopted by Canada or created through the work of GeoConnections and the CGDI. Resources have been made available to assist others in the take-up and implementation of these standards. While the data strongly support exposure to standards, presently there do not appear to be strong mechanisms for measuring actual usage and implementation. This is likely attributed to the voluntary nature of the CGDI, which poses challenges in monitoring actual usage of materials, including standards. Progress and status of the Standards and Specifications components is identified in Exhibit EX-4 below.

Exhibit EX-4
Results of CGDI Standards and Specifications Component
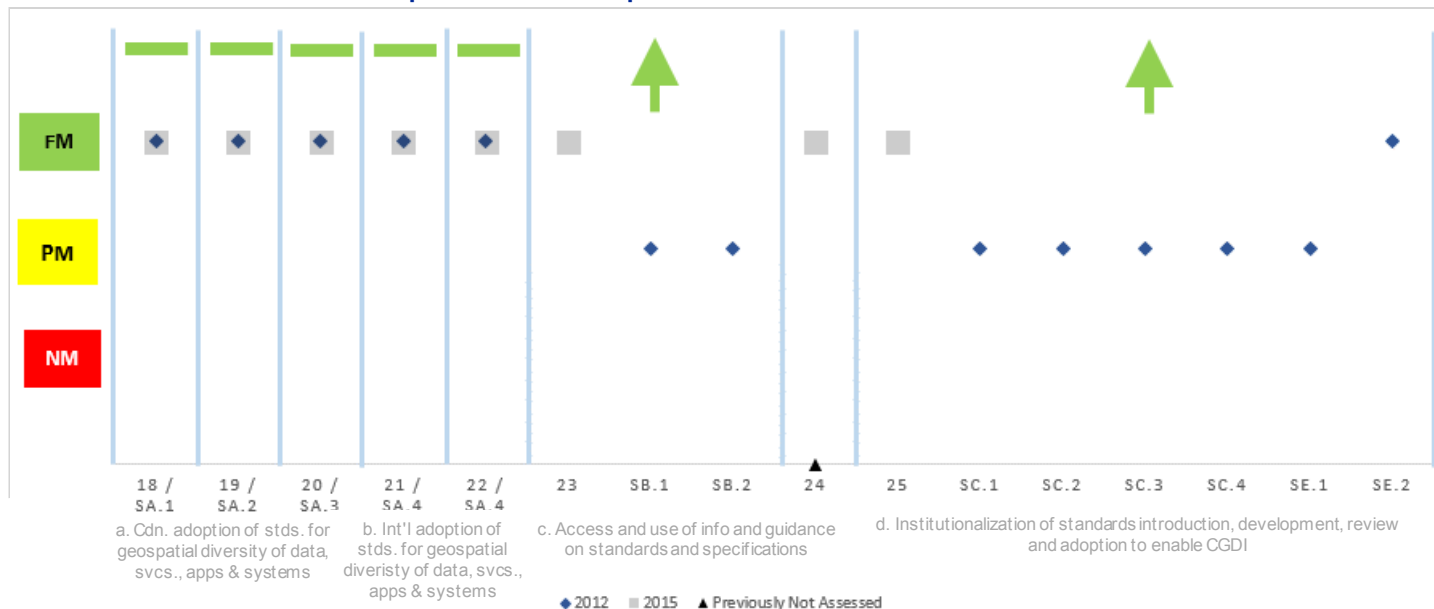
a. Cdn. adoption of stds. for geospatial diversity of data, svcs., apps & systems

b. Int'l adoption of stds. for geospatial diveristy of data, svcs., apps & systems

c. Access and use of info and guidance on standards and specifications

d. Institutionalization of standards introduction, development, review and adoption to enable CGDI

◆ 2012   ■ 2015   ▲ Previously Not Assessed

Technology component indicators have only partially been met but demonstrate incremental progress in the use of CGDI architecture model/tools in specific implementations since 2012. A number of technology tools exist to assist in the discovery, access and dissemination of location-based information. There has been an upward trend in downloads from GeoGratis and GeoBase data portals and an increase in clients served. Current technology tools appear to be aligned with the emerging internet and technology trends, such as mobile devices/accessibility and other 'leading edge' projects promising real-time data. However, the retraction of the Developer's Guide to the CGDI remains a gap and there is uncertainty surrounding the requirements to align the CGDI with future technological advancements or emerging issues. Progress and status of the Technology components is identified in Exhibit EX-5.

Exhibit EX-5
Results of CGDI Technology Component

a. Tech. tools in place for discovery, integration, mgmt., sharing, dissemination, visualization and access to Canada's location-based info over the Internet

b. Access and use of technology tool information and guidance by CGDI stakeholders

◆ 2012   ■ 2015   ▲ Previously Not Assessed
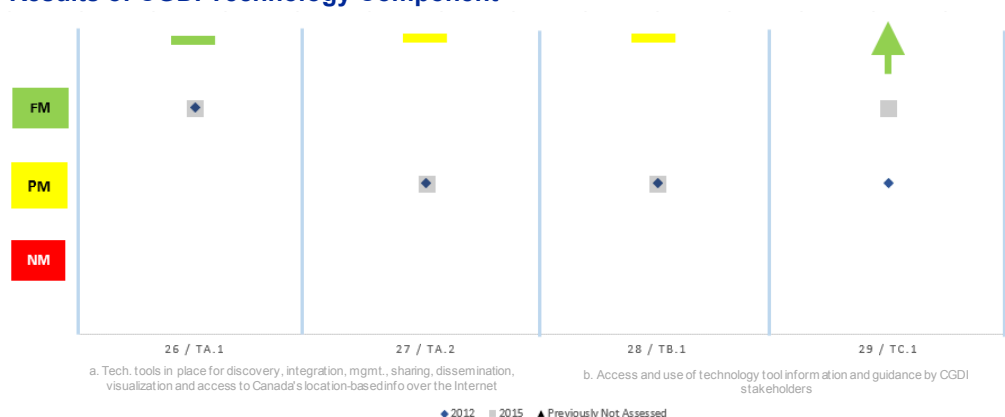
Chapter 1: Canadian Geospatial Data Infrastructure (CGDI) Overview

1.1.   Introduction to the CGDI

Geospatial data is information describing the location and names of features on, beneath, or above the earth's surface. Such geospatial data is collected in order to produce varied products, including: real-time weather maps; electoral maps; ice cover maps to monitor climate change; geological maps to stimulate mineral exploration by mining companies; maps of vegetation and wildlife distribution; and maps to track outbreaks of pests and diseases to protect the health of Canadians.[1]

A spatial data infrastructure (SDI) is a dynamic, hierarchic and multi-disciplinary concept that includes people, data, access networks, institutional policy, technical standards and human resource dimensions. SDIs were initially developed as a mechanism to facilitate access and the sharing of spatial data to use within a Geographic Information System (GIS) environment.[2]

A SDI is the implementation of a framework of geographic and geospatial data, metadata, users and tools that are interactively connected in order for spatial data to be used in an efficient and flexible way. Another definition for spatial data infrastructure that can be considered is "the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data."[3]

The SDI framework, as shown in Exhibit 1, coordinates the discovery and use of geospatial information through tools and services that connect through computer networks to various sources through a common end point. Key to the structure of an SDI is that data and metadata are managed by the data originator and/or owner and collaboration, coordination, common standards and recognized operational policies are essential to enable use of the data for multiple purposes beyond its original intent.[4]

Exhibit 1
Spatial Data Infrastructure
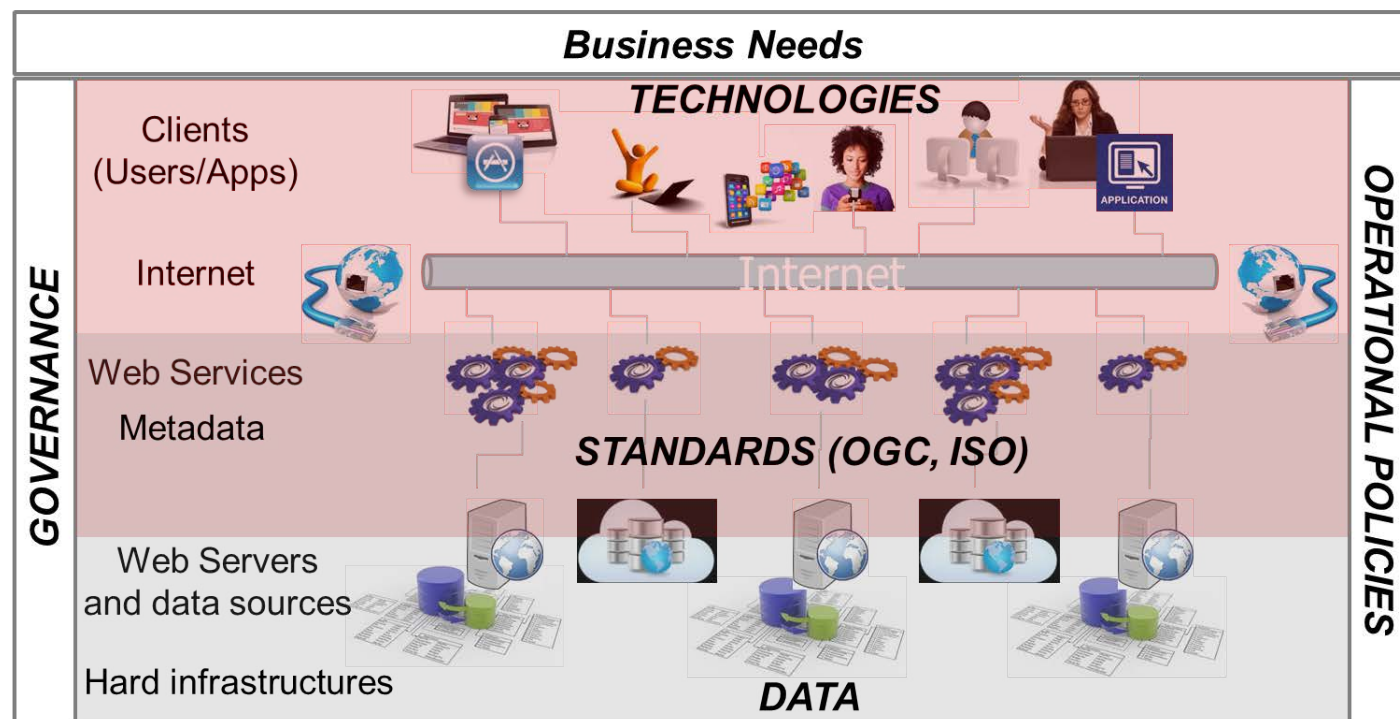
The importance of geospatial technologies is demonstrated by an increasing dependence on web maps, GPS systems, and location-based systems, to support access to basic information about the location of streets, buildings, services, and environmental features.[5] The role that SDI initiatives are playing within society is changing. Users now require the ability to gain access to precise spatial information in real time about real world objects, to support more effective cross-jurisdictional and inter-agency decision making in priority areas including emergency management, disaster relief, natural resource management and water rights. The ability to gain access to information and services has moved well beyond the domain of single organizations and SDIs now require an enabling platform to support the chaining of services across participating organizations.[6]

The CGDI is a convergence of common standards, tools, operational policies and accessible framework data layers necessary to harmonize all of Canada's location-based information. This harmonization results in the interoperability of federal, provincial, territorial and regional SDIs (SDI), creating a navigable online system of information, data, services and applications. The CGDI enables users to access and easily integrate the most current and accurate geospatial information in databases distributed across Canada. It does not host the data. Rather, it provides an infrastructure that allows a diverse community to access and share information directly from authoritative sources through the use of common standards. Exhibit 2[7] provides an illustration of the CGDI components and guiding principles.

Governance of geospatial information management in Canada is based on a cooperative approach between the federal, provincial and territorial governments, industry, academia and the public. Strong partnerships and collaborative relationships facilitate the management of geospatial information in Canada, where government is decentralized and no legislative framework for SDI and related institutional arrangements exist.[8]

1.2.   Objectives and Goals of the CGDI

Since 1999, the Canadian federal government has invested in the coordination of a national effort to build the CGDI through the establishment of a special program area supported by three phases of funding.   The GeoConnections program was established within Natural Resources Canada (NRCan) to drive and deliver CGDI efforts. The federal government has invested $150M in targeted funding to support GeoConnections to the end of March 2015.

During its first five years (Phase 1, 1999-2005), GeoConnections partners and stakeholders laid the foundation for the CGDI. The concept focused on the use of the internet as a platform for sharing geospatial data, and creating a distributed network where each data provider could retain control of and update their own information. Phase 1 also focused on developing strong partnerships, an inclusive governance structure, and promoting the development and adoption of standards that would enable interoperability – the ability to share and compare different data sets.[9]

Phase 2 (2005-2010) focused on the expansion of partnerships in order to facilitate and improve access to Canadian geospatial data. Phase 2 focused on enhancing capacity for user communities (e.g., municipalities, resource-based communities) to

harness the CGDI to support integrated decision making in key areas of federal priority: public health, public safety and security, sustainable development and the environment, and matters of importance to Aboriginal peoples."[10]

The goal of Phase 3 (2010-2015) was to provide "federal leadership to optimize the use of geospatial data for decision-making and lead strategic geomatics policy development."[11]   Moving beyond 2015, the GeoConnections program will continue to maintain its core federal leadership and coordination role to support the evolution and maintenance of the CGDI.[12]

However, the geomatics community, through the Canadian Geomatics Community Round Table (CGCRT) have recognized the importance and priority of establishing an "umbrella" governance structure under which shared leadership takes ownership of a new Pan-Canadian Geomatics Strategy. In January 2013, the CGCRT reached consensus on a "Team Canada" scenario to best describe the desired future for the Sector. This has been used to guide the development of the Pan-Canadian Geomatics Strategy. The Team Canada scenario describes a situation where the relationship between the private and public sectors has been clarified and where government has adopted a facilitating role to help ensure that the private sector can thrive within an enabling and stable policy framework.

According to CGCRT documentation, *in this scenario, governments keep a light regulatory touch on the Sector to ensure the legislative framework is appropriate for new uses of geospatial information and to ensure Accurate, Authoritative and Accessible (AAA) geospatial datasets, managed by committed and resourced custodians, critical to underpinning decision-making on societal priorities, continue to be made available at 'fit-for-purpose' quality. Governments' open data policies are strategically driven and continue to effectively support information needs of citizens, encouraging entrepreneurship and innovation that enhance economic development. Governments maintain responsibility for delivering core reference geographies and have increased their value-added services capabilities to meet growing demand for data integration and modeling to help solve complex horizontal policy issues.*[13]

The three phases of GeoConnections and the new Pan-Canadian Geomatics Strategy components are presented in Appendix A, highlighting the specific vision, mission and objectives, for each phase.

1.3.   The CGDI Performance Project

To report on the development and status of the CGDI, as well as to position it for future growth and continued relevance, the CGDI and its components were (re)defined by GeoConnections as it was moving into Phase 3 in 2010. The vision and way forward reflected changes in requirements and identified that an assessment framework was to be developed and used to assess progress and performance of the CGDI. A multi-phase project was executed over the 2010-2015 time period to assess the progress and performance of the CGDI according to a modernized definition and an updated vision and way forward.

The six phases of the CGDI Performance Project are as follows:

Phases	Description of project work	Status
1. Modernize the CGDI Definition	A modernized definition for the CGDI has been developed which states that the CGDI helps Canadians gain new perspective into social, economic and environmental issues, by providing an online network of resources that improves the sharing, use and integration of information tied to geographic locations in Canada.	Completed 2010
2. Update CGDI Vision, Mission and Roadmap	An updated vision, mission and roadmap for the CGDI was completed in 2012 - "CGDI Vision, Mission and Roadmap – the Way Forward". The document plays a role in shaping a comprehensive, usable, relevant SDI for Canada, and positions it for future growth and development in the context of a rapidly evolving Internet environment. The updated vision, mission and roadmap serve as a key instrument for GeoConnections, its partners and stakeholders in their collaborative effort to sustain the CGDI.[14]	Completed Summer 2012

Phases	Description of project work	Status
3. Develop CGDI Assessment Framework	Within the Canadian context there was a need to determine a practical and cost-effective assessment framework in order to assess the performance of the CGDI, measure the status of the CGDI and influence future funding priorities in order to advance the CGDI. In 2012, GeoConnections had developed a CGDI Assessment Framework based on international SDI assessment models as well as known assessment methods. The CGDI Assessment Framework developed in 2012 included 47 assessment criteria which were refined and applied during the CGDI Assessment phase of the CGDI Performance Project. The assessment criteria addressed the components of CGDI – standards, policies, technology, framework data, along with collaboration and leadership.	Completed Fall 2011
4. 2012 CGDI Assessment	This phase involved reviewing and analyzing the proposed CGDI assessment framework and proposing modifications / additional indicators in order to finalize the CGDI Assessment Framework. An assessment was conducted based on to the finalized CGDI Assessment Framework. The CGDI analysis and progress report of 2012 was the first time that GeoConnections undertook a targeted assessment of the CGDI based on a common understanding of its fundamental components and functionality. The assessment included qualitative and quantitative approaches to articulate progress in the development and use of Canada's SDI. This exercise resulted in recommended adjustments to the framework, measures and indicators. This output was used to communicate Canada's SDI status and to identify gaps and priorities for the CGDI investment.[15]	Completed Summer 2012
5. CGDI Assessment and Status Report 2015 (this report)	This phase involved analyzing CGDI measurement data and indicators and conducting an assessment according to the CGDI assessment framework (revised 2014). It included a comparison to any baseline data collected from other sources and the 2012 assessment. The analysis and progress report have attempted to document incremental achievement in toward the program goal to report on CGDI's status.	Completed Spring 2015
6. Evolution and Maintenance of the Canadian Geospatial Data Infrastructure	The next phase of the CGDI Performance Project will see: ▪ Efforts to modernize the CGDI definition to reflect evolution since 2012. ▪ Work to update the 2012 CGDI vision and roadmap to reflect future growth and development opportunities.	2015/2016

Starting with the goals and objectives of the redefined vision, mission and roadmap from 2012, CGDI performance outcome measures were defined. A flowchart depicting the relationship between the CGDI stated goals, the CGDI activity components and the resulting CGDI outcomes is depicted in Exhibit 3.

Exhibit 3
Linking Goals and Objectives to Performance Outcomes

CGDI Roadmap Goals and Objectives
Goal 1: Value – Focus on what the CGDI provides.
Objective 1.1: Public Asset
Objective 1.2: Economic Benefit
Objective 1.3: Leadership / Competitiveness
Goal 2: Performance – Refine how the CGDI behaves.
Objective 2.1: Quality / Usefulness
Objective 2.2: Adaptability
Objective 2.3: Data Access / Efficiency (high-value, low-cost data)
Objective 2.4: Innovation / Stimulation
Goal 3: Growth – Continue to enhance the CGDI
Objective 3.1: Culture of Sharing / Open Data
Objective 3.2: Collaboration / Incentive

CGDI Components (priorities, actions, implementation)

Collaboration

Framework Data
Operational Policies
Standards and Specifications
Technology

CGDI Outcomes

Collaboration
A complete and performing CGDI means that there is an identified leader/champion with a mandate to lead, with the appropriate resources, including the commitment and engagement of stakeholders, to deliver on a vision and long-term strategy for the CGDI.

Framework Data
A complete and performing CGDI means that a defined set of quality data themes are available and are complete, current and able to be integrated.

Operational Policies
A complete and performing CGDI means that there are policy resources in place that address common geospatial operational issues within Canada with linkages to international operational policy issues. CGDI stakeholders are able to access these policy resources. There are mechanisms and a clear process established for the introduction, development, review and adoption of geospatial operational policies. Also, there are mechanisms in place to monitor the adoption and implementation of the established operational policy resources.

Standards and Specifications
A complete and performing CGDI means that there are common technical and data standards in place that allow diverse data sources, services, applications and systems to operate with each other within Canada and internationally. CGDI stakeholders are able to access information and guidance on the implementation of these standards. There are mechanisms and a clear process established for the introduction, development, review and adoption of technical and data standards and there are institutional organizations in place to manage these mechanisms and processes. Also, there are mechanisms in place to monitor the adoption and implementation of the established technical and data standards.

Technology
A complete and performing CGDI means that there are technology tools in place that facilitate the discovery, integration, management, sharing, dissemination, visualization and access to Canada's location-based information where CGDI stakeholders able to access information and guidance on the implementation of these tools. Also, there are mechanisms in place to monitor the adoption and implementation of the established technical tools.

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[1] GoC, Federal Geospatial Platform: Transforming government to respond to today's reality, Primer, Fall 2014.
[2] Crompvoets, J. et al., Space for Geo-Information, Wageningen University and Centre for SDIs and Land Administration, Department of Geomatics, The University of Melbourne. A Multi-View Framework to Assess SDIs. 2008
[3] The White House, Office of Management and Budget (2002) Circular No. A-16 Revised, August 19, 2002
[4] Steiniger, S., and Hunter, A.J.S. (2012) preprint "Free and open source GIS software for building a spatial data infrastructure".
[5] Coalition of Geospatial Organizations, National SDI (NSDI) Report Card, February 2015.
[6] Crompvoets, J. et al., Space for Geo-Information, Wageningen University and Centre for SDIs and Land Administration, Department of Geomatics, The University of Melbourne. A Multi-View Framework to Assess SDIs. 2008
[7] Natural Resources Canada, 2015 CGDI Assessment Background, February 2015.
[8] Canada Country Report to the United Nations GGIM, August 2014.
[9] Natural Resources Canada. GeoConnections Program Design and Governance. Annex B. 2010.
[10] Ibid.
[11] Ibid.
[12] Ongoing funding is subject to NRCan's corporate costing model to be determined during 2015/2016. Source: Terms of Reference for the Evaluation of the Geospatial Innovation Sub-Program (GeoConnections).
[13] Canadian Geomatics Community Round Table. Pan-Canadian Geomatics Strategy. February 2015.
[14] http://geoscan.ess.NRCan.gc.ca/cgi-bin/starfinder/0?path=geoscan.fl&id=fastlink&pass=&format=FLFULL&search=R=292417
[15] http://geoscan.ess.NRCan.gc.ca/cgi-bin/starfinder/0?path=geoscan.fl&id=fastlink&pass=&format=FLFULL&search=R=295667

Chapter 2: CGDI Assessment Methodology

2.1   Background on the Development of the Assessment Methodology

GeoConnections undertook research into various SDI assessment models internationally as well as consulted international SDI assessment experts in order to define a practical and cost-effective assessment framework to measure the progress, performance and level of completion of the CGDI.   A general definition of an SDI assessment provided through the GeoConections research was found to be:

> *"SDI assessments in a narrow sense assess efficiency of access, intensity of use, and the extent to which spatial data are shared with others and in a broad sense assess the impact or effectiveness of spatial data access, use and sharing to stakeholder organizations."*[16]

Through this process, it was identified that assessing SDIs is difficult due to their complexity, constantly evolving nature and often times vague definitions. In addition, a comprehensive assessment would entail multiple aspects of the SDI and with the complexity of SDIs being developed worldwide, there is no one-size fits all assessment method. Additionally, assessing the CGDI posed other specific challenges, including being able to develop a framework that focused on the CGDI itself and not the GeoConnections program while still being able to link to the GeoConnections program evaluation requirements and reporting accountabilities for NRCan.

Nine international models were reviewed for applicability to the CGDI. These included a review of:

1. INSPIRE State of Play (European SDI) – focused on measuring the status of development of the member state SDIs, involves both quantitative reporting regarding data/services available and qualitative reporting regarding governance, cost/benefits and case study examples of usage;
2. CP-IDEA – SDI for the Americas – focused on governance, data/services and touches on societal/economic impact;
3. National SDI, United States of America (USA NSDI) – five categories of potential metrics: societal, environmental measures, data, technology and governance;
4. Dutch model - goal oriented assessment approach which includes indicators from multiple assessment approaches;
5. Clearinghouse suitability – measuring the quality and performance of national clearinghouses;
6. SDI-readiness – measurement of the capacity and willingness of countries to use SDIs;
7. Maturity approach – SDI maturity matrix and identifies 4 stages of SDI development;
8. Swedish success measurement – scores the success of the SDI based on 3 perspectives, Data and services, user perspective and co-operation and uses case studies to measure societal return on investment (ROI); and
9. EUROGI Self-Assessment - main purpose is to help SDI's in characterizing and describing themselves and it can be regarded as useful check-list to better focus on key issues in developing an SDI at the sub-national level.

The resulting assessment framework developed for the CGDI was primarily based on the INSPIRE State of Play model (2010/2011) and was developed to include the following attributes:

- The assessment framework would be realistic and cost-effective to conduct, focused on tangible criteria, with available data, relating to the core components of the CGDI.
- The assessment framework focuses on the minimum needed for a functional SDI.
- The assessment framework focuses on the core components of the CGDI as outlined in the modernized CGDI definition.
- The assessment framework can demonstrate progress.
- The conduct of the assessment would include both qualitative and quantitative approaches, supplemented with case studies to demonstrate impacts, benefits and interconnections.

The CGDI Assessment Framework developed in 2012 consisted of 47 criteria across the five CGDI component areas of Framework Data, Policies, Standards, Technologies as well as Leadership/Coordination. This research-based assessment framework was used to conduct the CGDI assessment in 2012 and subsequently revised based on lessons-learned throughout that process.

The CGDI Performance Assessment conducted in 2012 reported that CGDI was fully meeting its performance expectations against approximately half of its performance indicators and, at a minimum, at least partially meeting its performance expectations against the other half.   The study concluded that the CGDI had met the performance assessment criteria to a large extent, although gaps were still remaining.

2.2   2015 Assessment Objectives and Approach

In accordance with the multi-phase CGDI Performance Project, the 2015 assessment was undertaken to measure the continued progress of development, use, success and state of Canada's CGDI. The 2015 assessment involved reviewing and updating the CGDI Assessment Framework and analyzing CGDI measurement data and indicators against this revised CGDI Assessment Framework. In some instances, multiple indicators from 2012 were consolidated into one representative indicator for 2015. The number of criteria being assessed has dropped from 47 indicators in 2012 to 33 indicators in 2015. A mapping of the 2012 indicators to those used in 2015 is provided in Appendix B.
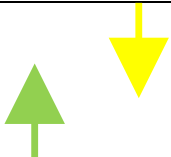
The 2015 assessment uses the same breakdown of measurement as applied during the 2012 assessment, namely analysis by:

- CGDI component (e.g., collaboration, operational policies, technical and data standards, technology and framework data)
    - Performance results by CGDI component
        - Performance indicator(s) by performance result

The 2015 assessment also uses the same qualitative scoring scale as used previously during the 2012 assessment. The qualitative scorecard consists of three categories:

- Green: Fully meets the criteria;
- Yellow: Partially meets the criteria; and
- Red: Does not meet the criteria.

A comparison of assessment ratings to the 2012 results was also performed. The comparison is presented graphically to show declining investment, progressive movement or sustained performance against the qualitative scorecard. The results have been identified by the following symbols:

Horizontal bar	—	Reflecting no movement or sustained performance from the 2012 levels – based on the rating applied at that time.
Vertical arrows	↑ ↓	Reflecting an increase or decrease in the qualitative rating from the 2012 levels.

2.3   Methodologies Employed

To address the 2015 CGDI Assessment a mix of qualitative and quantitative sources of information were used. Two methods were employed during the assessment: document review and the development of two case studies. The 2015 assessment was restricted to the employed methods as a result of project timing as well as resource availability.

Document Review

For the most part, the 2015 assessment was completed, and based upon, existing and available documentation supported by a high-level literature review. A majority of available documentation was received directly from NRCan. More than 75 documents of relevance were reviewed along with publicly available documentation and information obtained from the Internet.

Case Studies

The case study selection criteria for CGDI projects were proposed by GeoConnections as part of the Assessment Framework terms of reference. The projects selected were to be used to assess the use and benefits of the CGDI. Two case studies were developed to elaborate SDI usage, including the components of collaboration, policies, standards and framework data (access and integration).

Criteria used in the final selection of the case study candidate projects included:

- The project was advanced enough to be able to elaborate on use and benefits.
- The governance component is reflective of the manner in which the CGDI is directed and controlled and the manner in which the CGDI influences decision-making.
- The project demonstrates international collaboration with suppliers and users.

Based on the above criteria, two projects were selected by method of elimination. One case study focuses on a key Canadian federal government priority which highlights the policies, standards and tools used in order to facilitate the sharing of geospatial data. The other case study highlights the collaboration, leadership and governance for the CGDI but also assesses the use and benefits of the CGDI along the four component areas (collaboration, policies, standards and framework data). Further details on the two projects selected are provide in the table below.

	Key Canadian Government Priority	Advanced State	Reflects Governance Aspects	International Collaboration
1. Arctic SDI	Supports asserting sovereignty in the Arctic	Launched in 2011	CGDI governance linkage with Arctic Council and decision making among jurisdictions.	Eight national mapping agencies: Canada, USA, Russia, Iceland, Denmark, Finland, Sweden, Norway
2. FGP	Supports Canada's Action Plan on Open Government	The platform began phased operations in 2014	CGDI governance linkage with Federal Committee on Geomatics and Earth Observations (FCGEO), and decision making at the Departmental level with 21 departments and agencies.	N/A

Qualitative methods of review (document review and interviews) were employed in the development of the case studies.

Four interviews were conducted in support of the Arctic SDI case study; one internal interview with an NRCan representative, two external Arctic SDI and Arctic Council collaborators and one interview with a GeoConnections program proponent. The GeoConnections program proponent additionally provided a written response to the case study interview questions.

Four interviews were conducted in support of the FGP case study; all interviews were with Canadian Federal Government representatives. Two interviews were conducted with representatives of the FGP core project team and two interviews were conducted with other participating federal government departments.

Information and data from the case studies has been integrated into the assessment of the indicators. The detailed case studies can be found in Appendix C and D.

Data Limitations

Although every effort was made to assess the incremental changes for each indicator since the 2012 Assessment, this Assessment primarily relied on a review of documentation made available by GeoConnections, or retrieved through Internet searches. The case studies component provided some specific examples of CGDI at work; however, they represent only a limited amount of evidence. The Assessment was methodologically limited in that interviews were not conducted to obtain further elaboration on the presentation of information from documents. As such, there was an inability to acquire additional context in some places, to better understand the depth and breadth of the incremental changes identified throughout this report.

Our findings and assessment results for each of the CGDI's five expected outcome components of Collaboration, Framework Data, Operational Policies, Standards and Specifications, and Technology are provided in chapters 3 through 7 of this report. Descriptions of each component were provided previously under Exhibit 2 of the report for reference.

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16 Natural Resources Canada, 2015 CGDI Assessment Kick-off Meeting deck, January 2015.

Chapter 3: Assessment of CGDI Component: Collaboration

The outcome measure being assessed under the Collaboration component is defined in the Assessment Framework as:

A complete and performing CGDI means that there is an identified leader/champion with a mandate to lead, with the appropriate resources, including the commitment and engagement of stakeholders to deliver on a vision and long-term strategy for the CGDI.

Five performance result areas with nine corresponding indicators were assessed under the Collaboration component.

Performance Result (a): Has an identified leader/champion with the mandate to coordinate	
Indicator	**2015 Assessment Findings and Result**
1. There is an identified leader and/or coordinating body to coordinate the ongoing maintenance and evolution of the CGDI.	**Assessment: Fully Meets Criteria** There is evidence of an identified leader and coordinating bodies/mechanisms that continue to evolve at a number of levels in Canada. The CGCRT has brought about cross-sectoral collaboration and formal coordination. Organization between non-profit, public sector, private sector and academia leaders of the geomatics community has emerged continuing to contribute to drive the CGDI. The Federal Committee on Geomatics and Earth Observation coordinates a collaborative environment for the Canadian Federal Government, and the Canadian Council on Geomatics (CCOG) coordinates efforts at the federal/provincial levels. One of the key coordinating bodies, GeoConnections is also continuing its support role.

Analysis and Supporting Evidence

NRCan, more specifically the GeoConnections program, was found to be the CGDI coordinating body in the 2012 Assessment. Evidence was found of a formal assignment and acceptance of a leadership role by NRCan/GeoConnections in the internal government submissions, the Mapping Information Branch (MIB) operational plan, the NRCan Program Activity Architecture (PAA) and the GeoConnections business plan. In addition, the Geomatics Accord (2007) accepts GeoConnections as the secretariat and coordinating body for many of the activities undertaken by the CCOG. GeoConnections is also Canada's official representative to international bodies dealing with international SDI.

There is evidence that GeoConnections has continued to fulfill its' support role as secretariat of the CCOG and the CGCRT. The CCOG promotes collaboration between all government organizations in Canada and is responsible for the Canadian Geomatics Accord. The purpose of the Accord is to create a framework to allow federal, provincial and territorial government agencies involved in geomatics to collaborate, focus their effort on more efficient data collection, distribution and maintenance. The CGCRT is a collaboration between non-profit, public sector, private sector and academia leaders of the geomatics community.

Prior to June 2012, the Canadian Geomatics Community Round Table (CGCRT) was an advisory board to GeoConnections. In June of 2012 the CGCRT became a formal body. An interim steering committee was appointed and a formal mandate put in place. In January 2013, an elected Steering Committee with representation from public, private and non-profits segments of the geomatics community has led the CGCRT in the development of a Pan-Canadian Geomatics Strategy with community input gathered through 2013 and 2014. However, this work has been ongoing since 2007 with collective discussions among the geomatics communities on priorities and national issues of importance. [17]On January 31, 2015 the CGCRT Governance and Leadership Working Group presented a proposed new leadership and governance model for the Canadian Geospatial Community through the creation of an association named GeoAlliance that would "provide an umbrella structure for existing geospatial organizations in Canada to pool their energies and resources to collaboratively address sector-wide strategic priorities."[18] The plan is to launch GeoAlliance at a National Leadership Summit in Ottawa on April 15, 2015. The GeoAlliance would be governed by a Board made up from governments, not-for-profit, business and education members. The administrative support for the organization would be funded through annual membership dues.

There is also a coordinating body at the Canadian Federal Government level. The Federal Committee on Geomatics and Earth Observation (FCGEO) is a committee of senior executives from 21 department and agencies created to establish strategic direction on federal policy, interoperability, and infrastructure relating to geomatics and earth observation in support of GoC priorities. The FCGEO has launched the FGP (FGP), an initiative started in 2014.[19] The FGP will be a collaborative online environment consisting of authoritative geospatial data, services, and applications. The Platform will support Canada's Action Plan on Open Government[20] by providing access to comprehensive collections of accurate and authoritative geospatial information, including socioeconomic and environmental data.

Additionally, at the national level, the renewed Canadian Geomatics Accord contains the framework to allow federal, provincial and territorial government agencies involved in geomatics to collaborate and provide support for geomatics initiatives and focus their efforts on more efficient data collection, distribution, and maintenance. The CCOG coordinates inter-jurisdictional cooperation through the development of the renewed Canadian Geomatics Accord. The Accord has been signed by all provincial and territorial government except Newfoundland and Nunavut. The Renewed Canadian Geomatics Accord is officially in effect and will be signed by the minister of NRCan in the spring of 2015.

From 2015 onward, GeoConnections will have ongoing funding allocated through NRCan's corporate costing model. The provision of ongoing funding will allow the Program to maintain its core federal leadership role and coordination that will continue to support the evolution and maintenance of the CGDI.[21]

Conclusion

There is evidence of an identified leader and coordinating bodies/mechanisms that continue to evolve at a number of levels in Canada. The CGCRT has brought about cross-sectoral collaboration and formal coordination. Organization between non-profit, public sector, private sector and academia leaders of the geomatics community has emerged continuing to contribute to drive the CGDI. The Federal Committee on Geomatics and Earth Observation coordinates a collaborative environment for the Canadian Federal Government, and the CCOG coordinates efforts at the federal/provincial levels. One of the key coordinating bodies, GeoConnections is also continuing its support role.

Performance Result (a): Has an identified leader/champion with the mandate to coordinate	
Indicator	**2015 Assessment Findings and Result**
2. There is a network of resources within the coordinating body for the ongoing coordination of the CGDI.	**Assessment: Fully Meets Criteria** There continues to be a network of resources, voluntary time commitments and financial contributions to continue to support the coordination of the CGDI.

Analysis and Supporting Evidence

The 2012 CGDI Assessment had identified that the CGDI coordinating body, GeoConnections, had a clear business model and funding to sustain the program until at least 2015. There was a risk identified that without continued funding there could be a gap in the continued advancement of the CGDI.

A shift in leadership for the CGDI appears to be happening, where the geomatics community, including governments, non-profit, business and education stakeholders are moving to assume a more pronounced leadership role instead of a consultation role. Through a network of volunteer resources, a Pan-Canadian Strategy was developed under the CGCRT steering committees and working groups.

The Leadership and Governance working group have suggested the creation of a new entity, GeoAlliance Canada, that would replace the CGCRT and GeoConnections as the governing body of the CGDI and the geomatics sector overall. The funding for this organization would be provided by annual membership dues. There would be a need for one time start-up funding to facilitate the work of the volunteers, and to have project funding sufficient to undertake 3-4 high-priority strategic projects in the first and second year. Productive discussions are advancing with partners that have expressed interest in addressing this deficit by investing in the GeoAlliance Canada launch with financial and in-kind support.[22]

Commitment to the provision of ongoing funding is anticipated to allow the GeoConnections Program at NRCan to maintain its core federal leadership role and coordination efforts that will continue to support the evolution and maintenance of the CGDI.[23] It is anticipated that GeoConnections will have ongoing funding of $5 million[24] per year and the FGP received an approved three year, $40 million investment through reallocations of existing partnering Departments' internal budgets.

Canadian Federal Government resources are also committed in support of Canada's membership in the Arctic SDI initiative where the resources necessary for the activities of the Arctic SDI are comprised of voluntary contributions from the participating institutions. This includes both administrative and technical activities and operations as well as development and strategic activities.[25] Canada is currently performing the Secretariat function and is the Lead Country for 2014 and 2015.

Conclusion

There continues to be a network of resources, voluntary time commitments and financial contributions to continue to support the coordination of the CGDI.

Performance Result (b): Has a vision and strategy	
Indicator	**2015 Assessment Findings and Result**
3: There is a vision and a strategy for the CGDI that includes stakeholders' roles and is aligned with key stakeholder priorities	**Assessment: Fully Meets Criteria** The Pan-Canadian Geomatics Strategy presents an updated vision and mission for the geomatics sector that is aligned with stakeholder priorities, enabled through a series of inclusive working groups and events. The Pan-Canadian Strategy defines the future roles and responsibilities of the public sector, private sector and academia.

Analysis and Supporting Evidence

GeoConnections had implemented an official vision and strategy for the CGDI in 2005 and subsequently updated these documents in 2012. The vision and strategy were aligned with Canadian federal government priorities and it was found through a review of Canadian SDI projects and activities that an alignment of the CGDI with stakeholder strategies was present. However, the 2012 Assessment indicated that the roles of various stakeholders were captured, only in part, in the 2007 Geomatics Accord and in the GeoConnections business plan. Therefore, the 2012 Assessment indicated there was no one source that fully clarified the roles and the responsibilities of all the CGDI stakeholders.

As identified in Chapter 1 (Exhibit 2), the vision and mission for the CGDI has evolved since it was established in 2001. The Pan-Canadian Strategy initiated in 2012 by the CGCRT has stated objectives to better meet the needs of, and enable, the ever-growing geospatial community that depends on reliable, accurate and fit-for purpose geospatial services and expertise.

The CGCRT initiated the development of a White Paper: *The Pan-Canadian Geomatics Strategy and its Action and Implementation Plan.* The White Paper's purpose was to provide a foundation for the CGCRT to prepare the Pan-Canadian Geomatics Sector Strategy. [26] The White Paper introduced the concept of seven strategic dimensions including: Identity, Market, Business Model, Governance and Leadership, Location Capacity, Data Sources and Legal and Policy Framework areas. Subsequently, the framework for the Action and Implementation Plan was developed by seven volunteer working groups (one for each of the seven strategic dimensions) formed September 1, 2014.

The Pan-Canadian Strategy refers to the vision and mission of the geomatics sector. The geomatics sector provides geospatial information products and services, leveraged by the user community for geospatially enabling decision-making and policy planning. The geomatics sector is also responsible for the development and delivery of Canada's network of SDI providing users with necessary "core" data services. Canada's SDIs provide a set of geographic information, such as address, postal codes, roads, cadaster, and census data, including related metadata that is necessary for enabling geographic applications and service delivery. As such, the Pan-Canadian Strategy encompasses a slightly different view than that of the previous CGDI vision and mission. The Pan-Canadian Strategy's Vision and Mission is reflective of the geomatics sector view (or industry view) focused on products and services whereas the GeoConnections Vision, Mission and Roadmap was reflective of the view from Canada's perspective and focused on infrastructure. The two vision statements are as follows:

CGCRT: *"Canadian Geomatics will be a world class, thriving and openly engaged Sector providing reliable geospatial data and information products, technology, services and expertise underpinning Canada's economic success in the business of where."*

GeoConnections: *"Canadians have open, secure and continually available access to comprehensive location-based information about Canada through the community-sustained Canadian Geospatial Data Infrastructure in support of prosperity and well-being for all."*

The Pan-Canadian Geomatics Strategy clearly defines the relationship between the private and public sector. Roles are clearly defined under the Team Canada Scenario where government's role is to "*ensure the legislative framework is appropriate for new uses of geospatial information and to ensure Accurate, Authoritative and Accessible (AAA) geospatial datasets, managed by committed and resourced custodians, critical to underpinning decision-making on societal priorities, continue to be made available at 'fit-for-purpose' quality. Governments' open data policies are strategically driven and continue to effectively support information needs of citizens, encouraging entrepreneurship and innovation that enhance economic development. Governments maintain responsibility for delivering core reference geographies and have increased their value-added services capabilities to meet growing demand for data integration and modeling to help solve complex horizontal policy issues.*"

In response to government's facilitating role, the private sector has repositioned itself to embrace new markets and is more citizen-centric. The private sector has recognized dramatic market shifts and has moved up the value chain to strategically focus on specialized value-added geospatial information services for both consumer and business markets. [27]

Additionally, the Canadian Geomatics Accord identifies roles and responsibilities for the GoC and for provinces and territorial governments. The renewed accord is in effect through December 31, 2019.

Conclusion

There has been a shift towards a more inclusive vision and mission of the geomatics sector for all geomatics stakeholders including industry, academia, governments, non-governmental organizations, geospatial data and service companies, professional associations, individual Canadian citizens, as well as new and emerging players in the geomatics and Earth observations sector.

The Pan-Canadian Strategy defines the roles and responsibility of the public sector, private sector and academia.

Performance Result (b): Has a vision and strategy	
Indicator	**2015 Assessment Findings and Result**
4: The CGDI stakeholders contribute to strategies in support of CGDI development.	**Assessment: Fully Meets Criteria** Stakeholders are directly contributing to strategy development through inclusive processes being implemented by coordinating bodies. The CGCRT has involved stakeholders across the government, private, and academic sectors. The FGP has targeted both potential data users and providers through its planning and implementation phases.

Analysis and Supporting Evidence

According to the 2012 Assessment, CGDI stakeholders included: Federal Government, Non-Governmental Organizations (NGO) (Associations or Consortiums), Provincial Government, Municipal Governments, Aboriginal Peoples, Academia, Standards Organizations, Industry and Citizens.

A large contributor to CGDI is the CGCRT. The Pan-Canadian Geomatics Strategy and the Action and Implementation plan led by the CGCRT provides evidence that stakeholders from the geomatics sector directly contribute to the strategies that support the CGDI based on direct stakeholder engagement activities through workshops and webinars, and through the composition of the CGCRT Steering Committee.

In particular, a number of stakeholder workshops were held to further advance the Pan-Canadian Strategy. The first was the Steering Committee Workshop held on November 14-15, 2013. The second was the Team Canada Event on June 9-10, 2014

where work completed to date on the Pan-Canadian Geomatics Strategy was reviewed and priorities were identified for the Action and Implementation plan. The CGCRT has also hosted webinars to obtain stakeholder input and provide information on stakeholder perspectives. The CGCRT has reported that the last webinar attracted registration from 125 individuals or organizations from across the country and around the world.[28]

Additionally, the CGCRT Steering Committee consists of 11 Members and 2 Co-Chairs, comprising a mix of individuals representing Federal Government (GeoConnection, Canadian Space Agency (CSA), Provincial Government (British Columbia and New Brunswick), Academia (Dalhousie University), Non-Profit Organizations (Professional Surveyor Canada, Association of Canadian Map Libraries and Archives), and the private sector (MMM Group Ltd, CubeWerx, HAL Corporation, Intergraph, Spatial Geo-link Limited and MDA Corporation).

The CGCRT also engages input through an online comment form on its website that allows anyone to ask questions about the CGCRT activities or provide comments to help shape the future of the geomatics/geospatial sector in Canada. The CGCRT website also promotes communication interaction through social media such as Twitter and LinkedIn.

The FCGEO, through its' whole-of-government leadership role and support of the FGP initiative, also provides evidence of stakeholders' contributions to strategies of the CGDI. The FGP is a collaboration of 21 Canadian Federal Departments and Agencies. The initiative takes a broad collaborative approach to planning, development and implementation. In redefining the FGP vision for 2015, a client engagement process was undertaken that included 50 people across 11 departments and agencies to create client profiles that drove the definition of user needs. The FGP integrates the domains of data and policy by engaging both audiences in its collaborative efforts. A client work group has been established to engage partnering departments and identify requirements for the FGP solution.

Conclusion

Stakeholders are directly contributing to strategy development through inclusive processes being implemented by coordinating bodies. The CGCRT has involved stakeholders across the government, private, and academic sectors. The FGP has targeted both potential data users and providers through its planning and implementation phases.

Performance Result (c): Has the commitment and engagement of stakeholders	
Indicator	**2015 Assessment Findings and Result**
5: There is the commitment and engagement of CGDI stakeholders through structured and formalized networks (such as coordinating committees, national committees Federal-Provincial, Provincial/Territorial committees, Private Sector committees, policy/technology/ standards approval bodies).	**Assessment: Fully Meets Criteria** There is evidence of continued commitment and engagement of CGDI stakeholders through structured and formalized networks, such as the CGCRT working groups created to implement the Pan-Canadian Geomatics Strategy, the CCOG and the FCGEO.

Analysis and Supporting Evidence

The 2012 Assessment demonstrated that stakeholders were committed and engaged through structured and formalized networks. Established networks noted in the 2012 Assessment of the CGDI included the FCGEO, the CGCRT and the CCOG that were all supported by the GeoSecretariat. As noted on the NRCan website, these three Committees are still supported by the GeoSecreteriat with the addition of the Geographical Names Board of Canada. [29]

Stakeholder contribution has evolved as the CGDI evolved. Phase I was defined as the development of its stakeholder base, and stakeholder commitment to GeoConnections was demonstrated through the development of a Federal/Provincial/Territorial (FPT) agreement on Ministerial Geomatics Accord[30] . Phase II transitioned from "establishing and building" to "evolving and

expanding" the CGDI. External advisory committees were created which included a Thematic Advisory Committee, Data Management Board, Technical Advisory Network, Policy Advisory Committee and an Architecture Advisory Committee. Phase III of GeoConnections, the "Integrate and Sustain" phase of the CGDI, was witness to the refinement of established networks, as well as continued support of existing partnership networks.

Stakeholder commitment to the CGCRT has evolved and strengthened with the evolution of the CGCRT from an advisory committee to a permanent, formal body over the 2007 – 2014 period. The CGCRT led the Pan-Canadian Geomatics Strategy and the Pan-Canadian Geomatics Strategy Action and Implementation Plan.[31] As described previously, working groups were created for the implementation of the Pan-Canadian Geomatics Strategy for each of the strategic dimensions as defined under Indicator 3, page 13. The following are the identified leads:

▪ CGCRT Steering Committee ▪ Canadian Association of Geographers ▪ GeoConnections (NRCan) ▪ FCGEO	▪ Library Archive Community ▪ CCOG ▪ Canadian Geographic Education (CGE) and James Boxal ▪ Canadian Institute of Geomatics (CIG)

The federal, provincial and territorial governments are the key organizations for the development and maintenance of the CGDI. The CCOG is a federal-provincial-territorial government cooperative body that advances geomatics activities of common interest, and facilitates data collection, interoperability and integration between jurisdictions. Evidence of the commitment and engagement of these government stakeholders is provided by the signing of renewed Canadian Geospatial Accord, which emphasizes the importance of cross-jurisdictional collaboration related to geospatial data.

Conclusion

As demonstrated by the increased involvement of all geomatics sector stakeholders in the development of the Pan-Canadian Geomatics Strategy, stakeholder involvement has continued to evolve.

There is evidence of continued commitment and engagement of CGDI stakeholders through structured and formalized networks such as the CGCRT and the working groups created to implement the Pan-Canadian Geomatics Strategy, the CCOG for Provincial and Territorial Government through the Canadian Geospatial Accord, and the FCGEO.

Performance Result (c): Has the commitment and engagement of stakeholders	
Indicator	**2015 Assessment Findings and Result**
6: The identified leader/coordinating body communicates and promotes the CGDI with stakeholders.	**Assessment: Partially Meets Criteria – Gaps Evident** Communications among stakeholders from the geomatics community appears to be effective. The CGDI is promoted at a number of levels: internationally, federally and across sectors. However, there is limited evidence of general outreach and promotion of the CGDI with non-traditional users and the general public as noted in the GeoConnections Communication Strategy (2010-2015) and more recently the Pan-Canadian Geomatics Strategy identifies (as a strategic objective) (SO) the need to communicate a more cohesive and compelling geomatics story in Canada.

Analysis and Supporting Evidence

The 2012 Assessment noted that although communications was identified as an area for improvement in recent evaluations and other studies, the actual level of engagement of stakeholders had been high and a review of the available documentation also indicated that a significant amount of communication and promotional activities by GeoConnections for the CGDI was planned. The 2012 Assessment presented examples of workshops in which GeoConnections representatives either participated or sponsored.

The GeoConnections III Communication Strategy (2010-2015)[32] was created to address a need to enhance brand clarity for the CGDI, the need for more timely access and increased accessibility to the geospatial information federally, the need for increased communication and promotional activity and the need for development of a communication strategy.

Two priorities were identified in the Communication Strategy: increase awareness of GeoConnections and the benefits of the CGDI amongst Canadian geomatics stakeholders and increase outreach effort to non-traditional users and the general public about the benefits of the use and application of geomatics technologies and geo-data.

The Pan-Canadian Geomatics Strategy also identified a need to communicate a more cohesive and compelling geomatics story in Canada. The action and implementation plan elaborates on detailed steps to accomplish the SO; however, completion of these activities is not scheduled until 2015 or later. The planned activities include:

- Hire a marketing consultant to do branding, marketing and communications.
- Make use of the results of the Canadian Geomatics Environmental Scan and Economic Value Study to help build/validate/reinforce our identity and promote it to senior leaders via our sector champions.
- Identify and build sector champions that will promote the importance and value of what we do using language that everyone can understand.
- Articulate who the key stakeholders of the Canadian geomatics sector are by communities (geographers, librarians, cartographers, data science, government, private sector, analysts).

Develop a plan to get 'geomatics' defined in common dictionaries. The CGCRT, with secretarial support by GeoConnections, promotes the CGDI through various outreach initiatives domestically and internationally. CGCRT hosted several meetings, workshops and a webinar in order to raise the political profile of the sector, collaborate on projects to realize economies of scale and reduce duplication of effort, create a Pan-Canadian Geomatics Strategy, and Action and Implementation plan. These meetings and workshops initially took place annually and progressed to a semi-annual basis, between June 2011 and February 2015.[33]

The CGDI Operational Policy Activities, Project Plan 2012-2015 highlights the intention to intensify and continue outreach and awareness and consultation activities to promote polices, adoption processes and to showcase policy implementations. Reporting against these activities is unknown, based on the information available. The list of Activities include:

- Promotion of operational policy instruments and best practices through both electronic (GCPedia, web site, other electronic media) and more traditional means (factsheets, presentations, meetings, committees, etc.).
- Awareness-raising event planning and execution, including ongoing series of webinars, workshops and consultations.
- Participation in relevant conferences, meetings, events and working groups.[34] Webinars have been created to educate and promote CGDI policy, standards and other related CGDI information, such as the role and impact of geospatial information in the big data arena. In 2013 there were a total of 9 webinars produced in both official languages. Webinars continued as an outreach method beginning in February 2014 with new topics and guest speakers. The number of webinars decreased significantly from 2013 as only 4 were produced.[35]

The GeoConnections team continues to promote the CGDI by participating in numerous domestic and international geospatial bodies, including, but not limited to: the Canadian Council on Geomatics; the Canadian General Standards Board; the International Organization for Standardization; the UN (UN) Committee of Experts on Global Geographic Information Management (UNCE-GGIM); and the Federal Committee on Geomatics and Earth Observations.

In addition, an NRCan Communication Advisor participated in a GoGeomatics Canada Magazine interview that was posted on the web on April 1, 2013.[36] This interview is evidence of outreach to the Geomatics stakeholders, as the magazine is a specialized publication targeted to the Geomatics sector.

There have been both format and content changes in web communications since the 2012 Assessment. The information previously included on the GeoConnections.org website was required to migrate to the NRCan website under Earth Sciences to comply with new TBS web standards for the GoC.

The CGCRT website and twitter feed also provides evidence of this Committee's communications with stakeholders regarding its' mandate and the progress of the Pan-Canadian Geomatics Strategy Action and Implementation Plan.

The FGP project has conducted several departmental FGP communications events supported by common communications tools. Communications between the Core Project Team and interested members of the horizontal policy community have been ongoing since August 2014. The FGP uses a number of communications methods to encourage collaboration and buy-in including FGP video, decks, status updates, calendar, web page.

Conclusion

Communications among stakeholders in the geomatics community appears to be effective. The CGDI is promoted at a number of levels: internationally, federally and across sectors. Although there is evidence of outreach with traditional geospatial stakeholders, there is limited evidence of general outreach and promotion as noted in the GeoConnections Communication Strategy (2010-2015). Furthermore, the Pan-Canadian Geomatics Strategy identified as a Strategic Objective the need to communicate a more cohesive and compelling geomatics story in Canada.

Performance Result (c): Has the commitment and engagement of stakeholders	
Indicator	2015 Assessment Findings and Result
7: The policy makers use CGDI components (policies, standards, technology, framework data) to facilitate decisions.	**Assessment: Fully Meets Criteria** The various case studies funded by GeoConnections and completed as part of this assessment provide a description of how policies, standards, technology, and framework data are being used to facilitate decision making. The GeoBase and GeoGratis web portal statistics provide evidence that the Framework Data Components are being downloaded, with downloads having increased by approximately 28% since 2010-2011.

Analysis and Supporting Evidence

This criteria was not assessed in the 2012 Assessment of the CGDI.

Decision making is facilitated through the holistic utilization of all components in an SDI framework (see Exhibit 1 and definition previously provided). Coordination of the discovery and use of geospatial information through tools and services that connect through computer networks along with the technologies built to respond to a business need for information are all necessary components driving CGDI infrastructure usage.

The use of CGDI policies and standards was found through the FGP case study where it was identified that the FGP leveraged existing CGDI guidance materials on how to develop, manage, adapt and adopt operational level policy for organizations – the working groups utilized all relevant GeoConnections materials (contained in the CGDI Resource Centre) from a policy and standards perspective. This included, for example, policy classification and identification and inventory processes to enable the FGP to understand its policy landscape, classify and inventory what was in existence and then report on it. The FGP also used the CGDI geospatial data archiving and preservation reference material to inform the policy on data management lifecycle. More recently, the FGP is utilizing CGDI studies completed on data quality to establish the benchmark for the FGP. The FGP initiative regards adoption of geospatial standards as instruments of policy and has leveraged GeoConnections/CGDI metadata standards, particularly NAP for geospatial metadata. The case study recognizes participating FGP departments have implemented the standards, as the initiative is not contending with issues related to homogenization of data.

The Directive on Open Government is another example of a CGDI policy (where CGDI was a contributor and early adopter) that is intended to facilitate decisions by policy makers. The Directive's objective is to maximize the release of government information and data, of business value, to support transparency, accountability, citizen engagement, and socio-economic benefits.

Further information on the adoption of operational policies for decision making can be found under Indicator 16.

The Arctic SDI case study conducted as part of the 2015 Assessment identified the use of CGDI components to support decision-making. The project manager indicated that the Coordinated Online Information Network (COIN) is already assisting with water licensing for specific projects through enabling simultaneous consideration of multiple factors and potential impacts in order to conduct thorough and comprehensive assessments. When managed and displayed, the matrix style underpinnings of the CGDI (e.g. discrete raster grids) help facilitate a whole-board perception of the end users – something that has been strengthened through the project.

In the 2013-2014 fiscal year, NRCan released three national geospatial datasets: the National Railway Network (NRWN), the National Road Network (NRN), and the National Hydrographic Network. These datasets, maintained in partnership with provinces and territories, government agencies, and other stakeholders, will support informed decision-making for policy and economic development in natural resources sectors as well as other sectors of the economy. For example, the new Canada Base Map – Transportation web mapping service has been implemented and is currently used extensively by Passport Canada and Defence Research and Development (R&D) Canada's MultiAgency Situational Awareness System.[37] Base map services have been created to provide locational context with an emphasis on transportation networks over which thematic information can be overlaid. Cartography (colour, symbology, etc.) of the base map has been specifically designed so that thematic information will be more prominent than the locational information.[38]

Web analytics indicate the information from these three datasets is being utilized. For example there were 2,193,956 and 2,169,100 downloads from GeoBase (location of the above-named networks) in 2013-14 and 2014-15 respectively (the latter year number reflects 11 months only).[39]

For fiscal year 2013-14, files downloaded overall from the GeoGratis and GeoBase sites increased to a total of 7,056,376, up from the baseline number of 5,495,869 set in 2010-11. This represents an increase of approximately 28% over the last 3 years, or 9% per year, on average. In addition to downloads, NRCan delivers dynamic geospatial information through its Precise Point Positioning (PPP) service, which served 6,751 clients, a 30% increase over the number of clients served in the 2010-11 baseline year.[40] It should be noted that through 11 months of 2014-15 the number of downloads from GeoGratis and GeoBase are tracking lower compared to previous years (5,156,663 downloads).[41]

Other examples of the use of CGDI components was provided in case studies commissioned by GeoConnections:

▪ The first case study describes Parks Canada's activity over 30 years and its need for geospatial data. The case studies highlight that Parks Canada employees develop and use geo-information to help provide the basis upon which Canada's national parks are monitored, managed, planned, understood, funded and recognized internationally. Examples of geospatial data used by Parks Canada includes the following:

  − Parks Canada uses geo-information that ranges from the common national topographic system (NTS) map sheets to digital elevation models, hydrology layers, road networks, park ecology inventories, trail maps, management areas and key species habitats, among others. Agency staff make maps and interpret images from space or air photos to show different types of plants, habitats and landscapes. Staff also use this information to predict how changes will affect the ecosystem, to see how land changes over time, and to assess the home range of key species.
  − Parks Canada will employ information from satellite monitoring to prepare State of the Park reports, generate and revise mandatory management plans for individual parks, and document the extent and impacts of climate variability and change in some northern parks.[42]

▪ A second case study, developed for GeoConnections on the Multi-Agency Situational Awareness System (MASAS) identifies benefits and usage from many stakeholders. MASAS demonstrates a comprehensive implementation of the CGDI "spatial data infrastructure usage" (e.g., policies, standards, technology and framework data) in Canada. Emergency management and response agencies must cooperate and share information; effectively managing crises or disasters requires accessing and disseminating incident information in real time. Several different situational awareness (SA) tools are used across Canada. The ability to connect these different tools for shared SA is critical to improving interoperability and to ensuring efficient and effective responses. The MASAS initiative develops and supports capabilities that enable multiple emergency management and response agencies to share real-time, location-based SA information and alerts. MASAS uses open standards, architecture, policies and interoperable technologies based on national geospatial standards. MASAS aggregates incident information from diverse sources into a consolidated view made available to partners. Information is filtered through a centralized hub. Instead of pushing content to many, contributors publish it once for all. And, instead of

pulling information from many agencies, information is pulled from the hub. MASAS is a system of systems based on standards, which enables each participant to:

− Publish information for other participants to consume;
− View information across agencies in a predictable and reproducible manner, where each agency:
− Controls what they share;
− Decides what information from other agencies is relevant to them; and,
− Uses their existing systems to publish and consume information; and
− Integrate information from external sources into the local emergency operations system.[43] [61]

The hub of MASAS is a software system, hosted on a network of servers designed to allow multiple agencies to access real-time information from the system and feed information into the system, MASAS acts as an information broker. In this role, MASAS enforces a standard for structuring and packaging data to ensure interoperability between agencies. It also acts as information filter, enforcing access rights and levels of information to ensure confidentiality and meet possible security restrictions.

Conclusion

The various case studies funded by GeoConnections and completed as part of this Assessment provide a description of how policies, standards, technology, and framework data are being used to facilitate decision making.   The GeoBase and GeoGratis web portal statistics provide evidence that the Framework Data Components are being downloaded.

Performance Result (d): Linkages to international organizations	
Indicator	2015 Assessment Findings and Result
8: There is promotion/ exchange of experience with international organizations.	**Assessment: Fully Meets Criteria** There is substantial evidence that there has been a continued exchange of Canadian experience with international organizations. Canada has continued as an international leader in providing access to geospatial data, largely as a result of its participation within numerous international geospatial data related organizations, related forums, working groups, and international conferences. Canada's continued commitment to the international geomatics community is evidenced by the production of SDI Manuals for the Americas as well as its continued involvement with the Arctic SDI collaboration.

Analysis and Supporting Evidence

There was substantive evidence of exchange of Canadian experience with international organization in the 2012 Assessment of the CGDI. Canadian Stakeholders were found to be involved in all of the key international geomatics organizations.

Canada continues to hold memberships with a number of international organizations concerned with Geospatial data, including:

- The Global SDI - GeoConnections attending and presenting Standards and Operational Policy Workshop at GSDI 2013 in Ethiopia.[44]
- Open Geospatial Consortium - NRCan is a Technical member with vote and actively participates in technical meetings and committees.[45]
- The World Meteorological Organization – President (Environment Canada).[46]
- Intergovernmental Oceanographic Commission – Member, Department Fisheries and Oceans Canada (DFO).[47]
- UN Committee of Experts on Global Geographic Information Management – Member NRCan.[48]
- Permanent Committee on SDI for the Americas –CP-IDEA member.[49]
- Arctic Council – The Council is a high level intergovernmental forum to provide a means for promoting cooperation, coordination and interaction among the Arctic States, with the involvement of the Arctic Indigenous communities and other Arctic inhabitants on common Arctic issues. Presently chaired by Canada (2013-2015).[50]
- Arctic SDI (Arctic SDI) – Member and Chair (NRCan). [51]
- Centre for Spatial Policy and Law – Member (NRCan).[52]
- Global SDI Association (GSDI) – President (University of New Brunswick); Member (NRCan).[53]
- Group on Earth Observations (GEO) – Member of the Executive Committee (Environment Canada).[54]

- International Hydrographic Organization - Member and Chair of Committees/Sub-Committees, including the Marine SDI, the Transfer Standard Maintenance and Applications Development, and the Standing Committee on Undersea Feature Names (DFO).[55]
- International Organization for Standardization (ISO) – Member and Chair, ISO/TC211 Canada (NRCan), Member (DFO)
- International Maritime Organization – Member (DFO).[56]
- UN Committee on Global Geospatial Information Management: Americas (UN-GGIM: Americas) – Executive Board Member, North American Vocal (NRCan).[57]
- UN Committee on the Peaceful Uses of Outer Space (UN-COPUOUS) – Member CSA.[58]
- UN Group of Experts on Geographical Names (UNGEGN) – Member; past-Chair (2011-12) (NRCan).[59]

Canada also works closely with the United States Federal Geographic Data Committee (FGDC) supported by the U.S. Geological Survey (USGS), and the Infrastructure for Spatial Information in the European Community (INSPIRE).

In addition to participation with the above listed international organizations, Canada through GeoConnections, led the research development of the SDI Manual for the Americas. The Manual is part of Canada's contribution to the 2009 – 2013 work plan of CP-IDEA. The objectives of the Manual are threefold: to provide guidance on planning for and implementing SDIs in CP-IDEA member countries, to share international and Americas good practices in SDI implementation and to allow CP-IDEA members to learn from each other's experiences.[60]

Conclusion

Canada has continued as an international leader in providing access to geospatial data, largely as a result of its participation within numerous international geospatial data related organizations as well as related forums, working groups and international conferences. Canada's continued commitment to the international geomatics community is evidenced by the production of SDI Manuals for the Americas as well as its continued involvement with the Arctic SDI.

Performance Result (e): Has instituted mechanisms and processes to monitor the adoption and implementation of the CGDI and report on activities, status and achievements	
Indicator	2015 Assessment Findings and Result
9: The identified leader/coordinating body monitors and reports on SDI activities including: - Development and use of operational policy resources - Development and use of standards and specifications	Assessment: Partially Meets Criteria – Gaps Evident Although some monitoring and reporting is being conducted, there is no formal mechanism in place that allows for regular and comparative monitoring of actual performance of each of the CGDI components in a timely manner. The decentralized model employed in Canada creates challenges in the ability of one leading/coordinating body to accomplish this independently.
- Availability of standards-based technologies - Development and implementation of Framework data	

Analysis and Supporting Evidence

According to the 2012 Assessment of the CGDI, monitoring and reporting on SDI activity was limited to GeoConnections Annual Reports from 2005-06 through 2009-10. Annual reports are no longer produced by GeoConnections, but rather specific activities are consolidated in NRCan's annual departmental reporting. The 2012 Assessment also found that there were no formal mechanisms in place for monitoring, with the exception of Treasury Board Secretariat's (TBS's) monitoring of compliance of the federal department and agencies with TBS standards.

In addition to annual reporting, the following evaluations were completed during the GeoConnections Phase I and Phase II for specific components of the overall program:[61]

- GeoConnections Phase II (2010);
- Survey of GeoConnections Stakeholders: Methodology and Implementation Plan (2009);
- CGDI Sustainability Research Exercise (2008-2009);
- Access Component of the GeoConnections Program (2005);
- GeoInnovations Component (2005);
- Framework Data/GeoBase Component (2005);
- Atlas Component (2005); and,
- Sustainable Communities Initiative of the GeoConnections Program - Mid-term Evaluation 1999 to 2003 (2003).

This Performance Assessment and its predecessor, the 2012 Assessment, further demonstrate that the coordinating body monitors and reports on SDI activities and the CGDI's progress against expected outcomes.

NRCan is monitoring activities on its data portals. According to the NRCan Departmental Performance Report for 2013-14, "NRCan's open data portal, GeoGratis, continues to be monitored and reported on regularly using a series of web analysis tools to provide a better understanding of the current consumption of our geospatial datasets, information and web services. The Department has produced client profile analysis and reports on web traffic and visitor behaviour for GeoGratis and two other major portals: GeoBase and National Earth Observation Data Framework." Additional web analytics information is provided in the analysis under Indicator 7 in this report.

NRCan is also monitoring its geodiscover.cgdi.ca portal and Catalog Services for the Web (CSW) through providing a "health status" on each of the services listed in the catalogue. Catalogue services support the ability to publish and search collections of descriptive information (metadata) for data, services, and related information objects. Catalogue services are required to support the discovery and binding to registered information resources within an information community. Catalogue services support the use of one of several identified query languages to find and return results using well-known content models (metadata schemas) and encodings. As of April 24, 2015 there are 199 registered services being monitored. A health check page tracks availability of services, whether they are "up" or "down" and when the data was last checked and when it will be checked next.

Another example of monitoring is the recent work undertaken to inventory web services for the Arctic SDI. The growth of Arctic SDI is predicated on a diversity of web services, which provide a wealth of different data types not strictly predicated on framework data. Since many of these web services are international, their discovery is enabled via a hybrid of web catalogs and internet searches. The results identified 93 web services accessing 6,191 data layers (at April 24, 2015). The 93 working web services are mainly web map services (82) and web feature service (11) standard interfaces across international, national and private sector web services. See Appendix H for the inventory.

Internationally, NRCan's Canada Centre for Mapping and Earth Observation with input from the FCGEO has submitted a country report to the UN in 2014. The report describes Geospatial Information Management in Canada and recent developments related to Canada's SDI in areas including:

- Governance;
- Legal and Policy Context;
- Strategic Plan;
- Data collection, Generation and Production;
- Data Publishing and Sharing;
- Use of Geospatial Data, information and Applications; and
- Capacity Development and International Engagement. [62]

Conclusion

Although some monitoring and reporting are being conducted, there is no formal comprehensive process in place that allows for regular and comparative monitoring of actual results of the CGDI components in a timely manner.

Overall Component Conclusion - Collaboration

The leaders and coordinating bodies continue to evolve and drive the CGDI at a number of levels in Canada across public, private and academic sectors through the commitment of both in-kind and financial resources to the CGDI. A Pan-Canadian Geomatics Strategy has been developed that presents an updated vision and mission for the geomatics sector, defines future roles and responsibilities of stakeholders and is aligned with stakeholder priorities. Formalized networks and communications

and outreach activities continue to engage direct CGDI stakeholders allowing inclusive contributions to CGDI development and sustainability as well as the use of CGDI components to facilitate decision-making. Canada has continued to participate in numerous international geospatial data related organizations and has continued its commitment to exchanging and sharing experiences internationally.

The decentralized and volunteer model employed in Canada creates challenges in enabling formal monitoring and reporting at the overarching CGDI systems-level. In addition, general outreach and promotion of the CGDI with non-traditional users and the general public is limited and has been identified as a gap in a number of documents including the recent Pan-Canadian Geomatics Strategy and the GeoConnections III Communications Strategy. .

Overall, the CGDI Collaboration component indicators have largely been met demonstrating increased performance since 2012 in two areas and stability across the remaining indicators. Exhibit 3 depicts the comparison of 2015 results to those of the 2012 indicator results with applicable indicator mapping indicated within each column.

Exhibit 3
Results of CGDI Collaboration Component

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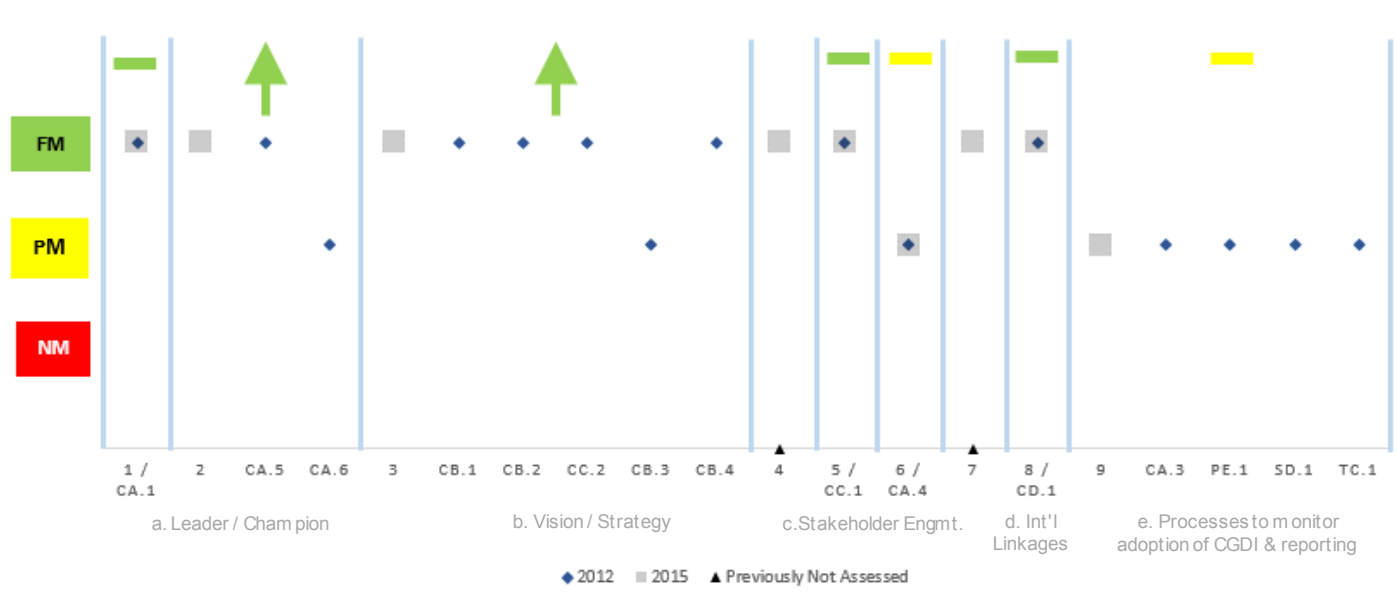
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Chapter 4: Assessment of CGDI Component: Framework Data

The outcome measure being assessed under the Framework Data component is defined in the Assessment Framework as:

Framework data, the core of the CGDI, is the common, up-to-date, and maintained base of quality geospatial data for all of Canada, which provides context and reference to physical features and other types of information linked to geography. These datasets are the base mapping layers required to develop applications, and are freely available for reuse. Framework data is the foundation upon which location-based information becomes spatially relevant to users.

Four performance results areas with four corresponding indicators were assessed under the Framework Data component.

Performance Result (a): Data themes are available that are current and complete with accompanying documentation	
Indicator	**2015 Assessment Findings and Result**
30. Completion of a pre-defined table of data themes to include information on the: existence of data model, existence of metadata, jurisdictional coverage (y/n), existence of mechanisms for searching, data accessible via download (y/n), data accessible via web services (y/n), access policies / licensing restrictions available (y/n), dissemination / publication date, listing of available scales, listing of dissemination portal(s), if applicable Canada's official languages policies are followed.	**Assessment: Fully Meets Criteria** Robust availability of data across data themes was identified in 2012. It was found that continuous contributions are being made by federal government departments and the pre-defined table of data themes has been updated. However, there is currently limited information available to update the table of data themes and incremental additions or changes that may have taken place since the 2012 Assessment across provinces and municipalities.

Analysis and Supporting Evidence

There was considerable evidence that data themes were available that were current and complete with accompanying documentation according to the 2012 Assessment of the CGDI.

The 2012 Assessment found that within Canada, and within the CGDI, the following federal government departments and provincial governments produce and update spatial data:

- Federal Government: Agriculture and Agri-Food Canada; Elections Canada; Environment Canada (EC); Fisheries and Oceans Canada; Natural Resources Canada; Statistics Canada; Indian and Northern Affairs Canada; and Public Works and Government Services Canada (PWGSC).
- Provincial/Territorial Governments: British Columbia; Alberta; Saskatchewan; Manitoba; Ontario; Quebec; New Brunswick; Nova Scotia; Prince Edward Island; Newfoundland and Labrador; Yukon; Northwest Territories; and Nunavut.

In addition, the following types of organizations also produced and maintained spatial data:

- Municipal and regional governments;
- Academic institutions;
- Non-governmental organizations;
- Private sector companies (e.g., geomatics companies, resource extraction companies, transportation companies, etc.); and,
- Aboriginal communities.

Data themes are continually being updated. For example, NRCan's GeoGratis application was improved to provide easier access to 182,000 Earth Sciences web resources (datasets, maps, publications). NRCan also published 426 new publications via GeoGratis in 2013-14, including 244 open files, 124 maps, 20 research documents and general information products.[63]

Other work completed by NRCan included the digitizing and re-releasing to the public an additional 736 publications and updated datasets pertaining to the National Road Network, National Hydro Network, NRWN, and Atlas of Canada. [64]

Additionally, data linked to certain data themes are now accessible via download in British Columbia (B.C.), which is new since 2012. For example, B.C. now permits geographical names and digital elevation data to be downloaded.

Updates to the table of data themes is provided in Appendix G.

Conclusion

The data themes kept current and available as of the 2012 Assessment still exist today. There does not appear to be any reduction in mobility in terms of what is available.

Performance Result (b): Framework Data themes are able to be integrated.	
Indicator	**2015 Assessment Findings and Result**
31. Evidence that spatial data themes are being integrated: ▪ Via layering or fully integrated via overlay where new data layers might be produced. ▪ Where multiple scales are being accessed and integrated within the same application.	**Assessment: Fully Meets Criteria** There is continued evidence that spatial data themes are being integrated by users of geospatial information.

Analysis and Supporting Evidence

The 2012 Assessment presented eight specific examples of how spatial data themes were being integrated and concluded this represented 'considerable evidence' of spatial data themes integration.

The eight data themes listed in 2012 as evidence that spatial data are being integrated are still in use today:

- Multi-Agency Situational Awareness System
- National Forest Information System
- Toporama (Atlas of Canada)
- AgriMap (Manitoba)
- Geo Portal for Eeyou Istchee
- MapSherpa
- Radio Mobile
- Online Injury Atlas for Ontario

In addition, Parks Canada is making particular use of these data themes to support decision-making, as referenced under indicator seven previously.

This evidence is further bolstered by the new Canada Base Map. The Canada Base Map is a transportation web mapping service that has been implemented and is currently used extensively by Passport Canada and Defence R&D Canada's Multi-Agency Situational Awareness System. These organizations have found Canada Base Map to be of particular use/value to them as a result of three recently developed networks contained therein - NRWN, National Road Network and National Hydrographic Network. [65]

A case study commissioned by GeoConnections on the North American Environmental Atlas, which permits users to view North American environmental maps and geo-referenced environmental data, reported that some of these maps and the data layers in them were developed in cooperation with other Commission for Environmental Co-Operation (CEC) projects, while the national atlas agencies contributed other layers. All completed data layers and associated metadata are shared with the public through the North American Environmental Atlas webpages at http://www.cec.org/naatlas/.

In 2003 the CEC, the Atlas of Canada, INEGI and USGS agreed to partner to compile a new harmonized set of framework data (also known as base layers) and a new paper map for North America. First, the map was compiled in partnership with the national atlas programs in Canada (NRCan), Mexico (INEGI-Instituto Nacional de Estadistica y Geografia) and the United States (USGS-United States Geological Survey). Second, it was accompanied by digital frameworks (or base maps) that the three countries had harmonized. These frameworks are available on-line with accompanying metadata. Framework data layers or base map layers include bathymetry, elevation, shaded relief, glaciers and sea ice, rivers and lakes, watersheds, major roads, political boundaries, population density, populated places, and railroads.

Together the three agencies prepared the base layers and additional map layers for specific themes (e.g. land cover, watersheds, ecoregions) both in hard copy and in digital form, to serve as a platform for other data. The layers provide a consistent, harmonized geographic data collection, known as the North American Atlas Framework, for displaying and analyzing thematic data at the North American scale.

Conclusion

There is continued evidence that spatial data themes are being integrated by users of geospatial information.

Performance Result (c): There are mechanisms in place for the development and maintenance of national framework data themes	
Indicator	**2015 Assessment Findings and Result**
32. Evidence of data sharing agreements between data suppliers (y/n).List all that apply. i.e., Memoranda of Understanding, data sharing agreements, licensing agreements, Service Level Agreements.	**Assessment: Fully Meets Criteria** There are formal agreements for the sharing of data between Canadian federal and provincial jurisdictions. There are also formal agreements supporting data sharing at the international level.

Analysis and Supporting Evidence

The 2012 Assessment of the CGDI found there was strong evidence of data sharing between suppliers. Key evidence presented was the Geomatics Accord supporting federal-provincial-territorial data sharing. The federal, provincial and territorial governments are the key organizations for the development and maintenance of national framework data themes.

The Geomatics Accords has been renewed for 2014-2019 and Canada participates in the G7/G8 Open Data Charter.

One available example of such sharing is a referenced MOU on inter-jurisdictional data sharing and exchange with the Department of National Defence to support national defence and security, emergency preparedness and response to man-made or natural disasters.[66]

The North American Environmental Atlas case study provides evidence of data sharing between suppliers. In October 2006, the national atlas agencies; the governments of Canada, the U.S.A. and Mexico; and the CEC Secretariat formalized their working relationship by creating the North American Atlas Coordination Group (NAACG). From 2007–2010 the CEC funded a project called "Mapping North American Environmental Issues" to enable users to view North American environmental information on maps. This project established the North American Environmental Atlas, an interactive mapping tool to research, analyze and

manage environmental issues in Canada, the U.S.A. and Mexico. In this project, each country controlled the quality of the base layer geometry and attributes; in other words, each took responsibility for its own data. All four partners monitored the quality of the entire printed map, as well as their digital data. While the data are shared and meant to be viewed as one data set (hence, for example, the printed map showed all three countries in the same colour), each partner retained responsibility for, and ownership of, its own data.[67]

The Arctic SDI also has data sharing arrangements in place to support the eight national mapping agencies in their collaboration work. The MOU supporting the Arctic SDI includes an understanding that the participants may include the exchange of cartographic and other necessary information.

Conclusion

There are formal agreements for the sharing of data between Canadian federal and provincial jurisdictions. There are also formal agreements supporting data sharing at the international level.

Performance Result (c): There are mechanisms in place for the development and maintenance of national framework data themes	
Indicator	2015 Assessment Findings and Result
33. Evidence of coordinated data collection, data quality control and data maintenance / updating processes (y/n). Elaborate/list all pertinent processes.	**Assessment: Fully Meets Criteria** In relation to framework data, mechanisms have been developed to coordinate data collection, quality control and maintenance. Roles and responsibilities have been identified in the Geomatics Accord.

Analysis and Supporting Evidence

The 2012 Assessment of the CGDI found that GeoBase was evidence of a coordinated data collection, data quality control and data maintenance/updating process. It was found that GeoBase falls within the framework of the Geomatics Accord where federal, provincial, and territorial governments work together cooperatively to help ensure the availability of quality digital base data for Canada, including the provision and maintenance/updating of databases. GeoBase partners, such as the federal and provincial/territorial governments, are involved in different levels of the data production process such as project funding, sharing of source data or by working on data collection and data processing.

In terms of GeoBase policies, the following were noted:

▪ The data custodians, as a final step prior to loading a particular dataset into GeoBase, are required to provide a letter to the chair of CCOG confirming their release of the data for public distribution and also confirming their commitment to the maintenance of the data according to the agreed upon schedule.

The renewed Canadian Geomatics Accord, indicates that the federal government has the responsibility of facilitating the discovery of and access to federal initiatives and links to similar provincial and territorial initiatives.[68]

The GeoBase portal has merged with the GeoGratis portal where NRCan is responsible for assuring coordinated availability of data for end users.

GeoConnections has supported special projects for coordinated data collection as well. A non-repayable contribution agreement was signed with Esri Canada Limited on May 17. 2012 for funding of the project called GeoFoundation Exchange (GFX) Prototype. The objective of the project was to develop an open exchange infrastructure to create and maintain a government-centric National Web Basemap. The potential of GFX is to offer more current data based on near real-time data feeds from trusted sources, e.g. municipal governments. This represents an evolution of previous coordinated data collection efforts such as GeoBase which aggregates and harmonizes municipal data from Provinces which could take a number of months for updates. The project included feeding data from approximately 100 participating organizations (with a goal of increasing that number) and undertook peer review for quality and demonstrated interoperability with the topographic data

management environment maintained by NRCan's Centre for Topographic Information. The Prototype is intended to support a comprehensive and authoritative presentation of Canada's geographic knowledge for Canadians. Projected outcomes for the project were: standard data models for seven essential base layers (leveraging GeoBase models) for use by municipal, provincial and federal project partners; creation of the GeoFoundation Exchange technology infrastructure to support the timely collection, maintenance and exchange of basemap data; a mechanism to allow users to enter observations about the stat stores in the GFX; automated tools to update the GFX core database from partner data (Esri and open data providers); and communications and outreach to encourage additional users of the GFX at the data provider and consumer level.[69] The GFX has employed a number of CGDI standards and policies including utilizing a set of automated quality control procedures as data comes in, along with processes for issue resolution with the data contributor and a feedback application to use "crowd sourcing" observations against the data contributed.

The FGP is also organized to coordinate efforts on data collection, quality control and maintenance. The majority of activity currently taking place is the organization and categorization of data within the platform according to the common standards and policies that have been defined and adopted.

Conclusion

In relation to framework data, mechanisms have been developed to coordinate data collection, quality control and maintenance. Roles and responsibilities have been identified in the Geomatics Accord.

Overall Component Conclusion – Framework Data

There is availability of data across data themes and continuous contributions are being made by federal and provincial governments. Formal agreements for the sharing of data between Canadian federal and provincial jurisdictions continue to be in place that include mechanisms to coordinate data collection, quality control and maintenance. Additionally, agreements to support data sharing at the international level have been established and maintained. Efforts in this component area are allowing for the integration of geospatial information by data users.

The CGDI Framework Data component indicators have been fully met demonstrating stable performance across all indicator areas. Exhibit 4 depicts the comparison of 2015 results to that of the 2012 indicator results with applicable indicator mapping indicated within each column.

Exhibit 4
Results of CGDI Framework Data Component
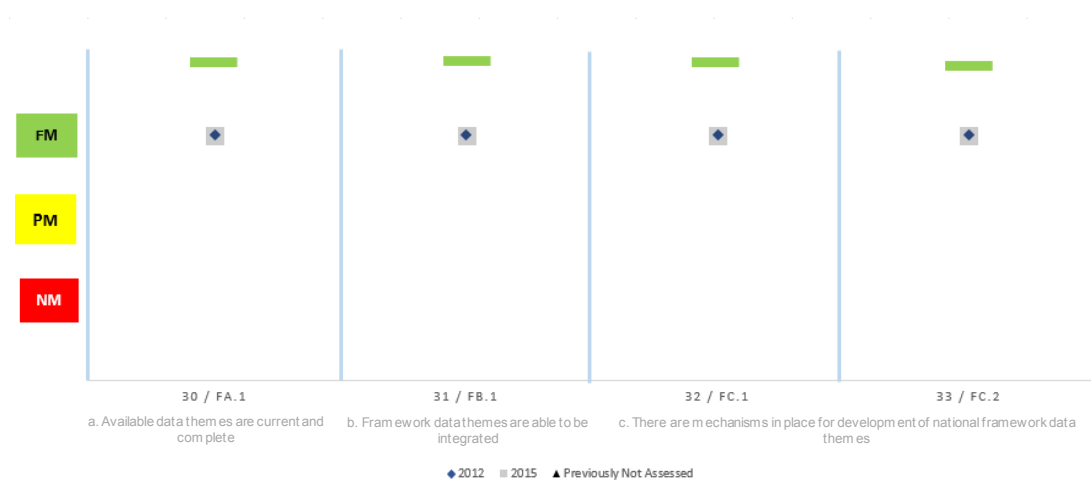
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Chapter 5: Assessment of CGDI Component: Operational Policies

The outcome measure being assessed under the Operational Policies component is defined in the Assessment Framework as:

Operational policies are essential to solving barriers and enabling the effective and efficient interoperable exchange of location-based information. These data policies address topics related to the lifecycle of location-based data (i.e. collection, management, dissemination, use) and make issues such as data access, quality, ownership, and integrity, easier to manage.

Four performance results areas with eight corresponding indicators were assessed under the Operational Policies component.

Performance Result (a): There are Canadian policy resources to support SDI interoperability	
Indicator	**2015 Assessment Findings and Result**
10: There are operational policy guidance and best practices that address: ▪ Licensing; ▪ Privacy; ▪ Volunteered GI; ▪ Intellectual property (IP) /copyright; ▪ Archiving and preservation of data; and ▪ Other elements.	**Assessment: Partially Meets Criteria – Gaps Evident** There is evidence of continued policy development that addresses previously identified user needs and policy gaps identified in the 2012 Assessment of the CGDI. However, policy gaps still exist regarding, data stewardship and data integration.

Analysis and Supporting Evidence

The 2012 Assessment of the CGDI found that policy resources had been developed. However an operational policies needs analysis completed by Hickling Arthurs Low (HAL) in March 2011 identified the following policy gaps:

▪ Archiving and Preservation	▪ Data integration
▪ Data quality and trustworthiness	▪ Volunteer geographic information (VGI) and
▪ Data Stewardship	▪ Cloud computing (CC)

The 2012 Assessment of the CGDI also report that during 2012, GeoConnections funded a number of operational policy studies and best practice reports, including:

- A Guide to Sharing Geospatial Data (2011).
- Volunteered Geographic Information (VGI) Primer (2012).
- Primer on Policy Implications of CC (2012).
- Report on Legislative Barriers to the Release of Geospatial Data (2012).
- A CGDI Best Practices Master Guide (2012).
- Final Report: Geospatial Operational Policy Roadmap Research 2012-2015 (2012). This report goes further than the HAL, March 31, 2011 CGDI Operational Policy Needs Analysis: Final Report, also identifying gaps and areas for further research including:

  − Guidance on geospatial data archiving and preservation.
  − Data quality and trustworthiness is cited repeatedly as both a user requirement and a deliverable of the CGDI. While this topic is related primarily to the policies, practices and available resources of data producers and, in principle, beyond the scope of operational policy work, guidance on how to assess the quality and trustworthiness of geospatial data also appears to be required.

- The principle of data stewardship is associated with the maintenance of data quality and trustworthiness. Although some work has been undertaken to assign "stewardship" roles in cooperative initiatives such as GeoBase, no formal rules or procedures for assigning such roles have been formulated or adopted. An operational policy on data stewardship would address this gap and contribute to a higher level of trust in the use of data provided by formally recognized stewards.
- Data integration issues are still prevalent in the CGDI stakeholder community. There is an apparent need for a more technical "how to" guide that addresses challenges with differing data standards and formats, data quality differences, inadequate metadata, and poor Web services and portal functionality.
- Although Initial Primer documents have been developed dealing with issues surrounding the use of volunteered geographic information (VGI) approaches and CC solutions. More focused "how to" guides will also be required.

More recently, the GeoConnections have funded the following operational policy studies and primers:

- Free and Open Source Software Licensing Primer.   This primer provides CGDI stakeholders with information on how to adopt, incorporate and use free and open source software according to varying licensing terms and conditions, and how to distribute (i.e., license) a new or modified software resource as free and open source software.[70]

- User's Guide on the Classification of Geospatial Information Policy Instruments. This guide describes a geospatial policy classification framework that was developed to facilitate the organization and retrieval of relevant policies. The objective of the classification framework is to give managers of geospatial data the ability to rapidly identify the relevant policies for management and dissemination of their data in order to increase compliance with those policies.[71]

- Geospatial Data Preservation Primer. This primer will provide CGDI stakeholders with information on how to incorporate archiving and preservation considerations into an effective data management process that covers the entire life cycle (DCC, 2013) (LAC, 2006) of their geospatial data assets (i.e., creation and receipt, distribution, use, maintenance, and disposition). It is intended to inform CGDI stakeholders on the importance of long term data preservation, and provide them with the information and tools required to make policy decisions for creating an archives and preserving digital geospatial data. [72]

  Prior to this primer, there was no commonly accepted guidance for CGDI stakeholders wishing or mandated to preserve their geospatial data assets for long-term access and use. More specifically, there is little or no guidance available to inform operational policy decisions on how to manage, preserve and provide access to a digital geospatial data collection. This primer meets a significant gap in the operational policy coverage for the CGDI.

- Although not finalized at the time of this report, GeoConnections has funded the development of a Geospatial Data Quality Guide. This guide explains how to manage geospatial data quality and risks of usage at every phase of a data product life-cycle: design, implementation, production, delivery and usage. It explains the geospatial data evaluation process as presented in the ISO 19157 Geospatial information – Data quality international standard. It also presents the general risk management framework of the ISO 31000 Risk management – Principles and guidelines international standard along with numerous examples related to the management of risks of inappropriate usage of geospatial data.[73]

- Additional work is currently underway by GeoConnections on operational policy and standards guidance including a Standards User Guide, Geosemantic Interoperability Backgrounder, Open Government Licence User Guide, and a "Big Data" Backgrounder.

In addition, on June 18, 2013 Canada and the other G7/G8 leaders adopted the open data charter which established open data principles for all member countries, and called for specific commitments to release core public sector data. Simultaneously the Open Government License was released on June 18, 2013.[74]

The Treasury Board of Canada has issued a Directive on Open Government that took effect on October 9, 2014. The objective of the directive is 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. This directive instructs all departments that they are required to maximize the release of GoC data and open information under the open government license and ensure that open data and open information is released in accessible and reusable formats via GoC websites and services designated by the Treasury Board of Canada Secretariat. [75]

The recently developed operational policy addresses policy gaps concerning archiving and data preservation and legal issues in regards to licensing and other barriers. Policy gaps regarding data stewardship and data integration have not yet been addressed.

Conclusion

There is evidence of continued policy development that addresses previously identified user needs and policy gaps as reported in the 2012 Assessment of the CGDI. However, policy gaps still exist regarding, data stewardship and data integration.

Performance Result (a): There are Canadian policy resources to support SDI interoperability	
Indicator	**2015 Assessment Findings and Result**
11: There are federal open data policies.	**Assessment: Fully Meets Criteria** The development of the Open Government Directive, Open Government License and the new www.open.canada.ca website that promotes and communicates recent developments of Canada's open government policies and action plan builds on Canada's commitment to becoming a more open, inclusive and accessible government is clear evidence of a continued federal open data policy.

Analysis and Supporting Evidence

The GoC has been working towards making data that is not sensitive in nature broadly available in reusable formats, from the passing of access to information legislation over 30 years ago to current open government and proactive disclosure activities. The GoC has worked to provide transparency on federal operations to enable Canadians to hold their government accountable.

The 2012 Assessment of the CGDI reported that, in March 2011, the Canada Open Data Portal was announced and created. The federal open data portal (www.data.gc.ca) provided an entry point to 20 different departments which provided access to over 273,211 data sets of which 260,296 datasets were in the geomatics area as of June 11, 2012.

In April 2012, Canada joined the Open Government Partnership (OGP) and remains committed to the principles of the OGP's Open Government Declaration. Canada's membership in the OGP provides key opportunities to advance the open government agenda, share and learn from international best practices, and collaborate with OGP colleagues on solutions that benefit citizens globally. As co-chair of the OGP's Open Data Working Group, Canada works with governments and civil society organizations defining shared principles for open data, including the use of common standards that will help align open data services around the world.[76]

On June 18, 2013, Canada and the other G7/G8 leaders adopted the open data charter which established open data principles for all member countries, and called for specific commitments to release core public sector data. Simultaneously, the Open Government License was released on June 18, 2013.[77]

The portal www.data.gc.ca migrated to the open data portal www.open.canada.ca. In the fall of 2014 the open data portal search engine for datasets belonging to 41 participating Canadian federal department and agencies was launched. On March 12, 2015, a total of 244,037 datasets are available from this portal, of which 235,955 (97%) are Geo Data originating primarily from GeoBase and GeoGratis.[78]

As stated previously, the Treasury Board of Canada issued a Directive on Open Government that took effect on October 9, 2014. The objective of the directive is 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. This directive instructs all departments that they are required to maximize the release of GoC data and open information under the open government license and ensure that open data and open information is released in accessible and reusable formats via GoC websites and services designated by the Treasury Board of Canada Secretariat. [79]

Natural Resources Canada contributes numerous information files and publications as part of the Open Government Policy. In 2012-13, inventory included 260,041 Open Information files such as maps and publications, and 70,137 Open Data files such as machine-readable datasets and tables, for a total of 330,178 products.[80]

Conclusion

The development of the Open Government Directive, Open Government License and the new www.open.canada.ca website that promotes and communicates recent development of Canada's open government policies and action plan builds on Canada's commitment to becoming a more open, inclusive and accessible government is clear evidence of a continued federal open data policy.

Performance Result (a): There are Canadian policy resources to support SDI interoperability	
Indicator	**2015 Assessment Findings and Result**
12: There are open data policies within other non-federal jurisdictions.	**Assessment: Fully Meets Criteria** The GoC has taken the lead to promote and encourage all governments in Canada to adopt an open data policy. An open government toolkit of key resources created by the GoC is available to help establish and maintain an open government program. There has been progress in the adoption of open data policy by non-federal governments: five provincial governments have adopted the Open Government Licence, of which three had no or limited open data initiatives at the time of the 2012 Assessment of the CGDI. There is also an increase in the number of municipalities now adopting an open data policy, increasing from 17 to 49.

Analysis and Supporting Evidence

When the 2012 Assessment of the CGDI was conducted, a number of provincial/territorial/municipal jurisdiction were in the early stages of establishing open data initiatives. At that time, most provinces (and some Canadian municipalities) did provide some open access to data.

The GoC is encouraging and supporting other non-federal jurisdictions to adopt an open government policy through its Canada's Action plan on Open Government 2014-16. In section B, Open Data – Open Data without Borders, the plan focuses on deepening the collaboration on open data between Canadian governments at all levels and with the private sector. The objective of these commitments is to harmonize open data services in Canada and encourage the reuse and commercialization of open data.

Provincial governments that have adopted an open government policy and license are summarized in the table below:

Provincial/Territorial Government	Open data/ initiative website	Comparison to 2012 Assessment of the CGDI
Government of Ontario	Ontario open data website http://www.ontario.ca/government/ontario-open-data	The Land Information Ontario (LIO) is now included in the Ontario open data portal, providing geospatial data. The Ministry of Natural Resources (MNR) provides datasets through an Unrestricted Use License at no cost.
Government of Québec	Données ouvertes (french only) http://www.donnees.gouv.qc.ca/?node=/accueil	There was no open government portal, and all data was sold at cost by Geoboutique Quebec.

Provincial/Territorial Government	Open data/ initiative website	Comparison to 2012 Assessment of the CGDI
Government of Newfoundland and Labrador	Open Data Newfoundland and Labrador http://opendata.gov.nl.ca/	No change. Limited data was available for free download. Digital maps were available at cost.
Government of Alberta	Alberta Open Data Portal http://data.alberta.ca/	Geodiscovery Alberta previously only provided a limited number of datasets for free download. The mapping was available at Atlis.com. All of the data products available at ATLIS are now under the open government policy and license.
Government of British Columbia	DataBC http://www.data.gov.bc.ca/	DataBC continues to be the open data portal for BC.

The following are open data initiatives that have been undertaken by other provincial and territorial government that have yet to adopt an open data policy.

Provincial/ Territorial Government	Open data/ initiative website	Comparison to 2012 Assessment of the CGDI
Nunavut Geoscience	Canada-Nunavut Geoscience Office (NGO) http://cngo.ca/	In 2012 there were no open data initiatives or licenses evident. Now, NGO publications and data can be downloaded, and there is open data license and policy information.
Northwest Territories Geoscience and Northwest Territories Center for Geomatics	Northwest territories geoscience Office http://www.nwtgeoscience.ca/google_earth/ Center for Geomatics http://www.geomatics.gov.nt.ca/ NWT discovery Portal http://nwtdiscoveryportal.enr.gov.nt.ca/geoportal/catalog/main/home.page	Consistent with the 2012 Assessment of the CGDI, no open data policy or licensing policy is evident. Terms of use are as follows: "The material on this web site is covered by the provisions of the Copyright Act, and by Canadian laws, policies, regulations and international agreements. Material may not be used or reproduced for commercial purposes without the prior written consent arranged by the publisher of the material. If it is reproduced or redistributed for non-commercial purposes, copyright must be appropriately acknowledged."
Nova Scotia	GeoNova http://www.novascotia.ca/geonova/home/default.asp	Consistent with the 2012 Assessment of the CGDI, no open data initiative exists.

Provincial/ Territorial Government	Open data/ initiative website	Comparison to 2012 Assessment of the CGDI
Manitoba Land Initiative (MLI)	MLI http://mli2.gov.mb.ca/	Consistent with the 2012 Assessment of the CGDI, no open data policy exists. However, open data is present, as "the government of Manitoba says it was the first in Canada to make all its publicly funded geospatial data freely available, without any licensing terms, to government, businesses and citizens."
Geomatics Yukon	Geomatics Yukon http://www.geomaticsyukon.ca/	Consistent with the 2012 Assessment of the CGDI, no open data initiative exists. Two directories exist based on their licence status: ▪ Public – all imagery contained in this directory is publicly accessible and can be shared with the public; ▪ Internal – all imagery contained in this directory is licenced to the Yukon Government and can only be used internally. Data Custodians (defined in Corporate SDI Governance) have ultimate authority on access. Access privileges must conform to Access to Information and Protection of Privacy (ATIPP) legislation, copyright, sensitivity issues, etc.
GeoNB	GeoNB Portal http://www.snb.ca/geonb1/e/index-E.asp	Consistent with the 2012 Assessment of the CGDI, data license is available through Service New Brunswick. No formal open data initiative exists, but GeoNB has an "Open Development" principle.
Geographic Information for PEI	GIS Data layers: Geographic Information for PEIhttp://www.gov.pe.ca/gis/	Consistent with the 2012 Assessment of the CGDI, there is no open data initiative. General terms and conditions under which GIS data will be provided is reflected in the License Agreement for GIS Data.
GeoSask	GeoSask https://www.geosask.ca/Portal/	Consistent with the Assessment of the CGDI, there is no open data initiative. All unrestricted data provided by GeoSask is free to use and download, however a licence is required for restricted data.

The above table shows that Newfoundland and Labrador, Quebec, Ontario, Alberta and BC have adopted open government data policies. All other provinces and territories have open data initiatives, with the exception of Nova Scotia and Nunavut. Compared to the open data status reported in the 2012 Assessment of the CGDI, there has been progress. The Government of Quebec did not have any open data available, and Alberta and Newfoundland and Labrador had limited open data available. This is clear progress for these three provinces. Ontario and BC already had an open data initiative and all other provinces' and territories' open data status is consistent with the 2012 Assessment of the CGDI.

Additionally, many municipal governments have adopted open data policies. The Open Government website lists a total of 49 municipalities that have adopted an open data policy, whereas the 2012 Assessment of the CGDI listed only 17 municipalities that had launched open data initiatives.[81] The Open Government website also provides valuable information under a section entitled Open Government Tool Kit. The toolkit has key resources created by the GoC to help establish and maintain an Open Government program, which include:

- Canada Action Plan on Open Government, to find out more about Canada's progress to date on open government, as well as information about commitments Canada has made to improving open government both at home and with its international partners.
- Open Data 101, to learn the basics of Open Data.
- Open Government FAQs.
- CKAN on GitHub. CKAN is an open-source data management system, is free to download and use, and is what the GoC uses to power its own open data portal.
- Data Validation Tool on GitHub.

Conclusion

The GoC has taken the lead to promote and encourage all governments in Canada to adopt an open data policy. An open government toolkit of key resources created by the GoC is available to help establish and maintain an open government program. There has been progress in the adoption of open data policies by non-federal governments: five provincial governments have adopted the Open Government Licence, of which three had no or limited open data initiatives at the time of the 2012 Assessment of the CGDI. There is also an increase in the number of municipalities now adopting an open data policy, increasing from 17 to 49.

Performance Result (a): There are Canadian policy resources to support SDI interoperability	
Indicator	**2015 Assessment Findings and Result**
13: There are data sharing arrangements other than open data policies.	**Assessment: Partially Meets Criteria – Limited Information Available** Consistent with the 2012 Assessment of the CGDI, there is limited information readily available regarding data sharing agreements other than open data. Outside the international, federal and jurisdictional data sharing arrangements found such as through the CCOG, other examples are not readily available for assessment due to the distributed nature of the CGDI stakeholders.

Analysis and Supporting Evidence

The 2012 Assessment of the CGDI provided examples of data sharing arrangements other than the open data policies with only a few references. Examples were provided from The Association of Canadian Map Libraries and Archives including reference to university portals and resources that provide licensed access to geospatial data for students and faculty. One provincial example was included for Ontario on the Ontario Geospatial Data Exchange (OGDE). The OGDE is a community of organizations that share and use digital geographic data about Ontario. The OGDE allows organizations to voluntarily share data at no cost through standard licence agreements, a metadata directory and a data warehouse.[82]

At the national level, the CCOG coordinates inter-jurisdictional cooperation through the development of the renewed Canadian Geomatics Accord. The Accord contains the framework to allow federal, provincial and territorial government agencies involved in geomatics to collaborate and provide support for geomatics initiatives and focus their efforts on more efficient data collection, distribution, and maintenance. GeoBase is another example of a framework data sharing and development agreement between the Federal, Provincial and Territorial governments.

One current example of data sharing arrangements found was through The North American Environmental Atlas. In October 2006, the national atlas agencies - the governments of Canada, the U.S.A. and Mexico - and the CEC Secretariat formalized their working relationship by creating the North American Atlas Coordination Group (NAACG). From 2007–2010, the CEC funded a project called "Mapping North American Environmental Issues" to enable users to view North American environmental information on maps. This project established the North American Environmental Atlas, an interactive mapping tool to research, analyze and manage environmental issues in Canada, the U.S.A. and Mexico. In this project, each country controlled the quality of the base layer geometry and attributes; in other words, each took responsibility for its own data. All four partners monitored the quality of the entire printed map, as well as their digital data. While the data are shared and meant to be viewed as one data

set (hence, for example, the printed map showed all three countries in the same colour), each partner retained responsibility for, and ownership of, its own data.[83]

The Arctic SDI also has data sharing arrangements in place to support the eight national mapping agencies in their collaboration work. The MOU supporting the Arctic SDI includes an understanding that the participants may include the exchange of cartographic and other necessary information.

Research into other broadly distributed data sharing arrangements that are likely in existence across stakeholder groups and across sectors was not readily available to support the assessment of this indicator.

Conclusion

Very little information is available to support data sharing arrangements other than open data policies. Outside the international, federal and jurisdictional data sharing arrangements found, other examples (e.g., municipalities, academia or private sector) are not readily available for assessment due to the distributed nature of the CGDI stakeholders.

Performance Result (b): Promotion of Canadian policy resources to facilitate, coordinate and align with SDIs at the international level	
Indicator	**2015 Assessment Findings and Result**
14: Evidence of alignment with international policy issues. ▪ Licensing; ▪ Privacy; ▪ Volunteered GI; ▪ IP/copyright; ▪ Archiving and preservation of data; ▪ Open Source; ▪ Open Data; ▪ Open Standards; and Other policy issues to be identified.	**Assessment: Fully Meets Criteria** There is evidence of continued alignment with international operational policy as evidenced by the adoption of the G7/G8 Open Data Charter and Canada's Open Government Licence. The case study of the North American Environment Atlas and Artic SDI are examples of projects that were made possible due to their alignment with international operational policy.

Analysis and Supporting Evidence

The 2012 Assessment of the CGDI concluded that international policy resources that promote interoperability are available and that there was evidence of alignment with international policy issues based on the conclusion of the reviews of international operational policy issues and practices conducted by HAL (2011 and 2012). The study concluded that although much policy development work had been done, the issues faced in Canada are similar to those faced by other countries.

Recently, Canada has undertaken activities that do support alignment with international policy areas. The first example is Canada's adoption of an Open Data Policy. The Open Data License and the Directive on Open Government are direct outcomes of Canada adopting the G7/G8 Open Data Charter. The Canadian Open Data License is a deliberate effort to align with the G7/G8 Open Data Charter.

Canada, through GeoConnections (NRCan), led the research development of the SDI Manual for the Americas. The Manual is part of Canada's contribution to the 2009 – 2013 work plan of CP-IDEA. The manual highlights good practices and lessons learned, including the basic SDI components of framework data, standards, policies and technologies, allowing the primary target audience for this guide, the people responsible for planning and implementing SDI initiatives in the Americas, to develop increasingly better SDIs to serve the needs of society.[84] The manual includes best practices scenarios from a number of countries and international SDI models.

As reported in the case study by Kim Geomatic Corporation, The North American Environmental Atlas provides evidence that CGDI policies on standards adoption are aligned with international policy. By adhering to international standards and data specifications, including descriptions of metadata, the partners (Canada, USA and Mexico) avoided having to create their own standards or adopt unique fixes to harmonize data. The partners also adopted a number of other technical standards and common approaches to data sharing. By so doing, the players brought their data together at low cost, with a common look and feel, and with relative ease[85.]

Additionally, the Arctic SDI case study conducted as part of this assessment found that standards are being addressed and, as one case study interviewee pointed out, most of the collaborating countries already have established SDIs and have adopted standards. However, collaborating members had to think through how standards employed within their own SDIs would work together. In Europe, for example, INSPIRE legislation is a regulatory framework that had to be considered by the collaborating countries. Standards for metadata supporting the background map WMS service have been agreed upon.

Conclusion

There is evidence of continued alignment with international operational policy as evidenced by the adoption of the G7/G8 Open Data Charter and Canada's Open Government License. The case study of the North American Environment Atlas and Artic SDI are examples of projects that are possible due to their alignment with international operational policy.

Performance Result (c): CGDI stakeholders are able to access and are using policy resources on operational issues	
Indicator	2015 Assessment Findings and Result
15: There are available resources to develop organizational capacity on operational policies.	**Assessment: Fully Meets Criteria** There is continued evidence of available resources to develop organizational capacity on operational policies as demonstrated by the development of the User's Guide on the Classification of Geospatial Information Policy Instruments, Free and Open Source Software Licensing Primer and the SDI Manual of the Americas Guide to Best Practices led by GeoConnections for CP-IDEA, together with available outreach mechanisms and activities delivered by GeoConnections.

Analysis and Supporting Evidence

The 2012 Assessment of the CGDI concluded that there was evidence that resources have been invested in capacity development with respect to operational policy. These include webinars, seminars, websites and other information sources.

Examples of capacity development cited in the 2012 Assessment, with respect to operational policy, include the following:

- In 2004, GeoConnections produced a CGDI Online Training Guide (2004).
- In 2007, GeoConnections published a training guide, Understanding User Needs and User Centered Design.
- Also in 2007, a CGDI Development Guide was produced.
- In 2009, GeoConnections produced a Framework Data Guide. The Infonaut Capacity Building Workshop, held in December, 2009 discussed interoperability and the CGDI;
- In 2010, GeoConnections produced a Geomatics Training Guide for Aboriginal Communities. This was followed in 2010 by:

  - A Good Practices Guide – Success in Building and Keeping an Aboriginal Mapping Program (2010);
  - Manager's Guide to Public Health Geomatics (2010).

Since that time, two new capacity development resources have been developed:

- A User's Guide on the Classification of Geospatial Information Policy Instruments (2013). This guide describes a geospatial policy classification framework that was developed to facilitate the organization and retrieval of relevant policies. The objective of the classification framework is to give managers of geospatial data the ability to rapidly identify the relevant policies for management and dissemination of their data in order to increase compliance with those policies.[86]

- Free and Open Source Software Licensing Primer (2012). This guide informs CGDI stakeholders about the nature and scope of Free and Open Source Software (FOSS) licensing and the realities, challenges and good practices of related operational policies.[87]

Internationally, the SDI Manual of the Americas – Guide to Best Practices led by GeoConnections for CP-IDEA, Permanent Committee for GeoSDI of the Americas is a capacity building tool. The SDI Manual is based upon thorough research, analysis and synthesis of information from documents and literature relating to SDI policies, standards, technologies, framework data, collaboration, leadership and governance. It incorporates the results of the GTplan survey of PCIDEA countries and international good practices gleaned from the document and literature research. The draft structure of the Manual was circulated to CP-IDEA members for their review and the final content has benefited from the feedback received from those reviewers.[88]

In addition to these operational policy documents, GeoConnections has offered a number of seminars and webinars to improve capacity with respect to operational policies:

- March 2013 --   CGDI and Geospatial Data Archiving & Preservation (EN and FR)
- May 2013 --   CGDI & Geospatial Operational Policies (EN and FR)
- June 2013 --   CC and the CGDI (EN and FR)
- June 2013 --   Volunteered Geographic Information (EN and FR)
- September 2013 --   How to share geospatial Information (EN and FR)
- October 2013 --   Geospatial Policy Inventory and Classification (EN and FR)
- November 2013 --   Geospatial Standards ISO/OGC/CGSB/TBS (EN and FR)
- November 2013 --   Introduction to Metadata ISO 19115, NAP (EN and FR)
- December 2013 --   Traditional Knowledge and Cybercartography (EN and FR)[89]

Conclusion

There is continued evidence of available resources to develop organizational capacity on operational policies as demonstrated by the development of the User's Guide on the Classification of Geospatial Information Policy Instruments, Free and Open Source Software Licensing Primer and the SDI Manual of the Americas – Guide to Best Practices led by GeoConnections for CP-IDEA, together with available webinars developed by GeoConnections.

Performance Result (c): CGDI stakeholders are able to access and are using policy resources on operational issues	
Indicator	2015 Assessment Findings and Result
16: There are examples of adoption of geospatial operational policy.	**Assessment: Partially Meets Criteria – Limited Information Available** Examples of the adoption of operational policy are limited as there is no mechanism for monitoring the adoption of operational policy. However, the case study of CGDI Operational Policies Case Studies for the GeoGratis portal and the FGP provide examples of adoption of geospatial operational policies.

Analysis and Supporting Evidence

This criteria was not assessed in the 2012 Assessment of the CGDI.

The CGDI Operational Policies Case Studies for the GeoGratis portal provided examples of adoption of geospatial operational policies as follows:[90]

- Protecting Personal Information - GeoGratis use the standard GoC disclaimer regarding privacy on the order form for dynamically extracted data: "The email information that you provide on this site is collected in accordance with the federal Privacy Act. You will be notified once your request has been processed and when it is ready for delivery. Information about your privacy rights." (Natural Resources Canada, 2014). In addition, they are using best practices to encrypt the information (e.g., the ANSI encryption standard).

- Protecting Intellectual Information and Data Licensing - Until recently, a GeoGratis license was employed to license data accessed via the portal and to protect the GoC's IP plus the IP on data provided by others, such as provincial and territorial government data integrated into GeoBase. With the CCOG's decision in January 2014, all GeoBase data will be discoverable and accessible through GeoGratis under the Open Government License – Canada. Under the contract with Iunctus (now Blackbridge Geomatics) for the SPOT lower resolution data, there is provision for distribution of that data through GeoGratis.
- Using Open Standards to Facilitate Data Interoperability - GeoGratis must comply with all the TBS standards and guidelines that apply: the Standards on Web Interoperability (TBS, 2012), Web Usability (TBS, 2013) and Web Accessibility (TBS, 2011), and the Standard on Geospatial Data (TBS, 2012). In addition, GeoGratis uses other open standards such as the OGC Web Processing Service (WPS) and Web Feature Service (WFS), and several of the W3C standards. They are also benefitting from the open standards work conducted by international bodies such as the Open Geospatial Consortium (OGC) and the World Wide Web Consortium (W3C). The total list of applicable standards is provided in Appendix C.
- Archiving and Preserving Data - Under a series of ISO 9000 procedures (NRCan, 2009), (NRCan, 2011), (NRCan, 2012), an internal IT group in Sherbrooke were handling data archiving until Shared Services Canada (SSC) assumed responsibility for IT functions. The GeoGratis database was being backed up onto tape monthly and weekly, and updates were backed up daily. Under this procedure, all the back-up tapes were moved offsite to a bank vault three times a year. Since SSC assumed responsibility, priorities have changed and this offsite storage function no longer exists. As a result, the offsite data archiving has not taken place for two years. This is an area that needs to be revisited jointly by NRCan and SSC.

The FGP case study conducted as part of this assessment identified that the FGP leveraged existing CGDI guidance materials on how to develop, manage, adapt and adopt operational level policy for organizations – the working groups utilized all GeoConections could offer from the policy and standards perspective. This included, for example, policy classification and identification and inventory processes to enable the FGP to understand its policy landscape, classify and inventory what was in existence and then report on it. The FGP also used the CGDI geospatial data archiving and preservation reference material to inform the policy on FGP's data management lifecycle. Most recently, the FGP is utilizing CGDI studies completed on data quality to establish the benchmark for the FGP.

As stated previously, the FGP initiative regards adoption of geospatial standards as instruments of policy and has leveraged GeoConnections/CGDI metadata standards, particularly NAP for geospatial metadata. The case study recognizes participating FGP departments have implemented the standards, as data being shared has good standardization and the initiative is not contending with issues related to homogenizing data.

The CGDI also contributes to operational policy development for the Arctic SDI.[91] Canada is named as a supporting country for the development of legal/administrative operational policies and NRCan's operational policy documents are referenced in the Arctic SDI framework document. Arctic SDI operational policies cross all infrastructure components including data sources, web services metadata, client users and applications and advanced visualization data and processes.

Attendance at webinars delivered by GeoConnections in support of increasing understanding of operational policies and access to guidance documents related to operational policy are presented under indicator 23 and support capacity building resources being in place. See page 50.

<u>Conclusion</u>

Examples of the adoption of operational policy are limited as there is no formal mechanism for monitoring the adoption of operational policy. However, the CGDI Operational Policies Case Studies for the GeoGratis portal and the case study of the FGP and Arctic SDI provide examples of adoption of geospatial operational policies.

Performance Result (d): There are mechanisms and a process established for the introduction, development, review and adoption of geospatial operational policies that enable the CGDI	
Indicator	**2015 Assessment Findings and Result**
17: There are mechanisms and a process to cover the lifecycle of geospatial operational policies including: • Identification of stakeholder requirements to guide the development of policy resources. • Organizational arrangements in place to manage the lifecycle of geospatial operational policies. • A process to introduce policy resources including prioritization of topics. • A process to identify stakeholder involvement for development. • A process to review policy resources including consideration for current vs. future state. • A process to advocate adoption of policy resources.	**Assessment: Fully Meets Criteria** GeoConnection's CGDI Operational Policy Project Plan, 2012-2015 and subsequent activities demonstrate NRCan's efforts to promote policy development, policy adoption, policy implementation and outreach, consultation and awareness activities.

Analysis and Supporting Evidence

The 2012 Assessment of the CGDI found that there were no specific mechanisms or institutional arrangements in place within Canada for the introduction, development, review and adoption of geospatial operational policies and there was no evidence of mechanisms in place to monitor the implementation of operational policy resources by the CGDI stakeholders.

The 2012 assessment of the CGDI found that a number of efforts were made to obtain user needs and feedback for policy development, which includes:

▪ CGDI Operational Policies: Preliminary Needs Assessment Report 1, GeoConnections (2010)
▪ HAL (2011), Final Report: CGDI Operational Policy Needs Analysis
▪ HAL (2012) Geospatial Operational Policy Roadmap Research 2012-2015

Based on these user needs, NRCan has funded policy development projects, which have resulted in a number of policy papers that suggest best practices for users, and data suppliers. Example of these include the following:

▪ A Guide to Sharing Geospatial Data (2011). This guide was developed to "promote the full and open exchange of geospatial data, within a context established by important principles of data sharing". These principles have been identified from the examination of good practices in Canada and internationally, and are explained in the report.
▪ Volunteered Geographic Information (VGI) Primer (2012). Given the fact that using volunteered geographic information to help create or maintain geospatial datasets is recognized as a rapidly growing trend, GC supported production of a guide as a quick reference to good practices in operational policy related to VGI, such as data quality, liability, privacy, security, licensing and copyright.

- Primer on Policy Implications of CC (2012). This guide is intended to provide guidance on CC and areas of related operational policy, such as liability, privacy and confidentiality, security, licensing, copyright, archiving, regulations and standards. Computing clouds provide computation, software, data access, and storage resources without requiring cloud users to know the details of the computing infrastructure.
- Report on Legislative Barriers to the Release of Geospatial Data (2012). This report provides an overview of federal and provincial legislation that contain specific provisions that negatively impact the open sharing of geospatial data. The report touches on issues of copyright, trade secrets and access to information legislation in Canada and in each of the provincial/territorial jurisdictions in Canada.
- A CGDI Best Practices Master Guide (2012). This guide provides an overview of best practices in: data integration, IP; privacy and risk management; sharing sensitive information; and dissemination of geographic data.
- Geospatial Data Preservation Primer. This primer will provide CGDI stakeholders with information on how to incorporate archiving and preservation considerations into an effective data management process that covers the entire life cycle (DCC, 2013) (LAC, 2006) of their geospatial data assets (i.e., creation and receipt, distribution, use, maintenance, and disposition). It is intended to inform CGDI stakeholders on the importance of long term data preservation, and provide them with the information and tools required to make policy decisions for creating archives and preserving digital geospatial data.[92]

The CGDI Operational Policy Activities, Project Plan 2012-2015 was created to support the goals, objectives, and initiatives found in GeoConnections' 2010 Treasury Board Submission and the 2012 GeoConnections Business Plan. This plan is developed and maintained by the Operational Policy Team, responsible for the coordination of operational policy activities and program deliverables for GeoConnections. Activities described in the plan include research, analysis, consultation and awareness-raising in its policy formulation and recommendations, and produces guidelines, directives, procedures, manuals and other policy instruments. Additionally, the project includes a technical overview of collaborative arrangements with external partners, consultation and the contribution of expertise in geospatial operational policies with federal government and other CGDI stakeholders, and proactive outreach and promotion of common approaches to geospatial operational policy for Canadian organizations. Finally, the CGDI Operational Policy project includes a policy adoption strategy and the development and implementation of policy adoption mechanisms.

The main objective of the CGDI Operational Policy Project Plan is to strategically position NRCan at the forefront of geomatics operational policies, enabling the CGDI to facilitate collaboration on geomatics data, standards and tools sharing. The following four project components support this objective:

- Policy Development: Monitor trends, perform research and consultation and develop geospatial operational policies in identified priority areas.
- Policy Adoption: Develop practical policy adoption processes to ease implementation and integration of CGDI Operational Policies by stakeholders.
- Policy Implementation: Support and enable broad implementation and integration of CGDI operational policies by national CGDI stakeholders.
- Outreach and Awareness: Intensify and continue outreach and awareness activities to promote polices, adoption processes and to showcase policy implementations.[93]

Webinars, seminars and NRCan participation with various national committees and organization are all examples of mechanisms used to promote policy adoption. Of the many webinars that were developed by GeoConnections, the following are examples of webinars that promote development, adoption and or implementation of operational policies:

- May 2013—Canada's SDIs & Geospatial Operational Policies (EN and FR) October 2013
- Geospatial Policy Inventory and Classification (EN and FR)
- October 2014 – The Role and Impact of Geospatial Information in the Big Data Arena (EN and FR)
- April 2014 — Geospatial Operational Policies and Standards Overview for Academia (EN and FR).

Conclusion

GeoConnection's CGDI Operational Policy Project Plan, 2012-2015 and subsequent activities demonstrate NRCan's efforts to promote policy development, policy adoption, policy implementation and outreach, consultation and awareness activities.

Overall Component Conclusion – Operational Policies

Policy development addressing previously identified user needs and policy gaps has been initiated through a formalized plan and subsequent development of policy guidance, as well as the development of resources to assist with developing organizational capacity on operational policies. There have been efforts to promote policy development, policy adoption, policy implementation and outreach, consultation and awareness activities undertaken.

An increasing number of governments in Canada have adopted open data policies, including the federal government's development of the Open Government Directive, Open Government License and creation of the new www.open.canada.ca website. However, there is limited information readily available regarding data sharing agreements other than open data. There is also evidence of continued alignment with international operational policy.

Policy gaps still exist regarding data stewardship and data integration.

The CGDI Operational Policies component indicators have substantially been met demonstrating stable performance across all indicator areas with a movement from "partially meets" to "fully meets" against two indicators. Exhibit 5 depicts the comparison of 2015 results to that of the 2012 indicator results with applicable indicator mapping indicated within each column.

Exhibit 5

Results of CGDI Operational Policies Component
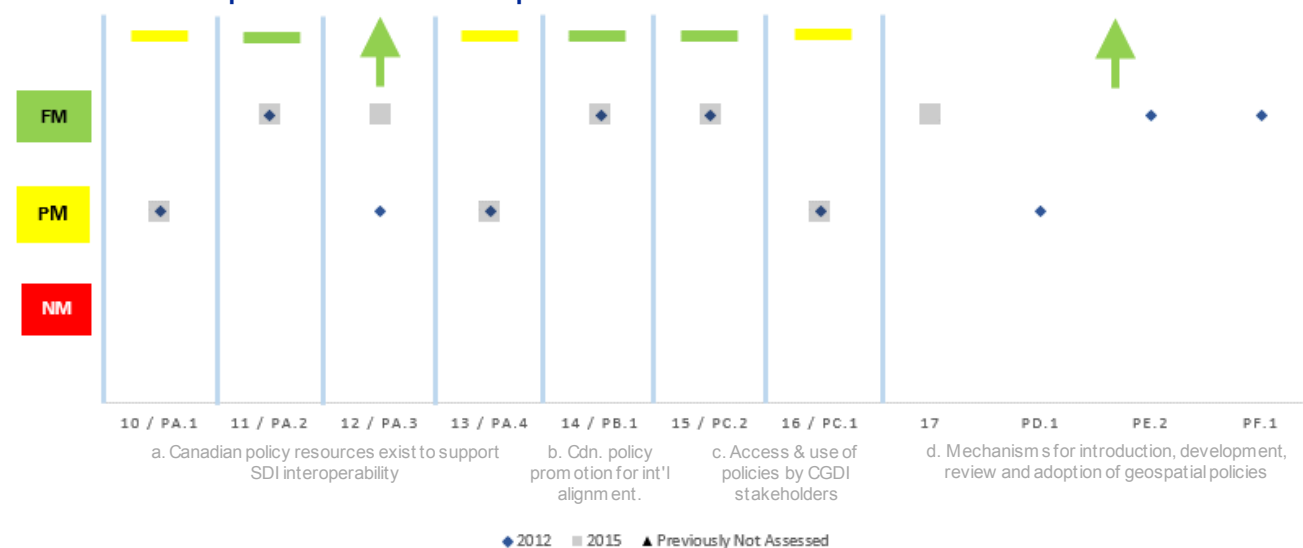
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Chapter 6: Assessment of CGDI Component: Standards and Specifications

The outcome measure being assessed under the Standards and Specifications component is defined in the assessment framework as:

A complete and performing CGDI means that there are common standards and specifications in place that allow diverse data sources, services, applications and systems to operate with each other within Canada and internationally. CGDI stakeholders are able to access information and guidance on the implementation of these standards. There are mechanisms and a clear process established for the introduction, development, review and adoption of standards and specifications, and there are institutional organizations in place to manage these mechanisms and processes. Also, there are mechanisms in place to monitor the adoption and implementation of the established standards and specifications.

The definition of 'standard' used in the preparation of this report is consistent with the definition used in the 2012 Assessment of the CGDI, and is as follows:

> *A document, established by consensus and approved by a recognized body that provides, for common and repeated use, rules guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.*[94]

Four performance result areas with eight corresponding indicators were assessed under the Standards and Specifications component.

Indicators 18, 19 and 20 all deal with assessing evidence of geospatial standards that support interoperability from different aspects of the CGDI. The following definitions of each aspect describe the differences between criteria.

Criteria	Aspect	Definition
18	Data interoperability	Distinct pieces of factual information, especially information organized for analysis or used to reason or make decisions. Data are usually formatted in a special way and presented in a variety of forms.
19	Service interoperability	A collection of operations, accessible through an interface, which allows a user to evoke a behaviour of value to the user.
20	Application/system interoperability	The use of capabilities, including hardware, software and data, to manipulate and process data for user requirements. Applications are designed to perform a specific function directly for the user or, in some cases, for another application program

Interoperability is generally defined as the ability of different types of computers, networks, operating systems and applications to work together effectively, without prior communication, in order to exchange information in a useful and meaningful manner. Each of criteria 18, 19 and 20 have been assessed using these definitions in the context of standards and specifications.

Performance Result (a): Common standards and specifications are in place and have been adopted that allow diverse geospatial data sources, services, applications and systems to operate with each other within Canada	
Indicator	**2015 Assessment Findings and Result**
18. Evidence of geospatial standards that support geospatial data interoperability. • Framework Data • Metadata • Thematic Data related to worldwide SDI priorities (Environmental themes and Public Safety/Security)	**Assessment: Fully Meets Criteria** Consistent with the 2012 Assessment of the CGDI, there is evidence of geospatial standards that support data interoperability.

Analysis and Supporting Evidence

Geospatial data interoperability are standards that allow framework data, metadata and thematic data to operate with each other.

The 2012 Assessment of the CGDI found there was evidence that geospatial standards had been adopted in Canada to support geospatial data interoperability. Canada follows the acknowledged international digital mapping standards developed collaboratively by both OGC and ISO, as well as by the U.S. FGDC.

Metadata

Metadata can be defined as structured information, usually in an XML format, that captures the basic characteristics of the geospatial data resource, and include information on the "who, what, when, where, why and how" of the resource. Federal government departments are required to use metadata standards, as per the Treasury Board (TBS) Standard on Metadata and TBS Standard on Geospatial Data which require all departments under the purview of the TBS to implement and comply with the standard ISO19115 Geographic Information, ISO19128 Geographic Information and NAP of ISO19115 Geographic Information to support interoperability of geospatial information.

Framework Data

GeoBase was the key framework data component of the CGDI at the time of the 2012 Assessment. GeoBase data complies with a standard data model and meets or exceeds a minimum standard for accuracy, resolution and currency. The provinces/territories also have framework data that is available through their portals. This data is also compatible with data standards to facilitate interoperability and integration with national data. For example framework or base data is used to integrate and align thematic data on a common geography.

Thematic Data

Thematic data describes characteristics of geospatial features or provides information on specific topics or themes, such as forest types, water contamination, historical flood areas, or disease patterns and trends, which are geospatially referenced to locations on the Earth using framework data, so that they can be shown in map form. The 2012 Assessment provided the following examples of thematic data standards:

▪ The Multi-Agency Situational Awareness System (MASAS) was designed to meet the needs of emergency responders. As such, it is a multi-stakeholder initiative with the aim of developing and supporting capabilities that enable the sharing of real-time, location-based situational awareness information and alerts among multiple emergency management and response agencies using open standards, architecture, policies and interoperable technologies, based on national CGDI geospatial standards.
▪ The National Forest Information System (NFIS) provides forestry-related information and integrates remotely-sensed data and provincial data in support of national and international reporting requirements for sustainable forest management.
▪ Thematic Water Data Standards were developed to support the process for interoperability and seamless sharing of information.

- Matters of Importance to Aboriginal Peoples provided best practices in data content standards for use between and within data providers and users of geospatial information related to Aboriginal peoples.
- Environment and Sustainable Development best practices in data content standards were developed for use between and within data providers and users of geospatial information related to the environment and sustainable development.

Conclusion

Consistent with the previous assessment, there is evidence that geospatial standards have been adopted in Canada to support geospatial data interoperability. Canada continues to follow the acknowledged international digital mapping standards developed collaboratively by both the OGC and the ISO.

Performance Result (c): CGDI stakeholders are able to access and are using policy resources on operational issues	
Indicator	**2015 Assessment Findings and Result**
19. Evidence of geospatial standards that support service interoperability. • Search • Discovery • Access • Visualization • Notification • Transactional • Query • Data Integration	**Assessment: Fully Meets Criteria** Consistent with the 2012 Assessment of the CGDI, there is evidence of geospatial standards that support geospatial services interoperability.

Analysis and Supporting Evidence:

Standards that support service interoperability are fundamental to achieving interoperability of information services related to search, discovery, access, visualization, notification, transactional, query and data integration. These services apply to metadata, framework data and thematic data and build on generic IT services.

NRCan has played important roles in both the Open Geospatial Consortium Inc. (OGC) and in ISO/ TC 211. With the OGC, Geoconnections is a principal member and as such is a voting member on the OGC technical committee and OGC planning committee. Geoconnections has supported the development of test beds to put geospatial standards in practice as well as identifying gaps in the standards inventory. NRCan experts have contributed to the development of a number of OGC standards through participation in many working groups such as GeoSemantics Domain Working Group (DWG), Metadata DWG, Web Map Service Standards Working Group (SWG), Simple feature SWG, Catalogue Service for the Web SWG, Web Coverage Service DWG, Big Data DWG, and the OGC Architecture Board. GeoConnections has also contributed in a more specific manner to the following OGC standards: OGC Catalogue Service Implementation Specification, GeoSparql, SensorThings API. In ISO/TC 211, GeoConnections led the Canadian delegation and has led multiple working groups and projects for the development of standards and standards resources such as: ISO 19101-1, Reference model - Fundamentals, ISO 19145 Registry of representations of geographic point locations, ISO 19150-1 Ontology – Framework, ISO 19150-2 Ontology - Rules for developing ontologies in the Web Ontology Language (OWL), Group for ontology maintenance (GOM) and several ad hoc groups.

The table below provides examples of standards that align with one aspect of interoperability however most will cross more than one type (i.e., each is not mutually exclusive).

Type of Service Interoperability	CGDI Service Interoperability Standards[95]
Search and Discovery	▪ **Catalogue Service for Web (CSW)** – Provides a registry service to support the ability to publish and search collections of descriptive information for data, services and related information objects. Metadata registered in catalogues represent resource characteristics that can be queried and presented for evaluation and further processing by both humans and software. Catalogue services are required to support the discovery and binding to registered information resources within an information community. ▪ **Z39.50 Service Node** – A protocol that defines a standard way to allow a client machine to search databases on a server machine and retrieve records that meet the criteria of the search request.
Access	▪ **GeoRSS** – An emerging standard for encoding location as part of a Web feed. ▪ **Sensor Observation Service (SOS) Standard** – Applicable to use in cases where sensor data needs to be managed in an interoperable way. ▪ **Web Coverage Service (WCS)** – Enables interoperable access to geospatial coverage consisting of intact, raw data. The term "gridded coverages" typically refers to content such as satellite images, digital aerial photos, digital elevation data, and other phenomena represented by values at each measurement point. ▪ **Web Feature Service (WFS)** – Defines a set of operations that retrieve and manipulate geographic features. Data manipulation operations include the ability to get or query features based on spatial and non-spatial constraints, create a new feature, modify a feature, or delete a feature.
Visualization	▪ **Web Map Service (WMS)** – Defines a service to retrieve a map or image of geo-referenced data. ▪ **Web Map Context Implementation Specification (WMC**)- Specifies how a grouping of one or more maps coming from one or more Web Map Services servers can be described in a portable, platform-independent format for storage in a repository or for transmission between clients. ▪ **Web Map Tile Service (WMTS)** - Provides access to cartographic maps of geo-referenced data, not direct access to the data itself. The tile service standard specifies the manner in which map tiles are requested by clients, and the manner in which servers describe their holdings. ▪ **Styled Layer Descriptor (SLD) Profile of the Web Map Service Implementation Specification** - The SLD provides a map-styling protocol for communicating with an OGC® Web Map Service (WMS) about the appearance of map layers.
Notification	▪ **Web Notification Services (WNS) -** Standard web service interface for asynchronous delivery of messages or alerts from SAS and SPS web services and other elements of service workflows
Transactional	▪ **Web Processing Service (WPS)** - Provides access to calculations or models that operate on spatially referenced data. A WPS can be configured to offer any sort of Geographic Information System (GIS) functionality to clients across a network, including access to pre-programmed calculations and/or computation models. The WPS standard provides a mechanism to identify the spatially-referenced data required by the calculation, to initiate the calculation, and to manage the output from the calculation so that it can be accessed by the client.

Type of Service Interoperability	CGDI Service Interoperability Standards[95]
Query	▪ **Web Feature Service (WFS)** – Defines a set of operations that retrieve and manipulate geographic features. Data manipulation operations include the ability to get or query features based on spatial and non-spatial constraints, create a new feature, modify a feature, or delete a feature. ▪ The internationally developed **Filter Encoding Standard** provides XML and KVP encoding of a system-neutral syntax for expressing projection, selection and sorting clauses, collectively called a query (or filter) expression. Filter encoding can handle both spatial and non-spatial aspects of a query, and will restrict the records that are returned in response to the query.
Data Integration	▪ **Table Joining Service (TJS**) - Defines a simple way to describe and exchange tabular data that contains information about geographic objects. TJS takes attribute data (which refers to spatial features, or "geolinked data") and joins it to a geospatial dataset so that it can be mapped by a Web Map Service (WMS) or used in a Geographic Information System (GIS). It serves as a front-end to an existing WMS, and enables real-time mapping of data stored in non-spatial databases.

All of the above listed standards that support service interoperability were developed, approved and published by the OGC, with two exceptions: the TJS Standard was published by the OGC based on initial work undertaken in support of the CGDI; and the Filter Encoding Standard was developed jointly by the OGC and the International Organization of Standards ISO/TC 211, and published as ISO 19143, Geographic Information – Filter Encoding.

Conclusion

Consistent with the 2012 Assessment of the CGDI, there is evidence of geospatial standards that support geospatial services interoperability.

Performance Result (c): CGDI stakeholders are able to access and are using policy resources on operational issues	
Indicator	**2015 Assessment Findings and Result**
20. Evidence of standards that support application/system interoperability: ▪ Within the GoC (GoC) ▪ Nationally throughout Canada (i.e. between levels of government or within the same level of government) ▪ Internationally	**Assessment: Fully Meets Criteria** There have been numerous internationally developed standards since 2012, by the OGC and ISO Technical Committee 211, to support application and system interoperability. Additional interoperability standards work is taking place through the Arctic SDI and FGP.

Analysis and Supporting Evidence

Evidence that standards support application/system interoperability in the GoC nationally across Canada and internationally was found in the 2012 Assessment of the CGDI. Within the GoC, the TBS Standard on Geospatial Data, issued in 2009, requires all federal departments and agencies to conform to the ISO 19115 Metadata Standard and the ISO 19128 Web Map Server Interface Standard by May 1, 2014. These standards help ensure interoperability across federal government departments and agencies. In addition, the CGSB metadata standard and the North American Profile (NAP) of ISO 19115, as well as CCOG endorsed standards used by the Geobase Portal contribute to applications/system interoperability across Canada and internationally.

Furthermore, the 2012 Assessment of the CGDI found that the CGDI is fully compatible with the SDIs of other nations, meaning that Canada's data can be integrated and are compatible with that of our international partners and can be used by commercial geographic information systems. For example, a number of cross-border projects have been undertaken, including: the North American Environmental Atlas of environmental issues, the MASAS B.C. earthquake simulation involving the U.S. Department of Homeland Security with a key goal of improving the interoperability between systems in Canada and the U.S., and the MASAS Information eXchange (MASAS-X) Pilot Project which involves the objective of harmonizing MASAS with the U.S. Integrated Public Alert and Warning System (IPAWS) to improve the coordination of response efforts during disasters affecting both sides of the border.

The 2012 Assessment reported the OGC website, based on analysis of information, contained 55 standards. As of March 13, 2015, based on a new analysis, the OGC website now lists 83 standards (e.g. Open Modelling Interface Standard, Web Coverage Service Interface, etc.).[96]

In addition, the aforementioned OGC White Papers (e.g. IT Standards for Sustainable Development, Smart Cities Spatial Information Framework, etc.) represent additional evidence for standards supporting interoperability both within Canada and internationally. We have assumed at least an indirect influence on one or more of these standards, based on GeoConnections' affiliation with the OGC; however, GeoConnections was specifically a sponsor contributing to the development of the OGC's Testbed 10 (OWS-10). This was a rapid prototyping activity to develop standards and best practices aimed to reduce technology risk, reduce technology lifecycle costs, mobilize new technologies, and expand markets and improve customer choice.

The 2012 Assessment also reported that the ISO Technical Committee 211 on Geographic Information and Geomatics listed 81 standards on its website, based on analysis. There are currently 66 complete standards, plus 24 standards in development, for a total of 90 standards, based on new analysis.[97] ISO 19115 is of particular importance, as this was the basis for the 2010 TBS Standard on Geospatial Data, which was updated on April 1, 2012.[98]

Additionally, cooperation is occurring between eight mapping agencies as part of Arctic SDI, to provide geographically related Arctic data, digital maps and tools to facilitate monitoring and decision making. A technical working group is focusing on the creation of design, architecture and standards. [99]

Lastly, the FGP (supported by the Federal Committee on Geomatics and Earth Observation provides defined standards for sharing and integration of cross-disciplinary data across federal departments. [100]

Conclusion

Overall, in 2015 there exist many more geospatial standards to support application and system interoperability both domestically and internationally than in 2012. Given that the previous Assessment rating was 'Fully Meets the Criteria', and in consideration of these additionally identified standards, this indicator continues to fully meet the criteria.

Performance Result (b): Common standards and specifications have been adopted and are in place that allow diverse geospatial data sources, services, applications and systems to operate with each other internationally	
Indicator	2015 Assessment Findings and Result
21. Evidence of alignment with international standards and specifications.	**Assessment: Fully Meets Criteria** Canada, in relation to geospatial data, has continued to adhere to internationally developed standards as noted in the 2012 Assessment, the major ones being ISO 19115 and ISO 19128. There are no changes in this regard. Canada has further demonstrated alignment with international standards through its commitment to Open Data via the G7/G8 Open Data Charter.

Analysis and Supporting Evidence

The 2012 Assessment did not specifically examine alignment with international standards, so much as it focused on the CGDI's influence on them. However, reference was made regarding Canada's propensity to adopt international standards, while still contributing in many ways to developing them (see Indicator 22 below).

The prime example of alignment with standards is reflective in the adoption of ISO 19115 (Metadata Standard) and ISO 19128 (Web Map Server Interface Standard). These have been adopted as Treasury Board standards within the GoC. Additionally CGDI is fully compatible with the SDIs of other nations, as demonstrated through collaborative projects such as the MASAS B.C. earthquake simulation involving the US Department of Homeland Security, and the MASAS Information eXchange Pilot Project involving harmonization of MASAS with US Integrated Public Alert and Warning System (referenced previously).

Canada is a member of the CP-IDEA Technical Specifications Working Group (NET) that is establishing a set of standards and technical specifications that are applicable to the Americas region as a whole. NET has conducted an evaluation in 17 countries in the Americas on the use of "core or framework data" standards including Geospatial Data Model, Metatdata and Interoperability.

Canada's commitment to Open Data (via the G7/G8 Open Data Charter) enables citizens, the private sector, and non-government organizations to leverage and build upon government data in innovative and value-added ways. Based on the United Kingdom's Open Government Licence for Public Sector Information, the Open Government Licence (OGL) v. 2.0 released in May 2014 removes restrictions on the reuse of all types of published GoC information (data - including geospatial data - information, websites, and publications) and aligns with international best practices to promote the re-use of federal information as widely as possible.[101]

The Arctic SDI case study also identifies Canada's alignment with international standards and specifications through the collaborative development of supporting tools, standards, operational policies and best practices directly in support of the Arctic SDI initiative in which eight countries must be in alignment.

Conclusion

There is strong support for the CGDI's alignment with international standards, based by and large in conformance with ISO 19115 and ISO 19128, but also in its commitment to Open Data via the G7/G8 Open Data Charter and its work with other international geomatics organizations.

Performance Result (b): Common standards and specifications have been adopted and are in place that allow diverse geospatial data sources, services, applications and systems to operate with each other internationally	
Indicator	**2015 Assessment Findings and Result**
22. Evidence of the CGDI influence on international standards.	**Assessment: Fully Meets Criteria** Canada has continued to play an active role in developing standards directly or indirectly that influence the use of international data globally.

Analysis and Supporting Evidence

The 2012 Assessment of the CGDI found that while Canada has largely adopted international standards, Canada is actively involved in establishing the international standards, as previously noted. The following are key examples:

▪ GeoConnections worked with the Canadian General Standards Board (CGSB)[102], and the U.S. Inter-National Committee for IT Standards Committee L1 to develop the geographic metadata content needed to tailor the international standard ISO 19115 to meet the requirements of both countries. The resulting standard is the North American Profile (NAP) of ISO 19115.
▪ Through GeoConnections, Canada is an active member of both OGC and ISO. In OGC, GeoConnections is one of 18 Principal members, and currently has several members on the OGC Global Advisory Council.
▪ Canada's involvement with CP-IDEA and the UN-GGIM provide an opportunity to contribute to international standards development, evolution and promotion.

Since 2012, GeoConnections was responsible for the creation of the SDI Manual for the Americas (see http://unstats.un.org/unsd/geoinfo/RCC/docs/rcca10/E_Conf_103_14_PCIDEA_SDI%20Manual_ING_Final.pdf). This manual has been designed to provide guidance in several areas not covered by previous SDI manuals, including user-needs assessments, SDI governance, policy processes, and the impact of SDIs and benefits measuring and monitoring. The manual

provides guidance to countries of the Americas that have already shown to adopt international standards. These include Colombia, Mexico, Ecuador, Brazil, Chile and the United States.[103]

Additionally, since the 2012 Assessment, Canada contributed to A Guide to the Role of Standards in Geospatial Information Management, an output of the UN Committee of Experts on Global Geospatial Information Management. The report addresses the role of standards in geospatial information management.[104] The Guide specifically references definitions of two key types of standards based on GeoConnections/Government of Canada definitions.

Through its role in Arctic SDI, Canada contributes to the collective promotion and adoption of international standards through working group activities, and as a founding member of the GSDI Association, Canada supports the funding of projects to develop capacity internationally to use standards and best practices surrounding spatial data.

Conclusion

Canada has both adhered to international geospatial data standards, participated in committees that have created standards for international adoption, and directly developed standards via GeoConnections.

Performance Result (c): CGDI stakeholders are able to access and are using information and guidance on the implementation of standards and specifications	
Indicator	**2015 Assessment Findings and Result**
23. Availability of capacity development resources (i.e., guidance documentation and training) to support standards and specifications implementation.	**Assessment: Fully Meets Criteria** There are numerous capacity development resources and training opportunities available to support standards and specifications implementation. These include webinars and other written materials, which are being accessed worldwide.

Analysis and Supporting Evidence

The 2012 Assessment of the CGDI found that The GeoConnections website contains recently updated documentation on CGDI standards.[105] In addition, the website includes additional publications on a variety of topics related to CGDI, including standards. Further, GeoConnections provided "A Developer's Guide to CGDI: Developing and Publishing Geographic Information, Data and Associated Services (2004)" for use by developers, and TBS Board provides "A Guide for Implementation of Standard on Geospatial Data" which provides guidance to federal government departments and agencies. In terms of training, GeoConnections and ISCG provided the Geospatial Standards, Tools and Technologies Workshop (Nov 8-9, 2011) which reached an estimated 120 people - 80 in person, and the remainder connected via internet. Attendance was limited to GoC employees.

Additional webinars have been held in the time period since the 2012 Assessment. The following table provides details on webinars relevant to supporting standards and specifications implementation, as well as respective participation rates and reach.[106]

Webinar Title	Number of Participants		International Participation Rate
	English	**French**	
CGDI and Geospatial Data Archiving & Preservation	220	38	16.3%
Canada's SDIs & Geospatial Operational Policies	131	37	9.5%
Geospatial Standards ISO/OGC/CGSB/TBS	146	42	18.6%

Most recently, Canada was a contributor to A Guide to the Role of Standards in Geospatial Information Management, an output of the UN Committee of Experts on Global Geospatial Information Management. The report addresses the role of standards in geospatial information management.[107]

Lastly, some download data are available for several guidance resources produced by GeoConnections. A total of eight such documents have been identified. The summary of downloads over the time period from 2011 to February 2015 is provided in the table below. Note these statistics do not identify whether each download was a unique instance or a repeat user of the resource database but did indicate the resources were being retrieved across a number of user categories including academic, federal and provincial government, and business users.

Name of Resource	Number of Downloads (2011-2015)
GeoConnections (2012). How to share geospatial data prevail. CGDI, Information Product 27th,; 34 pages 10.4095 / 292415	511 (43 French; 468 English)
GeoConnections (2007). Understanding users' needs and user centered design. CGDI, Information Product 24th,; 67 pages 10.4095 / 292113	95 (27 French; 68 English)
HAL Corporation (2012). Volunteered geographic information (VGI) primer. CGDI, Information Product 21st,; 27 pages 10.4095 / 291948	458 (88 French; 370 English)
AMEC Earth & Environmental (2010). Best practices for sharing sensitive environmental geospatial data. CGDI, Information Product 15,; 75 pages 10.4095 / 288863	392 (77 French; 315 English)
Canada Privacy Services Inc (2010). Geospatial privacy awareness and risk management guide for federal agencies. CGDI, Information Product 12; 67 pages 10.4095 / 288860	203 (English)
GeoConnections (2009). Quick Guide for CGDI Service Compliance Testing and Performance Optimization. CGDI Information Product 10; 16 10.4095 / 288857 pages	64 (20 French; 44 English)
GeoConnections (2009). GeoConnections framework data guide. CGDI, Information Product 9; 99 pages 10.4095 / 288855	280 (64 French; 216 English)
AMEC Earth and Environmental (2006). Web feature service considerations for CGDI government partners. CGDI, Information Product 6; 30 pages 10.4095 / 288850	78 (20 French; 58 English)

Conclusion

The 2012 Assessment presented evidence of some training to support standards implementation. Additional evidence in the form of three new webinars and eight other guidance documents have been identified. The materials and information have a global reach, and are available in two languages. This evidence supports a conclusion that the indicator is fully met.

Performance Result (c): CGDI stakeholders are able to access and are using information and guidance on the implementation of standards and specifications	
Indicator	2015 Assessment Findings and Result
24. Evidence of use of standards and specifications capacity building resources.	Assessment: Fully Meets Criteria There is evidence of both intended use, and of extensive reach of materials.

Analysis and Supporting Evidence:

The 2012 assessment of the CGDI suggested that some capacity building with respect to standards use had been undertaken. The supporting evidence provided previously under Indicator 23 identifies the up-take of standards capacity building resources by stakeholders.

Conclusion

There is evidence of both intended use, and of extensive reach of materials.

Performance Result (d): There is a process and institutional arrangements in place for the introduction, development, review and adoption of standards and specifications that enable the CGDI	
Indicator	**2015 Assessment Findings and Result**
25. Evidence that mechanisms and a process exists to cover the lifecycle of geospatial standards and specifications including:	**Assessment: Fully Meets Criteria** There is an inherent challenge in ensuring lifecycle maintenance of geospatial standards and specifications in a system based on volunteered participation.
- Identification of stakeholder requirements to guide the development of standards and specifications. - Organizational arrangements are in place to manage the lifecycle of standards and specifications - A process to introduce standards and specifications to the stakeholder communities including prioritization of topics. - Stakeholders are involved in the development. - A process to review standards and specifications. - A process to advocate adoption of standards and specifications.	Without evidence of a formal plan and somewhat fragmented mechanisms, there is still evidence of efforts to identify requirements, involve stakeholders, introduce standards and encourage adoption.

Analysis and Supporting Evidence

The 2012 Assessment reported that, although there is clear evidence of domestic and international bodies involved in the introduction, development and review of technical and data standards, (e.g TBS, CGSB, CCOG, OGC, ISO), it was unable to identify evidence and clear process related to the adoption of the standards. The Canadian situation is premised on collaboration and partnership, with adoption generally voluntary in nature and therefore information to support this indicator is not readily available.

There are, however, a number of initiatives that encourage the adoption of standards:

- Information that is contained in the GeoConnections Discovery Portal is required to conform to Metadata standards.
- CCOG, which is responsible for the GeoBase portal, develops and promotes standards with its participating organizations (federal, provincial and territorial governments).
- As part of GeoConnections funding role in the geomatics community, one of the requirements for accessing funding in the contribution program was conformance with accepted standards.
- For commercial applications, the OGC Compliance & Interoperability Testing & Evaluation (CITE) program, also known as the OGC Compliance Testing Program, is designed to increase systems interoperability while reducing technology risks, through testing for compliance with OGC standards. This program provides mechanisms by which users and buyers of software who implement OGC standards can be certain that the software follows the mandatory rules of implementation as specified in the standard. Canadian firms have been involved in this testing program.

Furthermore, the 2012 Assessment found that there is a process to develop standards, however complex. The CGSB follows a formal standards development process consisting of the following eight stages: Preliminary and Proposal Stages, Drafting Stage

(Standards Committee and Committee Deliberations), Public Review and Committee Review Stage, Committee Approval Stage, Second-Level Approval Stage, Standards Council of Canada (SCC) Ratification Stage, Publication Stage and Review Stage.

In the case of the TB Standard on Geospatial Data, which was developed over a period of three years, commencing in 2006, the following were key events in the process:

- A working group, with members from the FCGEO, was established in March 2006;
- Subsequently, several working group meetings were supplemented by communications via e-mail, and teleconferences;
- The primary working group output was Compliance and Implementation Plans (CIPs). This addressed the scope, phasing of implementation, cost estimates, etc. and were substantially completed by all Departments.
- Twenty-eight (28) departments and agencies were formally consulted through a balloting process under the TBS CIO Standards Program (formerly known as the Treasury Board IT Standard (TBITS) process);
- The organizations that responded overwhelmingly supported the Standard on Geospatial Data;
- All issues raised were successfully addressed by the Working Group;
- TBS and NRCan jointly developed responses to the 'Policy Renewal Challenge' questions; and
- The TBS Standard on Geospatial data was approved and became mandatory in June 2009.

In terms of adoption of technical and data standards, examples are the TBS Standard on Geospatial Data which is required to be adopted by all federal government departments and agencies by 2014, and the OGC CITE program for commercial systems described above.

For Involvement of stakeholders in the introduction, development, review and adoption process, the 2012 Assessment found that the CCOG develops and promotes standards with its participating organizations (federal, provincial and territorial governments) to conform to specific standards. The federal government and CCOG National Mapping Strategy are illustrative of stakeholders that have institutional arrangements to integrate standards into their business processes. Federal government departments and agencies are required to conform to the TBS Standard on Geospatial Data by 2014. In addition, the provinces and territories, as part of the Geomatics Accord and participation in CCOG, are committed to work cooperatively with the federal government and each other, in establishing the CGDI, including standards and specifications, and information production, integration and sharing.

Monitoring of the implementation of the established technical and data standards was found to be partially accomplished in the 2012 Assessment of the CGDI, as Canada and the CGDI rely on voluntary compliance, which is different from the regulatory approach used in the European Union (EU). As such, there is no formal monitoring of the adoption of technical and data standards that enable the CGDI, with the exception of the TBS Standard where federal government departments and agencies will be assessed for compliance.

The 2012 Assessment of the CGDI also found that Canadian geospatial personnel participate in standards development both in Canada and internationally. All standards bodies (e.g., OGC and ISO) solicit input from users through their members. GeoConnections most recently sought feedback in mid-2011 through a survey of broad spectrum users in the Canadian geospatial community to support the revision of the CGDI Vision, Mission, and Roadmap (VMR) (2012) document. Survey respondents expressed the view that GeoConnections has been a leader in standards development for web services and metadata, and was a crucial element for the introduction of interoperable standards, and established principles that were considered cutting edge at the time.

One current example identified through review of documentation was in relation to the Canadian Geometrics Community Round Table (CGCRT). An elected Steering Committee with representation from public, private and non-profits segments of the geomatics community has led the CGCRT in the development of a Pan-Canadian Geomatics Strategy (See Section IV). With community input gathered through 2013 and 2014, this Strategy was finalized at a two-day workshop in June 2014. To complete its term in office – which ended in January 2015 - the Steering Committee is currently exploring models for a new CGCRT governing body whose mandate will focus on implementing, monitoring and reporting on the Strategy.[108]

A significant number of private sectors organizations are involved in the adoption of geospatial standards, through their direct participation with the Open Geospatial Consortium (OGC) and/or the Canadian Advisory Committee on the International Organization for Standardization's Technical Committee on Geographic information/Geomatics (CAC-ISO/TC 211). Examples of

private sector companies that actively participate in either of these are: ESRI Canada, Fujitsu and Bentley Systems Inc. NRCan is also a member. Both the OGC and CAC-ISO/TC 211 are standards bodies that allow participants to achieve leading edge work as they build commercial geospatial products. OGC standards support interoperable solutions that are essential to the Canadian Geospatial Data Infrastructure (CGDI). OGC and ISO/TC 211 are collaborating on the development of geospatial standards via the Joint Advisory Group (ISO/TC 211 – OGC JAG). NRCan's membership in OGC allows the department to exercise its leadership in the adoption of open geospatial standards as well as supporting participating organizations.

Conclusion

Although the voluntary nature of CGDI has made for more complexity in the system, there is clear evidence of stakeholder involvement in developing standards, and other mechanisms to manage the lifecycle.

Overall Component Conclusion – Standards and Specifications

Overall results have been maintained on those indicator areas rated as 'Fully Meets' in the 2012 Assessment, and progress has been made in the indicator areas that were rated as 'Partially Meets' in relation to standards. Presently there are many standards either adopted by Canada or created through the work of GeoConnections and the CGDI. Additionally, resources have been made available to assist others to take up and implement these standards.

Presently the sole area for improvement is in relation to the usage of standards. The data strongly support exposure to them, but presently there do not seem to be strong mechanisms for measuring actual usage and implementation, with minor exceptions. This is likely attributed to the voluntary nature of the CGDI, which poses challenges in monitoring actual usage of materials, including standards.

The CGDI Standards and Specifications component indicators have been met demonstrating stable performance across all indicator areas with a movement from "partially meets" to "fully meets" in two areas. Exhibit 6 depicts the comparison of 2015 results to that of the 2012 indicator results with applicable indicator mapping indicated within each column.

Exhibit 6
Results of CGDI Standards and Specifications Component
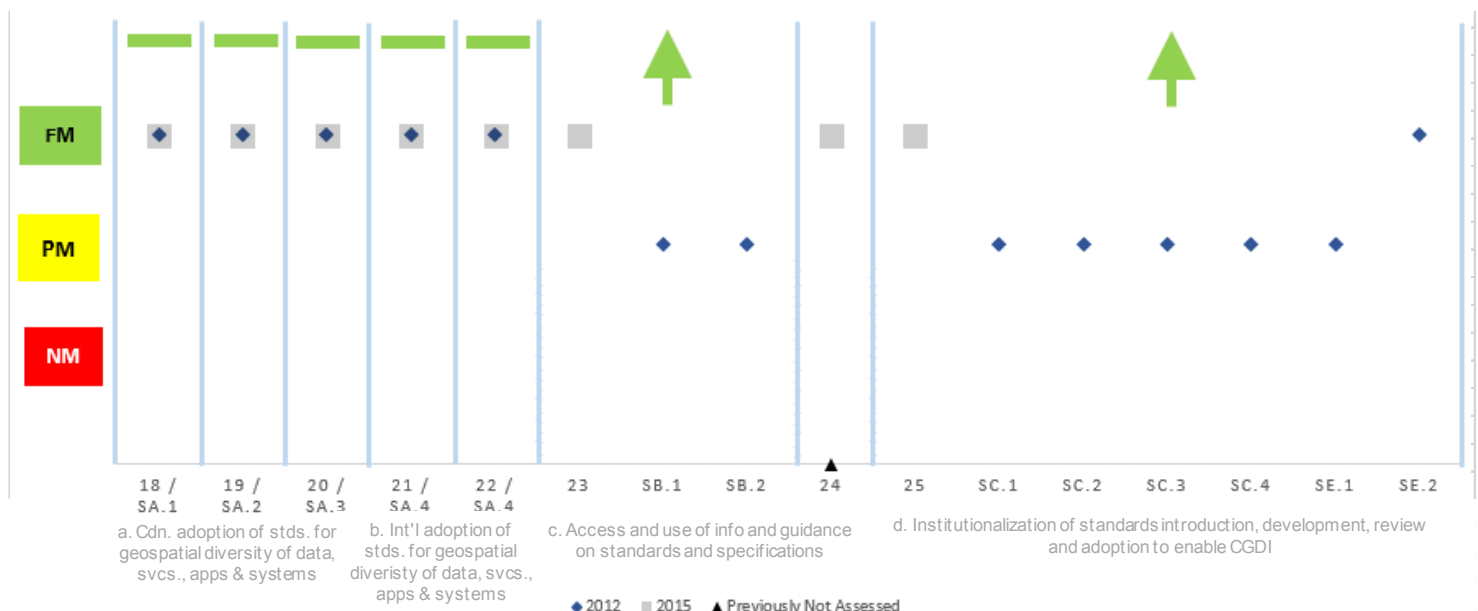
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100 United Nations Statistics Division. Country Report of Canada. 2014.

101 United Nations Statistics Division. Country Report of Canada. 2014.

102 The Canadian General Standards Board is a federal government organization that offers comprehensive standards development and conformity assessment services, including programs for certification of products and services, registration of quality and environmental management systems, and related services. It is accredited by the Standards Council of Canada and is currently responsible for 915 standards and specifications.

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108 United Nations Statistics Division. Country Report of Canada. 2014.

Chapter 7: Assessment of CGDI Component: Technology

The outcome measure being assessed under the Technology component is defined in the assessment framework as:

The CGDI uses a suite of innovative tools to provide a functional and accessible environment, which enables the development of systems and applications that integrate location-based information. The CGDI's open and flexible architecture continually adapts to the rapidly evolving Internet environment. These technologies facilitate the discovery, integration, sharing and dissemination, and access to Canada's location-based information.

Four performance results areas with four corresponding indicators were assessed under the Technology component.

Performance Result (a): There are technology tools in place that facilitate the discovery, integration, management, sharing, dissemination, visualization and access to Canada's location-based information over the internet	
Indicator	**2015 Assessment Findings and Result**
26. Technology tools exist for the discovery, access and dissemination of location-based information based on an architecture model.	**Assessment: Fully Meets Criteria** Numerous examples of location-based information-based technology tools have been identified to assist in discovery, access and dissemination of location-based information.

Analysis and Supporting Evidence

The 2012 Assessment of the CGDI found there was evidence that a significant number of portals exist for the discovery, access and dissemination of location-based information based on an architecture model. Example of portals included:

- The GeoConnections Discovery Portal as the prime discovery and access component of the CGDI.

- GeoBase was the primary source of framework data in Canada (has now been merged with GeoGratis). In 2012-13 there were 4,672,480 hits accounting for 15.2 terabytes of data on the GeoBase site.[109]

- GeoGratis provides geospatial data at no cost and without restrictions. In 2012-13 there were 6,472,405 hits accounting for 66.054 terabytes of data on the GeoGratis site.[110] A Data Extraction Tool was added as part of GeoGratis in 2013. This is a custom clipping area where users can choose what to download. Data show that in 2014-15 there were 11,817 downloads through 11 months.[111]

- The Atlas of Canada provides authoritative, current and accessible geographic information products at a national level.

- GEOSCAN is a searchable bibliographic database for scientific and technical publications of the Earth Sciences Sector (ESS) of NRCan.

- Canada's NFIS provides Web tools, ranging from simple portrayal to sophisticated analyses.

- The Groundwater Information Network (GIN) is focused on improving knowledge of groundwater systems and enhancing groundwater management through increased access to groundwater information.

The GeoConnections Discovery Portal [112] remains a key hub for sources of information on geospatial infrastructure tools and services. A new GeoScience Data Repository has been added, which offers access to scanned Geological Survey of Canada maps and GIS layers for thousands of published maps. Another addition to the Discovery Portal was the National Land and Water Information Service, which provides access to web sites and interactive mapping tools and GIS layer downloads dealing with land, soil, water, climate and biodiversity resources in Canada. The GeoConnections Discovery Portal saw 15,775 visits in 2012-13, although these only began being tracked during the second quarter of that year.[113]

In addition to the many regional portals made available through the Discovery Portal, there were four additions since 2012:

- COINAtlantic – An initiative of the Atlantic Coastal Zone Information Steering Committee (ACZISC) that is working to provide open access to data, information and applications relevant to Atlantic Canada.

- Great Lakes Information Network – Provides a centralized location to discover, publish, and acquire geospatial data for areas within the Great Lakes region.

- MLI – Offers a variety of methods of viewing and accessing a wide range of geospatial information for the province of Manitoba. Resources are available through interactive mapping, direct download, or referral to outside sources. Data files include topographic information, land use, orthoimagery, forest inventory, place names, and geology.

- SmartBay – Improves access to information for management and sustainable development of the diverse coastal and ocean resources of Placentia Bay.

The Discovery Portal also contains 12 thematic portals (e.g. Geology Ontario, Indian and Northern Affairs Canada GeoPortal, CLAIMaps, etc.), and four international portals as follows:

- Committee on Earth Observation Satellites (CEOS) International Directory Network (U.S.) – An international effort developed to assist researchers in locating information on available datasets. It is sponsored as a service to both the Earth and space science communities.

- Geospatial One-Stop (U.S.) – Serves as a public gateway for improving access to geospatial information and data under the Geospatial One-Stop E-Government initiatives.

- Australian Spatial Data Directory – Provides these search interfaces to discover geospatial dataset descriptions throughout Australia.

- Global Change Master Directory (U.S.) – Offers a high quality resource for the discovery, access, and use of Earth science data and data-related services worldwide, while specifically promoting the discovery and use of NASA data. The directory resource is targeted to serve as a valued location for sharing data from multinational sources and in turn will contribute to scientific research by providing stewardship of metadata and direct access to Earth science data and services.

Additionally, Cube Werx, a private company and a recipient of GeoConnnection's Departmental Class Grants and Contributions Program, has developed a Cloud-based National Imagery service. The service is intended to enable users to access imagery data from multiple federal and provincial government sources in an interoperable and integrated way. With the use of GeoConnections standards, tools and operational policies for sharing, using and integrating geospatial data and service expertise, the recipient was able to develop an effective, standards-compliant National Imagery Service housing a large volume of imagery from the collaborating partners.

Finally, two data sources are now available for the creation of elevation products: the Canadian Digital Elevation Model (CDEM) and the Canadian Digital Surface Model (CDSM). Besides digital elevation models, other derived products such as slope maps, shaded relief maps, color relief maps, color shaded relief maps, aspect maps, and elevation points can be extracted. Parameters allow users to personalize their products. The web interface offers a dynamic map for pre-visualizing the information and to locate the area of interest. Current efforts are underway to add capability to the system for the acquisition, quality control, storage, management and distribution of derived elevation models.[114]

It is also noteworthy to mention that the OGC is leveraged as a conduit/vehicle to industry's adoption of standards in technologies and business applications. The OGC enables development, testing, and demonstration of proprietary and open source technologies against each other for interoperability through the promotion of standards. As such, geospatial data can be used interoperably on different platforms and Web services. The geospatial software industry that implements OGC standards can test their software against tests called CITE tests (http://www.opengeospatial.org/compliance) for OGC certification. OGC certified software provides confidence of compliance with OGC standards and interoperability. The OGC certification process fits into the CGDI to ensure that users of the Canadian infrastructure can be accessed through interoperable applications and can interoperate with other SDIs worldwide.

Conclusion

There is adequate evidence from both the 2012 Assessment and the current assessment to support a rating of 'Fully Meets' for this indicator. There are a wide variety of technology tools and resources available for users to access CGDI data.

Performance Result (a): There are technology tools in place that facilitate the discovery, integration, management, sharing, dissemination, visualization and access to Canada's location-based information over the internet	
Indicator	**2015 Assessment Findings and Result**
27. Technology tools are aligned with emerging internet and technology trends.	**Assessment: Partially Meets Criteria** While current technology tools appear to be aligned with the emerging internet and technology trends, such as mobile devices/accessibility and other 'leading edge' projects promising real-time data, there is a gap related to the uncertainty of updating existing data and tools to align with future technological requirements.

Analysis and Supporting Evidence

The 2012 Assessment of the CGDI found that there is a need for CGDI and other SDIs to adapt and keep up with the rapidly evolving internet and technology environment. Issues relating to the technology area of CGDI that were identified by GeoConnections in the Framework for the Sustainability of the CGDI are as follows:

- Advent of mass market geomatics (MMGs) - the emergence of mass market geomatics, such as Google Earth™, and their intuitively easy user interfaces, highlight new opportunities and threats to the CGDI. For example, by enabling non-geo experts to easily contribute geospatial data, MMGs are challenging important CGDI principles, including the principle that data should be collected and maintained closest-to-source, and the very idea that the CGDI is a repository of authoritative data.

- Barriers to CGDI use and access - in order to decrease the barriers to adopting CGDI technology and access to data, services and applications, the ease of use of the related technology needs to increase.

- Technical Governance - furthering the technological development of the CGDI requires a governing body to effectively perform many community building tasks, such as administering the standards adoption and review process. Currently, CCOG and TB perform some of these functions, although it pertains to only part of the overall CGDI and to certain technological areas.

Several examples of new and modified technology tools for aligning with internet and technology trends were identified. For instance, Canada uses leading-edge satellite ground systems technology to provide real-time scientific information on its landmass to address a wide array of topics that are important to Canadians, such as environmental monitoring, stewardship, resource exploration and development, emergency response, navigation, sovereignty and security. The GoC is revitalizing NRCan's satellite station facilities with the installation of four antennas: two in Prince Albert, Saskatchewan (June 2014 and fall 2014); one in Gatineau, Québec (June 2014); and one in Inuvik, Northwest Territories (August 2014). These satellite station facilities are strategically located across Canada to provide full coverage of Canada's landmass. The revitalization also includes a data management system to house and safeguard satellite information and to help ensure the data received by these facilities are accessible to the users.[115]

The Height Reference System Modernization (Height Modernization) is a project at NRCan for the development, implementation and promotion of a gravity-based height reference system for Canada. In other words, it is the realization of a new vertical datum for Canada by geoid modelling, rather than by geodetic levelling. It will enable measurements of elevations with respect to a consistent vertical datum everywhere across the country using the Global Positioning System (GPS) and emerging Global Navigation Satellite System (GNSS) technologies. This new approach will allow reduction dependency on monumented networks for height determination. It will reduce the physical maintenance from some 80,000 federal benchmarks to some 250 stations making the Canadian Active Control System (CACS) and Canadian Base Network (CBN). These networks will be augmented by the provincial High Precision Networks (HPN).

The Canadian Geodetic Vertical Datum of 2013 (CGVD2013) was released in November 2013, and is now the new standard for heights across Canada. This new height reference system is replacing the Canadian Geodetic Vertical Datum of 1928 (CGVD28), which was adopted formally by an Order in Council in 1935.

Arguably mobile access to data and information is an ongoing technological requirement. The ESS website content is able to be accessed and used by mobile devices; however, there was minimal access in this manner in 2012-13. In fact, mobile usage accounted for only 5%, while traditional desktop/laptop usage accounted for 90%. For 5% of the access, the platform is unknown.[116]

Canada's membership in the OGC also provides an ability for the CGDI to remain aligned with emerging internet and technology trends. With the OGC's more than 500 participating members and alliance partners, the OGC is well positioned to respond to cross-cutting requirements for innovative and relevant processes, standards and supporting services. Continuous and evolving standards development and testing certification enables members to be at the forefront of trending technology needs and gaps to support interoperability on different platforms and Web services during the development and commercialization of products.

Lastly, a report of the Coalition of Geospatial Organizations, in reviewing the U.S. National SDI (NSDI) found there is a critical need to "fund the infrastructure that supports data coordination, management, maintenance, and distribution functions. These are typically not 'sunk costs' that have already built adequate infrastructure. They are ongoing costs that are essential for maintaining data accuracy and currency, and changing technologies." That report also identified a concern about the ability to align with emerging technological trends. It stated, "New technologies, processes, and standards will undoubtedly be adopted or acquired as part of normal agency operations, resulting in incremental steps forward. While these efforts should keep a status quo, it does not promise significant steps forward for the Framework component of the NSDI".[117]

Conclusion

While current technology tools appear to be aligned with the emerging internet and technology trends, such as mobile devices/accessibility and other 'leading edge' projects promising real-time data, there is a gap regarding the uncertainty of updating existing data and tools to align with future technological requirements.

Performance Result (b): CGDI stakeholders have the capacity to implement technology tools.	
Indicator	2015 Assessment Findings and Result
28. Availability of implementation capacity building resources to support technology implementation (i.e., guidance documents, architecture models and/or reusable tool documentation).	**Assessment: Partially Meets Criteria** There are a number of capacity building resources to support technology implementation available. However, an update to the Developer's Guide (2007) is required. The evidence identified has not supported adequate replacement of this key document.

Analysis and Supporting Evidence

The following guides were listed as available in the GeoConnections Discovery Portal in the 2012 Assessment: User's Guide, Supplier's Guide and Computer Based Training, in the Developer's API Guide, Portlet Deployment, Iframes, and Application Sharing. However, GeoConnections used to provide a document entitled "A Developer's Guide to the CGDI: Developing and Publishing Geographic Information, Data and Associated Services." This guide dated 2007 is no longer available, although it is identified frequently in internet searches and is cited by CP-IDEA as a Best Practice under Standards. When the 2012 Assessment of the CGDI was completed, it did not appear the current suite of information on the GeoConnections website effectively replaced this Developer's Guide.

Although this appears to be a gap, there are several other guidance documents available, as listed as part of the evidence for Indicator 23. However, none of these appear to have been published subsequent to the 2012 Assessment, which leads to uncertainly regarding what has replaced the Developer's Guide.

The OGC analysis and test bed activities provide support for technology implementation which is a benefit of Canada's membership in the organization.   The geospatial software industry that implements OGC standards can test their software

against tests called CITE tests (http://www.opengeospatial.org/compliance) for OGC certification. OGC certified software provides confidence of compliance with OGC standards and interoperability.

Conclusion

Despite the existence of several resources to support technology implementation, there does not appear to be an adequate replacement for the Developer's Guide to the CGDI, which the 2012 Assessment highlighted as a key gap. Until there is evidence of a replacement for this document, this indicator cannot be concluded as fully met.

Performance Result (b): CGDI stakeholders have the capacity to implement technology tools.	
Indicator	**2015 Assessment Findings and Result**
29. Evidence of CGDI architecture model/tools used in specific implementations.	**Assessment: Fully Meets Criteria** Specific examples of CGDI architecture are evidenced in the 2012 Assessment and continue to perform as live applications. The Arctic SDI project and FGP are current examples of CGDI architecture used in practice.

Analysis and Supporting Evidence

The 2012 Assessment found there was evidence that CGDI architecture models/tools are used in specific implementations. This was largely based on the fact that there were many applications identified that use the CGDI architecture model. These include:

- GeoBase;
- GeoGratis;
- Atlas of Canada;
- GEOSCAN;
- NFIS; and,
- GIN.

In addition to this evidence, there are the many portals noted in Indicator 26 that use the CGDI architecture model, and many of the applications use the tools provided by the portals. There are also specific project examples that point to CGDI architecture model usage. These include, the Arctic SDI and the FGP.

The Arctic SDI technical architecture is intended to help ensure users have easy access to current spatial data from the National Mapping Agencies and from thematic data producers in the Arctic. Data are published to a variety of web-based services. These services are based on international standards and leverage SDI methods and operational policies. The Arctic SDI technical architecture considers metadata, data models, use of technology, user requirements for download, data combining, data analyzing and processing, and operational policies in its design.[118] One example of implementation of this architecture is a Michigan Tech project commissioned by the Arctic Council. The project developed circumpolar earth observation products from MODerate resolution Imaging Spectroradiometer (MODIS) sensor.[119]

The FGP architecture model is not yet fully developed, but is intended to be completed in summer 2015. It is intended to be robust, conform to TBS standards and guidelines, align with industry standards and trends, incorporate 'Best of Breed' components, be flexible and simple, include support, be affordable by leveraging existing investments, and comprise a loosely coupled integrated ecosystem. It will consist of the following technical components and a supporting application development environment:[120]

Technical components

- A shared infrastructure, in which the technical components of FGP will be developed, tested and deployed. The infrastructure is provided by Shared Services Canada.
- A collection of standards based web services exposing data held in departmental spatial databases.
- A web-accessible geospatial data visualization application consuming web-accessible services providing access to a selection of federal government datasets relevant to Responsible Resource Development Use Case. The application is available from the data.gc.ca (URL to change) open data portal for the GoC. The visualization application is also freely

available on GitHub (a web-based hosting service for software development projects that use the Git revision control system.

- A metadata catalogue describing geospatial data, services and applications that are available from federal government departments contributing to the FGP project. New spatial search functionality is available on the data.gc.ca Open Data portal for the GoC.

Application development environment

- A shared development environment for FGP's technical contributors to build applications which consume web service
- Following Year 1, additional development phases will bring the FGP to its Year 2 implementation target state. This approach allows the FGP team to establish a presence on data.gc.ca while facilitating feedback to improve user experience and access to data in subsequent architecture iterations and project phases.

Conclusion

Specific examples of CGDI architecture were evidenced in the 2012 Assessment and continue to perform as live applications. The Arctic SDI project and FGP are current examples of CGDI architecture used in practice.

Overall Component Conclusion – Technology

The assessment concludes that the technologies component performance indicators have been partially met. A number of technology tools exist to assist in the discovery, access and dissemination of location-based information. There has been an upward trend in downloads from GeoGratis and GeoBase data portals and an increase in clients served. Current technology tools appear to be aligned with the emerging internet and technology trends, such as mobile devices/accessibility and other 'leading edge' projects promising real-time data.

However, the retraction of the Developer's Guide to the CGDI remains a gap and there is uncertainty surrounding the requirements to align the CGDI with future technological advancements or emerging issues.

The CGDI Technology component indicators have only partially been met but demonstrate incremental progress in at least one area. Exhibit 7 depicts the comparison of 2015 results to that of the 2012 indicator results with applicable indicator mapping indicated within each column.

Exhibit 7
Results of CGDI Technology Component

| | 26 / TA.1 | 27 / TA.2 | 28 / TB.1 | 29 / TC.1 |

a. Tech. tools in place for discovery, integration, mgmt., sharing, dissemination, visualization and access to Canada's location-based info over the Internet

b. Access and use of technology tool information and guidance by CGDI stakeholders

◆ 2012   ■ 2015   ▲ Previously Not Assessed
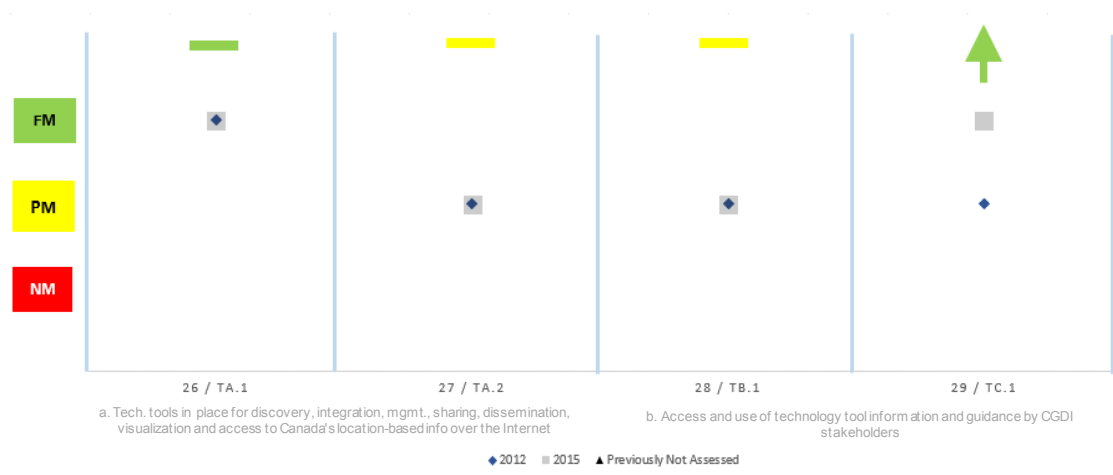
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Chapter 8: Summary of Progress and Development of the CGDI

NOTE: The overall account of progress and development will be further elaborated upon the client's review of the draft assessment ratings contained in this draft report.

8.1 Overall Performance

This chapter presents a summary of overall performance against the 33 indicators of the CGDI Assessment Framework, and progress toward the Roadmap objectives. Overall, 79% of the indicators have achieved performance as their criteria are fully met by the available evidence (see Exhibit 8). This is an increase of 26% since the 2012 Assessment. The remainder (21%) of indicators are only partially met by the available evidence. None of the indicators are considered unmet, which is consistent with the 2012 Assessment. The 2012 Assessment reported on 47 indicators with 25 (53%) fully meeting the criteria and 22 (47%) partially meeting the criteria.

Exhibit 8
Summary of Performance against CGDI Assessment Indicators
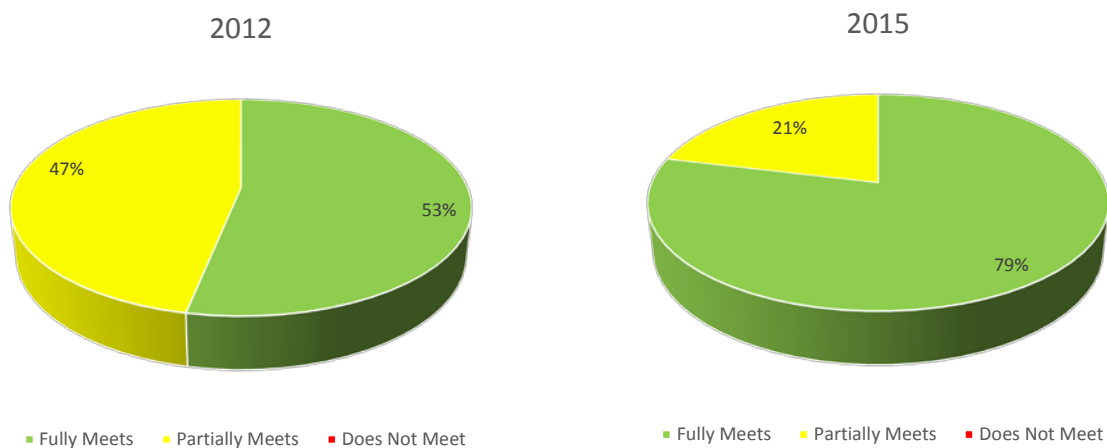
Exhibit 9 is a graphical summary (matrix of ratings) by component, indicator and criteria. The summary illustrates the rating for each criteria assessed both during this assessment as well as the 2012 Assessment to illustrate the change between the two time periods.

Exhibit 9
Summary of 2015 versus 2012 Indicator Ratings

Collaboration

	1 / CA.1	2	CA.5	CA.6	3	CB.1	CB.2	CC.2	CB.3	CB.4	4	5 / CC.1	6 / CA.4	7	8 / CD.1	9	CA.3	PE.1	SD.1	TC.1

a. Leader / Champion   b. Vision / Strategy   c.Stakeholder Engmt.   d. Int'l Linkages   e. Processes to monitor adoption of CGDI & reporting

◆ 2012   ■ 2015   ▲ Previously Not Assessed

Operational Policies

10 / PA.1	11 / PA.2	12 / PA.3	13 / PA.4	14 / PB.1	15 / PC.2	16 / PC.1	17	PD.1	PE.2	PF.1

a. Canadian policy resources exist to support SDI interoperability   b. Cdn. policy promotion for int'l alignment.   c. Access & use of policies by CGDI stakeholders   d. Mechanisms for introduction, development, review and adoption of geospatial policies

◆ 2012   ■ 2015   ▲ Previously Not Assessed

Standards and Specifications

18 / SA.1	19 / SA.2	20 / SA.3	21 / SA.4	22 / SA.4	23	SB.1	SB.2	24	25	SC.1	SC.2	SC.3	SC.4	SE.1

a. Cdn. adoption of stds. for geospatial diversity of data, svcs., apps & systems   b. Int'l adoption of stds. for geospatial diversity of data, svcs., apps & systems   c. Access and use of info and guidance on standards and specifications   d. Institutionalization of standards introduction, development, and adoption to enable CGDI

◆ 2012   ■ 2015   ▲ Previously Not Assessed

Technology

26 / TA.1	27 / TA.2	28 / TB.1	29 / TC.1

a. Tech. tools in place for discovery, integration, mgmt., sharing, dissemination, visualization and access to Canada's location-based info over the Internet   b. Access and use of technology tool information and guidance by CGDI stakeholders

◆ 2012   ■ 2015   ▲ Previously Not Assessed

Framework Data

30 / FA.1	31 / FB.1	32 / FC.1	33 / FC.2

a. Available data themes are current and complete   b. Framework data themes are able to be integrated   c. There are mechanisms in place for development of national framework data themes

◆ 2012   ■ 2015   ▲ Previously Not Assessed

8.2 Comparison of Achievements and Gaps with CGDI's Roadmap

This assessment's findings were collected in conjunction with the approved methodology and performance indicators in Chapters 3 through 7. The evidence presented below in the table is evidence available that relates to the goals and objectives presented in the Vision, Mission and Roadmap – the Way Forward Report produced by GeoConnections, (2012)

Goal	Objectives	Evidence of Achievement of the CGDI Roadmap Goals and Objectives
VALUE	1. **Public Asset**: Ensure that the CGDI is a national asset for all Canadians, which facilitates effective decision making, innovation, and the management of Canada's issues and priorities.	This Assessment has found that the following findings support the goal and objectives for Public Asset: ▪ Open Government Directive and Open Government Licence demonstrate substantial effort to render published federal government's data and information accessible to citizens, researcher and civil society. ▪ Documented examples of the impact and benefits of open geospatial data exist in the form of case studies, five distinct examples of usage of the CGDI for better decision making. ▪ Development of the Pan-Canadian Strategy by the CGCRT included involvement from all stakeholders of the Geomatic Sector.
	2. **Economic Benefit**: Ensure the CGDI helps the geomatics industry to be a thriving and competitive industry.	This Assessment has found that NRCan has announced the Canadian Geomatics Environmental Scan and Economic Value Study that is scheduled to be completed in the spring of 2015. The primary focus for the study is to understand the current situation and emerging trends in Canadian geospatial activities and their overall direct and indirect economic value and contribution to the Canadian economy.
	3. **Leadership/Competitiveness**: Ensure the CGDI is a leading example and a world model in SDI development.	This Assessment has found that the following findings support the goal and objectives for leadership/competitiveness: ▪ GeoConnections (NRCan) was the lead in the production of The SDI Manual for the Americas for CP-IDEA ▪ GeoConnections worked with the CGSB, and the U.S. Inter-National Committee for IT Standards Committee L1 to develop the geographic metadata content needed to tailor the international standard ISO 19115 to meet the requirements of both countries. ▪ Canada contributed to A Guide to the Role of Standards in Geospatial Information Management, an output of the UN Committee of Experts on Global Geospatial Information Management.

Goal	Objectives	Evidence of Achievement of the CGDI Roadmap Goals and Objectives
PERFORMANCE	4. **Quality/Usefulness**: Refine and promote systems that clearly identify the quality and value of data so that end-users can interpret and trust its content.	This Assessment has not found evidence to support the goal and objectives for quality/usefulness; furthermore, data quality and trustworthiness were identified as areas of policy gaps.
	5. **Adaptability**: Ensure that data is used for maximum benefit through seamless, integrated technology that enables fluid end-user transactions and simultaneous user access to diverse sources of data.	This Assessment has found that the following findings support the goal and objectives for adaptability: ▪ Within the GoC, the TBS Standard on geospatial data, issued in 2009, requires all federal departments and agencies to conform to the ISO 19115 Metadata standard and the ISO 19128 Web map server interface standard by May 1st, 2014. These standards help ensure interoperability across federal government departments and agencies.
	6. **Data Access/Efficiency**: Ensure that all Canadian data is managed for maximum efficiency at the lowest cost with the greatest positive impact on or for Canadian society.	This Assessment has found that the following findings support the goal and objectives for data access/efficiency: ▪ NRCan released three national geospatial datasets: the NRWN, the National Road Network, and the National Hydrographic Network.
	7. **Innovation/Stimulation**: Update and create regulations, policies, standards and tools that will ensure the continued integration of geospatial data into functions of the Canadian economy and governance.	This Assessment has found that the following findings support the goal and objectives of culture of Innovation/Simulation:: ▪ GeoConnection has produced policies and standards related to Voluntary Geospatial Information (VGI) and policies and standards related to CC. ▪ Operational policies and capacity building resources are available from NRCan's website, under CGDI-Resource Centre.
GROWTH	**Culture of Sharing /Open Data**: Create and formalize a culture of open data sharing through alignment of policy that is driven by a common understanding of the importance to manage and share Canadian geospatial data.	This Assessment has found that the following findings support the goal and objectives of culture of sharing/open data: ▪ The Open Government Directive provides clear and mandatory requirements for federal department and agencies in regards to open data and information. ▪ The Open Government website communicates and promotes the benefits of open data and open information, it also encourages all government jurisdiction to adopt an open government policy. ▪ The Canadian Geospatial Accord has been renewed for the period 2014-2019. ▪ Produced the case study of GeoGratis Portal that identify and assess the uptake, use, value and benefits of geospatial operational policies contributing to the interoperability and sustainability of the CGDI.

Goal	Objectives	Evidence of Achievement of the CGDI Roadmap Goals and Objectives
	Collaboration/Incentive: Support the CGDI by establishing clear incentives and ongoing collaboration that focuses on sustaining and growing the data available through the CGDI.	This Assessment has found that the following findings support the goal and objectives of culture of collaboration/incentive: - Renewed Canadian Geomantic Accord that defines roles and responsibility of framework Geospatial Data in Canada. - Development of the Pan-Canadian Strategy by the CGCRT, required the collaboration of all stakeholders of the Geomatic Sector.

Chapter 9: Overall Conclusions

9.1   Overall Conclusions

The CGDI continues to develop in its maturity and has implemented mechanisms to fully meet almost 80% of the criteria upon which it is being assessed. Increased maturity or stable performance was noted across all assessment areas with only a few gaps identified in monitoring and reporting, communication, and policy development.

Overall, the Collaboration component indicators have largely been met demonstrating increased performance since 2012. The leaders and coordinating bodies continue to evolve and drive the CGDI at a number of levels in Canada across public, private and academic sectors through the commitment of both in-kind and financial resources to the CGDI. A Pan-Canadian Geomatics Strategy has been developed that presents an updated vision and mission for the geomatics sector, defines future roles and responsibilities of stakeholders and is aligned with stakeholder priorities. Formalized networks and communications and outreach activities continue to engage direct CGDI stakeholders allowing inclusive contributions to CGDI development and sustainability as well as the use of CGDI components to facilitate decision-making. Canada has continued to participate in numerous international geospatial data related organizations and has continued its commitment to exchanging and sharing experiences internationally.

Framework Data component indicators have been fully met demonstrating stable performance. There is availability of data across data themes and continuous contributions are being made by federal and provincial governments. Formal agreements for the sharing of data between Canadian federal and provincial jurisdictions continue to be in place that include mechanisms to coordinate data collection, quality control and maintenance. Additionally, agreements to support data sharing at the international level have been established and maintained. Efforts in this component area are allowing for the integration of geospatial information by data users.

The Operational Policies component indicators demonstrate stable and improved performance with movement from "partially meets" to "fully meets" against two indicators. Policy development addressing previously identified user needs and policy gaps has been initiated through a formalized plan and subsequent development of policy guidance, as well as the development of resources to assist with developing organizational capacity on operational policies has been completed. There have been efforts to promote policy development, policy adoption, policy implementation and outreach, consultation and awareness activities undertaken. Policy gaps still exist regarding data quality and trustworthiness, data stewardship and data integration.

Additionally, an increasing number of governments in Canada have adopted open data policies, including the federal government's development of the Open Government Directive, Open Government License and creation of the new www.open.canada.ca website. There is also evidence of continued alignment with international operational policy. However, there is limited information readily available regarding data sharing agreements other than open data.

The Standards and Specifications component indicators also demonstrate improved performance since 2012. Presently there are many standards either adopted by Canada or created through the work of GeoConnections and the CGDI. Resources have been made available to assist others in the adoption and implementation of these standards. While the data strongly support exposure to standards, presently there do not appear to be strong mechanisms for measuring actual usage and implementation. This is likely attributed to the voluntary nature of the CGDI, which poses challenges in monitoring actual usage of materials, including standards.

Technology component indicators have only partially been met but demonstrate incremental progress in the use of CGDI architecture model/tools in specific implementations. A number of technology tools exist to assist in the discovery, access and dissemination of location-based information. There has been an upward trend in downloads from GeoGratis and GeoBase data portals and an increase in clients served. Current technology tools appear to be aligned with the emerging internet and technology trends, such as mobile devices/accessibility and other 'leading edge' projects promising real-time data.

However, the retraction of the Developer's Guide to the CGDI remains a gap and there is uncertainty surrounding the requirements to align the CGDI with future technological advancements or emerging issues.

9.2   Case Studies Conclusions

The two case studies conducted as part of the 2015 CGDI Assessment were both able to demonstrate adoption, use and implementation of CGDI policies, standards, technology and framework data. These cases studies are included as Appendix C and D.

For the FGP, access to up-to-date standardized data is reducing much of the work and re-work required to use geospatial data across departments by providing the common platform of technical infrastructure, policies, standards and governance. This is similar to the Arctic SDI in where efforts at the international level through the development of a framework to integrate and access datasets inter-jurisdictionally is providing a common platform to advance interoperability among countries. The Yukon Water Board project is already assisting in decision-making on water licensing for specific projects through enabling simultaneous consideration of multiple factors and potential impacts in order to conduct thorough and comprehensive assessments. The base geospatial layers have assisted in assessing the risks and potential magnitude of impacts of each program on the surrounding environment and specific First Nations holdings.

In all cases the CGDI was leveraged to achieve benefits surrounding identified business needs, including improved access to information, accessibility, reduced duplication of effort and improved collaboration.

Appendix A - Evolution of the CGDI's Vision, Mission and Objectives

	2001[121]	2005[122]	2012[123]	2015[124]
	GeoConnections Establish & Build (Phase I) "The Supply-Side"	**GeoConnections Evolve & Expand (Phase II) "The Demand-Side"**	**GeoConnections Integrate & Sustain (Phase III) "Tying it All Together"**	**Canadian Geomatics Community Round Table The Pan-Canadian Geomatics Strategy**
CGDI Vision	A Canadian geospatial information infrastructure that is accessible to all communities, pervasive throughout our country, ubiquitous for its users, and self-sustaining, to support the protection and betterment of Canada's health, social, cultural, economic and natural resource heritage and future.	To enable access to the authoritative and comprehensive sources of Canadian geospatial information to support decision-making.	Canadians have open, secure and continually available access to comprehensive location-based data about Canada through the community-sustained CGDI in support of prosperity and well-being for all.	Canadian Geomatics will be a world class, thriving and openly engaged Sector providing reliable geospatial data and information products, technology, services and expertise underpinning Canada's economic success in the business of "where".
CGDI Mission	GeoConnections will foster the creation of a CGDI to enable online access and sharing of geographic information and services.	− Enable decision-making and policy development that addresses Canada's priority issues such as health, social, cultural, economic, and natural resources. − Facilitate access to the leading sources of Canadian geospatial information − Provide continued involvement and leadership in the development of geospatial standards and specifications. − Foster partnerships and sharing of geospatial	− Communicate the benefits of maintaining a national geoSDI. − Encourage and inspire all Canadians to manage, access, share and contribute comprehensive Canadian location-based data. − Support the continued evolution and enhancement of data availability within the CGDI through the development of innovative and robust policies, standards and technologies.	We make recognizable, highly valued contributions to the Canadian economy, environment and society by providing geospatial data and information products, technology, services and expertise to address priority economic, environmental and societal needs.

	2001[121]	**2005**[122]	**2012**[123]	**2015**[124]
	GeoConnections Establish & Build (Phase I) "The Supply-Side"	**GeoConnections Evolve & Expand (Phase II) "The Demand-Side"**	**GeoConnections Integrate & Sustain (Phase III) "Tying it All Together"**	**Canadian Geomatics Community Round Table The Pan-Canadian Geomatics Strategy**
		information across all sectors, at all levels of government, and at the international level. − Support a broad and vibrant user community. − Ensure that infrastructure operations are ongoing and sustainable.		
Objectives	− Increase the amount of geospatial data, information and services available on-line; − Ease data integration issues and data standardization; − Expand the use and application of geo-info − Promote the development of innovative technology; and − Simplify the conditions for geo-info use and resale.	− Develop the capacity of new users to apply geospatial information to decision-making priorities; − Secure long-term access to the geospatial data needed by users; − Operate and evolve infrastructure technologies and standards in support of user needs; and − Coordinate the management of federal, provincial and territorial, and municipal geomatics policies to avoid duplication and increase benefits.	− Increase awareness of the benefits of using geospatial data and tools to achieve goals for key economic, social and environmental priorities; − Facilitate the integration and use of geospatial data to support effective decision making; − Lead the coordination, development and support the implementation of national policies, standards and mechanisms to ensure maintenance and up-dating of geospatial data and integration with global standards; and − Keep Canada at the leading edge of accessing, sharing and using geospatial information via the Internet.	Objectives are detailed through a set of seven Strategic Dimensions: − Identity: The Canadian Geomatics Sector needs to reposition its identity to evolve beyond the primary focus on data capture, processing and delivery; − Market: Canadian Geomatics companies needs to differentiate themselves and strategically align their activities to compete at a high level globally and to become leaders in the industry; − Business model: A new Geomatics Sector business model collaboratively defined and optimized between the public and private sectors based on clear definitions of respective roles and responsibilities; − Leadership and Governance: Governance structure that enhance communication among all levels and dimensions of the Sector, engaging and mentoring of next-generation leaders and contribution from all major groups in the Geospatial community;

	2001[121]	2005[122]	2012[123]	2015[124]
	GeoConnections Establish & Build (Phase I) "The Supply-Side"	**GeoConnections Evolve & Expand (Phase II) "The Demand-Side"**	**GeoConnections Integrate & Sustain (Phase III) "Tying it All Together"**	**Canadian Geomatics Community Round Table The Pan-Canadian Geomatics Strategy**
				− Education and Capacity Building: A coherent geomatics education system from K to post-graduate with an adaptive and proactive curriculum that: meets the demand for geomatics professionals and specialists to support Canada's network of SDIs; − Data Sources: Consistent and seamless access through Canadian SDI (SDIs) to open, easily accessible Canada-wide authoritative geospatial data sets (land, sea, air, statistical, environmental, socioeconomic, etc.); and − Legal and Interoperability: A harmonized, consistent and transparent policy framework evolving with the pace of technological change, which supports geospatial-enablement of society through effective and inclusive collaborative governance.

[121] GeoConnections. (2001). Canadian GeoSDI Target Vision. http://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/288/288842/cgdi_ip_02_e.pdf

[122] GeoConnections. (2005). Vision: The Canadian GeoSDI. Better knowledge, better decisions. http://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/288/288848/cgdi_ip_05_e.pdf

[123] GeoConnections. (2012). Canadian GeoSDI. Vision, Mission and Roadmap Project. The Way Forward and Mapping Information Branch. (2011). GeoConnections III: Supporting Knowledge Integration. http://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/292/292417/cgdi_ip_28e.pdf

[124] CGCRT (2014). The final draft of the Pan-Canadian Geomatics Strategy. http://cgcrt.ca/en/round-table-outcomes/strategy-2/

Appendix B - Assessment Indicator Mapping 2012 vs 2015

		2015 Indicator			2012 Indicator
Collaboration					
a) Has an identified leader/champion with the mandate to coordinate.	Indicator 1	Evidence of an identified leader/coordinating body to coordinate the ongoing maintenance and evolution of the CGDI.	CA.1:		Evidence of an identified leader/coordinating body to coordinate the ongoing maintenance and evolution of the CGDI
	Indicator 2	Evidence of a network of resources within the coordinating body for the ongoing coordination of the CGDI.	CA.5:		Evidence that the identified leader/coordinating body has a budget and clear business model to sustain it
			CA.6:		Evidence of adequate resources within the coordinating body for the ongoing coordination of the CGDI
b) Has a vision and strategy	Indicator 3	Evidence of a vision and a strategy for the CGDI that includes stakeholders' roles and is aligned with key stakeholder priorities.	CB.1:		Evidence of a vision for the CGDI
			CB.2:		Evidence of a strategy for the CGDI
			CC2.:		Evidence that CGDI stakeholders contribute to strategies in support of CGDI development.
			CB.3:		CGDI stakeholder roles and responsibilities in the SDI are articulated within the vision /strategy
			CB.4:		Evidence that the vision or strategy is aligned with federal government priorities
	Indicator 4	Evidence that CGDI stakeholders contribute to strategies in support of CGDI development.			Indicator not assessed
c) Has the commitment and engagement of stakeholders.	Indicator 5	Evidence of the commitment and engagement of CGDI stakeholders through structured and formalized networks (such as coordinating committees, national committees Federal-Provincial, Provincial/Territorial committees, Private Sector committees, policy/technology/standards approval bodies).	CC.1:		Evidence of commitment and engagement of CGDI stakeholders through structured and formalized networks.
	Indicator 6	Evidence that the identified leader/coordinating body communicates and promotes the CGDI with stakeholders.	CA.4:		Evidence that the identified leader/coordinating body communicates, engages and promotes the CGDI with stakeholders
	Indicator 7	Policy makers use CGDI components (policies, standards, technology, framework data) to facilitate decisions.			Indicator not assessed
d) Linkages to international organizations.	Indicator 8	Evidence of promotion/exchange of experience with international organizations.	CD.1:		Evidence of promotion/exchange of experience with international organizations
e) Has instituted mechanisms and processes to monitor the adoption and implementation of the CGDI and report on activities, status and achievements.	Indicator 9	Evidence that the identified leader/coordinating body monitors and reports on SDI activities including: - Development and use of operational policy resources - Development and use of standards and specifications - Availability of standards-based technologies - Development and implementation of Framework data	CA.3:		Evidence that the identified leader/coordinating body initiates, monitors and reports on SDI activities.
			CPE1:		Description of mechanisms in place for monitoring
			CSD1:		There are mechanisms in place to monitor the implementation of the established technical and data standards by CGDI stakeholders.
			CTC.1:		Evidence of CGDI architecture model/tools used in specific implementations.

2015 Indicator			2012 Indicator	
Operational policy				
a)	There are Canadian policy resources to support SDI interoperability.	Indicator 10	Operational policy guidance and best practices that address: - Licensing; - Privacy; - Volunteered GI; - Intellectual property/copyright; - Archiving and preservation of data; and - Other elements.	PA.1:	Operational policy guidance and best practices
		Indicator 11	Evidence of federal open data policies.	PA.2:	Evidence of national open data policies.
		Indicator 12	Evidence of open data policies within other non-federal jurisdictions.	PA.3:	Evidence of open data policies within Provincial/Territorial/Municipal jurisdictions
		Indicator 13	Evidence of data sharing arrangements other than open data policies.	PA.4:	Evidence of data-sharing arrangements other than open data policies.
b)	Promotion of Canadian policy resources to facilitate, coordinate and align with SDIs at the international level.	Indicator 14	Evidence of alignment with international policy issues: - Licensing; - Privacy; - Volunteered GI; - Intellectual property/copyright; - Archiving and preservation of data; - Open Source; - Open Data; - Open Standards; and - Other policy issues to be identified.	PB.1:	Evidence of alignment with international policy issues.
c)	CGDI stakeholders are able to access and are using policy resources operational issues.	Indicator 15	Evidence of available resources to develop organisational capacity on operational policies.	PC.2:	Evidence of capacity development resources with respect to operational policy
		Indicator 16	Examples of adoption of geospatial operational policy.	PC.1:	Examples of use of geospatial operational policy resources.
d)	There are mechanisms and a process established for the introduction, development, review and adoption of geospatial operational policies that enable the CGDI.	Indicator 17	Evidence that mechanisms and a process exists to cover the lifecycle of geospatial operational policies including: - Identification of stakeholder requirements to guide the development of policy resources. - Organizational arrangements in place to manage the lifecycle of geospatial operational policies. - Processes to introduce policy resources including prioritization of topics, to identify stakeholder involvement for development, to review policy resources including consideration for current vs. future state, and to advocate adoption of policy resources.	PD.1:	Evidence of mechanisms and/or institutional arrangements and a process for the introduction, development, review and adoption of geospatial operational policies.
				PF.1:	F.1: User Needs and Feedback is Integrated into the Policy Development Process.

Standards and specifications				
a) Common standards and specifications are in place and have been adopted that allow diverse geospatial data sources, services, applications and systems to operate with each other within Canada.	Indicator 18	Evidence of geospatial standards that support geospatial data interoperability: - Framework Data - Metadata - Thematic Data related to worldwide SDI priorities (Environmental themes and Public Safety/Security)	SA.1:	Evidence of geospatial standards that support geospatial data interoperability
	Indicator 19	Evidence of geospatial standards that support service interoperability.	SA.2:	Evidence of geospatial standards that support geospatial service interoperability.
	Indicator 20	Evidence of geospatial standards that support application/system interoperability: - Within the Government of Canada - Nationally throughout Canada (i.e. between levels of government or within the same level of government) - Internationally	SA.3:	Evidence of standards that support application/system interoperability: (a) In the GoC, (b) Nationally throughout Canada (i.e., between levels of government or the same level of government and (c) internationally.
b) Common standards and specifications have been adopted and are in place that allow diverse geospatial data sources, services, applications and systems to operate with each other internationally.	Indicator 21	Evidence of alignment with international standards and specifications.	SA.4:	Was aligned with both Indicator 21 and 22
	Indicator 22	Evidence of the CGDI influence on international standards.	SA.4:	Evidence of the CGDI influence on international standards.
c) CGDI stakeholders are able to access and are using information and guidance on the implementation of standards and specifications.	Indicator 23	Availability of capacity development resources (i.e., guidance documentation and training) to support standards and specifications implementation.	SB.1:	Availability of guidance documentation and training to support technical and data standards implementation.
			SB.2:	Availability of capacity development resources with respect to standards use.
	Indicator 24	Evidence of use of standards and specifications capacity building resources.		Indicator not assessed
d) There is a process and institutional arrangements in place for the introduction, development, review and adoption of standards and specifications that enable the CGDI.	Indicator 25	Evidence that mechanisms and a process exists to cover the lifecycle of geospatial standards and specifications including: Identification of stakeholder requirements to guide the development of standards and specifications; Organizational arrangements are in place to manage the lifecycle of standards and specifications; A process to introduce standards and specifications to the stakeholder communities including prioritization of topics; Stakeholders are involved in the development; A process to review standards and specifications; A process to advocate adoption of standards and specifications.	SC.1:	Evidence of mechanism and a clear process for the introduction, development, review and adoption of technical and data standards.
			SC.2:	Evidence of institutional arrangements in place to manage technical and data standards introduction, development, review and adoption processes.
			SC.3:	Evidence of CGDI stakeholder involvement in technical and data standards introduction, development, review and adoption process.
			SC.4:	Evidence that CGDI stakeholders have institutional arrangements in place to integrate standards into their business processes.
			SE.1:	Evidence that user requirements guide the implementation of standards.
			SE.2:	Evidence of CGDI stakeholder involvement in the standards development process

2015 Indicator				2012 Indicator	
Technology					
a)	There are technology tools in place that facilitate the discovery, integration, management, sharing, dissemination, visualization and access to Canada's location-based information over the internet.	Indicator 26	Technology tools exists for the discovery, access and dissemination of location-based information based on an architecture model.	TA.1:	Evidence of the existence of one or more portals for the discovery, access and dissemination of location-based information based on an architecture model.
		Indicator 27	Technology tools are aligned with emerging internet and technology trends.	TA.2:	Evidence that technology is aligned with emerging internet and technology tools.
b)	CGDI stakeholders have the capacity to implement technology tools.	Indicator 28	Availability of implementation capacity building resources to support technology implementation (i.e., guidance documents, architecture models and/or reusable tool documentation).	TB.1:	Evidence of the availability of guidance documents to support the implementation of technology tools.
				TB.2:	Evidence of projects that build technology capacity.
		Indicator 29	Evidence of CGDI architecture model/tools used in specific implementations.	TC.1:	Evidence of CGDI architecture model/tools used in specific implementations.
Framework Data					
a)	Data themes are available that are current and complete with accompanying documentation.	Indicator 30	Completion of a pre-defined table of data themes to include information on the: existence of data model, existence of metadata, jurisdictional coverage (y/n), existence of mechanisms for searching, data accessible via download (y/n), data accessible via web services (y/n), access policies / licensing restrictions available (y/n), dissemination / publication date, listing of available scales, listing of dissemination portal(s), if applicable Canada's official languages policies are followed.	FA.1:	Evidence that data themes are available which are current and complete with accompanying documentation.
b)	Framework Data themes are able to be integrated.	Indicator 31	Evidence that spatial data themes are being integrated: - Via layering or fully integrated via overlay where new data layers might be produced. - Where multiple scales are being accessed and integrated wi+C18thin the same application.	FB.1:	Evidence that spatial data themes are being integrated.
c)	There are mechanisms in place for the development and maintenance of national framework data themes.	Indicator 32	Evidence of data sharing agreements between data suppliers (y/n).List all that apply. i.e., MOU's, data sharing agreements, licensing agreements, Service Level Agreements.	FC.1:	Evidence of data sharing agreements between suppliers.
		Criteria 33	Evidence of coordinated data collection, data quality control and data maintenance / updating processes (y/n). Elaborate/list all pertinent processes.	FC.2:	Evidence of coordinated data collection, data quality control and data maintenance/updating process

Appendix C - Case Study – Federal Geospatial Portal

Initiative Description

The FGP is an initiative of the Federal Committee on Geomatics and Earth Observations, a committee of senior executives from 21 Canadian federal government departments and agencies that are producers and/or consumers of geospatial data, or have an interest in activities, requirements and infrastructure related to Geomatics and earth observations. In 2012, the FCGEO recognized an opportunity for federal departments and agencies to manage geospatial information assets in a more efficient and coordinated way by using a common platform of technical infrastructure, policies, standards and governance.[1] Treasury Board approved the FGP project in May 2014.

The objectives of the FGP is to build a collaborative online environment consisting of authoritative geospatial data, services, and applications, built on a shared infrastructure enabling the government's most relevant information to be managed, analyzed, and displayed in a visual context to enhance decision-making in support of government priorities. The FGP supports Canada's Action Plan on Open Government by providing access to comprehensive collections of accurate and authoritative geospatial information, including socioeconomic and environmental data.

Ten federal departments and agencies are actively partnering and have formally signed commitments of time and resources to the FGP initiative using a phased approach over the 2014-2015 through 2016-2017 timeframe.

The FGP is funded through existing departmental budgets. No new funding has been received in support of the initiative. The five lead partner departments are:

- Aboriginal Affairs and Northern Development Canada
- Agriculture and Agri-food Canada
- Environment Canada
- Department of Fisheries and Oceans
- Natural Resources Canada

The other five departments that will be supplying geospatial data resources are:

- Canadian Food Inspections Agency
- CSA
- Elections Canada
- Parks Canada
- Transport Canada.

Individual departments will continue to hold authority of their existing content and will continue to manage their data to fulfill individual mandates. The FGP is intended to establish common policies, standards, services, and applications that can be used by multiple departments allowing departments to focus on the data and allow the FGP to handle the dissemination. The technology infrastructure is provided by Shared Services Canada and the Open Data portal (open.canada.ca) championed by Treasury Board. This is the primary dissemination channel for the FGP currently, however case study interviewees indicated that other initiatives are also anticipated to draw information from the FGP through data sharing arrangements (i.e., other international organizations).

Since the data is federated, data held on departmental servers will be described/identified by metadata records that will provide standard pathways to retrieve the information to feed the web service.

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[1] GoC. FGP: Year 1 High-Level Architecture Strategy. Final. September, 2014.

The FGP will expand and simplify access to geospatial data and tools for an increased number of users across the federal government, including policy analysts, senior managers, and non-technical users. Provision of geospatial data to the public and others (academia, industry, etc.) is also a benefit of the FGP.

The FGP has just completed its first year of implementation and has advanced in six key areas including completing the enterprise architecture as well as the data inventory and assessment with triple the amount of datasets targeted for initial release than originally planned. Work is focused on organizing data within the platform according to common standards and policies ready to be visualized. In the spring of 2015, the FGP's new geospatial data and services are planned to be available on the Open Government Portal at open.canada.ca. At the time of developing this case study, it was anticipated that up to 150 geospatial datasets will be available for interactive viewing or downloading in the initial release that are sourced from 10 different departments. The data volume is expected to grow as the project proceeds.

Case study interviewees indicated that the project has had initial success by focusing on the internal collaborative space (e.g., for internal use by Federal Departments) by building a user base of participating departments and coordinating efforts with a centralized project management office. The project has built in business transformation and change management as part of operations.

Interviewees see the FGP as the federal layer or federal node of the CGDI.

Context and Need

Today, the GoC is dealing with issues of increasing urgency and complexity, such as more frequent natural disasters, the need for adaptive strategies to respond to climate change and the tension between enabling responsible natural resource development to promote economic and social well-being and also safeguarding the environment. Decision-making in this environment requires access to integrated information about the social, economic and environmental conditions and trends for a given area or location.[2]

While these geospatial data resources may be accessible through departmental websites, no tool is available to allow these spatial data sets to be discovered and viewed in a common platform to support the complex analyses required to inform decision making. As a result, policy analysts and decision makers have to spend considerable time and effort to find and gather information from a variety of sources.[3]

Some of the primary drivers for the creation of the FGP include:

- Current inability for federal departments and agencies to manage geospatial information assets in an efficient and coordinated way by using a common "platform" of technical infrastructure, policies, standards and governance.
- Data currency and accuracy concerns, duplication of efforts resulting in inefficiencies.
- Limited access to geospatial data and information products for policy and decision-making.
- Continued fiscal constraints that have encouraged collaboration for efficiency.

The partnering departments confirmed the need for collaboration and efficiency. One interviewee noted: "*Historically, sharing data was cumbersome. Every time there was a need to use data from another department, you would have to restart from scratch. Up-to-date data was not always available and would be valid for only a short period of time without a mechanism to continuously update. Crossing the border of another department was like living in another country. The FGP is going to eliminate this work and re-work.*"

Governance and Collaboration

The FCGEO is the federal committee champion of the FGP and is represented throughout the governance structure.

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[2] GoC. Federal Geospatial Platform: Transforming government to respond to today's reality. Primer. Fall 2014.
[3] Ibid.

The Management Board's Chair and members are drawn from the Assistant/Associate Deputy Ministers on the FCGEO and Directors General from the FCGEO DG Shadow Committee. The FGP Management Board is the ultimate decision-making body for reviewing and resolving strategic issues, and problem-solving related to the FGP. It provides direction to the FGP Core Project Team that has the responsibility to successfully implement the FGP project.

The Chair of the FGP Client Board of Directors is the FGP Project Director (leading the Core Project Team) and its members are Directors drawn from the 21 departments and agencies. The Client Board of Directors has working groups on: data, technology, operational policies and standards, and client engagement that also include resources from participating federal organizations. It provides the Core Project Team with feedback to ensure that FGP services are aligned with the needs of clients.[4]

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│   FGP Executive Sponsor: DM           │
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│   FGP Management Board            │  │ FCGEO  │
│   (FCGEO & Dept's - ADMs/DGs)     │  └────────┘
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┌──────────────────────────────────┐
│   FGP Client Board of Directors   │
│   (from FCGEO & Dept's - Directors)│
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┌──────────────────────────────────┐  ┌──────────────────────┐
│   FGP Core Project Team           │  │  Working Groups,     │
│   (Director & Manager from Dept's)│  │  Subcommittees       │
│                                   │  │  (from FCGEO & Dept's -│
│   Data Integration; Client        │  │  Resources)          │
│   Services; Data Management;      │  │                      │
│   Policy & Standards              │  │                      │
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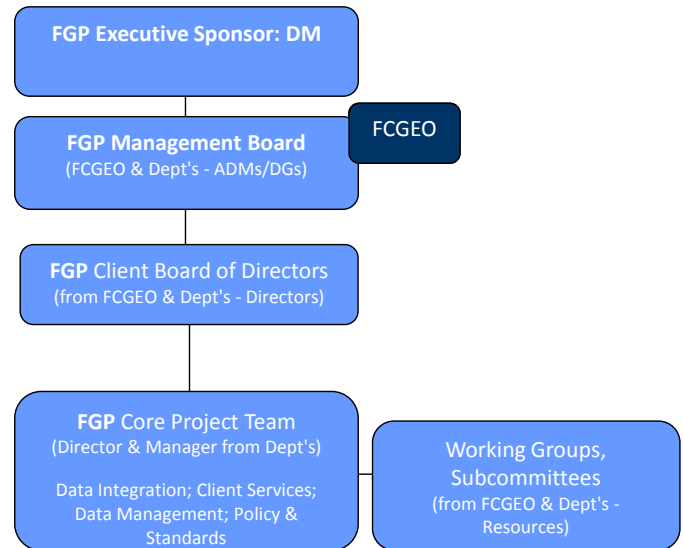
A formal Project Management Office has been established to support the FGP. The PMO provides quarterly dashboard reporting to the Management Board and the Client Board of Directors that tracks resources, risks and issues.

The initiative takes a broad collaborative approach to planning, development and implementation. In redefining the FGP vision for 2015, a client engagement process was undertaken that included 50 people across 11 departments and agencies to create client profiles that drove the definition of user needs. The FGP integrates the domains of data and policy by engaging both audiences in its collaborative efforts.

A client work group was established to engage partnering departments and identify requirements for the FGP solution. Several departmental FGP communications events were held that were supported by common communications tools. Communications between the Core Project Team and interested members of the horizontal policy community have been ongoing since August 2014. The FGP uses a number of communications methods to encourage collaboration and buy-in including FGP video, decks, status updates, calendar, and a dedicated web page.

The initial implementation of the FGP takes into account existing investments by FCGEO member departments. For example, the FGP is utilizing existing expertise and mature solutions residing with EC, e.g., development framework for visualization) and NRCan's experience with standards and best practices to move the initiative forward in an efficient and effective manner.

Application of Standards and Policies

The FGP has established an Operational Policies and Standards Working Group that is mandated to support the collaborative design, development, adoption and implementation of a suite of operational policies and standards for the FGP. Principally, the FGP has committed to align with industry standards and current trends. This includes consideration for employing coding standards, web service standards (ESRI, OGC, ISO), and data content standards. Recent actions include:

- Developing Phase 1 of FGP Data Management and Stewardship Policies and Procedures - with a focus on data validation, structure and release.
- Developing best practices guides including a proposed approach to implementation.
- Resolution of outstanding implementation issues to ensure that departments create more consistent, interoperable geospatial metadata based on the Harmonized North American Profile (HNAP).

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[4] GoC. The Federal Geospatial Platform: Presentation for Employees.

- Developed a guidance document intended to help FGP participating departments prepare and provide the metadata, datasets and web services identified by the FGP Data WG.5
- Working to implement a release approval process for the data sets that will be available through the FGP.
- Developing a FGP guidance document for file naming conventions.
- Developing a two-part Web Services Development and Use Guide. The purpose of this guide will be to explain to suppliers, developers and potential clients how to provide, use and manipulate Web services for the FGP Y.

The FGP initiative is also in the planning stages of developing, in collaboration with Treasury Board, a new policy "the TBS Directive on Management of Geospatial Information as part of the five year cycle of standards and policy development.

Case study interviewees indicated CGDI has guided the FGP project. FGP leveraged existing guidance materials on how to develop, manage, adapt and adopt operational level policy for organizations – the working groups utilized all GeoConections could offer from the policy and standards perspective. This included, for example, policy classification and identification and inventory processes to enable the FGP to understand its policy landscape, classify and inventory what was in existence and then report on it. Another benefit of the CGDI (through work completed by GeoConnections) mentioned by one of the case study interviewees was the effort of CGDI in building up awareness of the importance around using standards and promotion of the need for openness and interoperability. The effectiveness of utilizing standards based on international consensus-based standards made it much easier to make the case for the FGP as well as develop the architecture, standards and technology to be used by the FGP. The CGDI has enabled the application of standards to be performed as consistently as possible across a number of organizations in the same fashion and the same spirit – even if the implementation is slightly different.

Case study interviewees indicated that harmonized metadata standards for FGP partners are in place and will eventually extend to the entire federal family. Partnering department interviewees acknowledged the distribution of guidelines and processes to help convert metadata to the standards. It was also noted by interviewees that the FGP is working with its partners to try and find overlap to open opportunities for other things. The federal community is already well versed in geospatial standards and does apply common standards to existing geospatial data. The task has been to adapt the interpretation of standards application to enable common use.

Webservice standards were also considered important, and one case study interviewee indicated the FGP did reference CGDI standards for the webservice component. The FGP has now indicated that partner departments must provide data that is compliant with OGC web map service or ESRI map services (ESRI are interoperable with CGDI standards). In addition, best practices on file formats and formats for open data have been applied to facilitate system interoperability.

The majority of activity currently taking place is the organization and categorization of data within the platform according to the common standards and policies defined and adopted.

Application of Tools and Technologies

The FGP project is still in its early stages (at the demonstration phase, no functional release has been made yet) but moving towards its objective of developing the required internal collaborative space that will provide one publishing path to provide the data to the public. A technical solution has been selected and was collaboratively developed by the partnering departments. A development and testing environment has been created, and the web presence has been developed that includes one web map service allowing for visualization of the data and querying online. The visualization tool has been built on API from ESRI which meets federal requirements (i.e., bilingual capability) and leverages existing technologies utilized by most federal GIS development units.

The project is also reporting that integration with the Open Government portal has been advanced.

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[5] GoC. Status Update on the Federal Geospatial Platform. November 27, 2014.

Benefits and Impacts

The FGP project is intended to result in increased efficiency, better policy decision-making and improved accessibility of geospatial data to a wider range of internal and external audiences. The FGP initiative has detailed some of the benefits to be:

- **Improved access to information:** The FGP will result in faster and easier access to comprehensive information. Improved access to information and data will facilitate government operations, support business innovation, and enhance government services and decision making.
- **Accessibility:** The information will be more available and better organized for people who are not specialists in Geomatics. An improved search capability will ensure users can easily find what they need. This means that researchers, policy analysts, and executives will be able to make better use of the data.
- **Breadth of use:** Geospatial information will be re-used with greater ease because data will be available to users through common formats and encodings, following standards and best practices.
- **Meeting user demand:** The FGP is needed to meet a burgeoning demand for geospatial data in a cost-effective and efficient manner.
- **Efficiencies:** The FGP will help to reduce duplication and increase efficiency when collecting, using, and storing the data.
- **Increased value for users:** By making it more accessible, the data will be used more by people inside and outside government thus increasing the return on the time and money invested.
- **Improved collaboration:** Complete information that uses common standards will help government organizations to work more efficiently together and with outside groups.

One of the case study interviewees described the contribution of the CGDI as key: *"In theory if we didn't have the commitment to interoperability and standards, the FGP would be a nightmare. Everyone would be doing their own thing. The CGDI is the arrow for the entire geospatial sector."*

The partnering department interviewees indicated that the FGP will provide seamless and effortless access to data without having to go out search for it, take a copy and develop a process for updating. Another interviewee felt efficiencies were gained through the joint development of the FGP portal which has saved individual departments from creating something on their own and has helped legitimize the flow of data.

Challenges

One of the challenges mentioned by case study interviewees is that the FGP is increasing demand on departments with large data holdings. FGP may potentially increase workloads for these partners not only in the short term implementation of established standards and policies but in the future through increased demand for accessible data, maintenance of that data and the ability to keep up with evolving best practices, standards and technologies. If maintenance is not prioritized, confidence in the data may waiver. Connected to the maintenance requirement is the ability to be able to link the efforts and investment to a business need. Understanding what the use requirements are, for any organization, will be key in providing data to support innovation across stakeholder groups. Having a business analysis functionality will assist in managing the risk of developing a lack of clarity in which data to prioritize and provide that will be used to help secure its sustainability and authoritativeness.

Another challenge mentioned by case study interviewees was dealing with the various interpretation of standards. Each standard is open for interpretation and may have been applied in a slightly different manner by partner departments. This was not seen as a challenge that could not be overcome but rather identified to demonstrate that minor adjustments were required to make the CGDI (and TB) standards work in the context of the FGP.

Appendix D - Case Study – Arctic SDI

National Arctic Spatial Data – The Yukon Water Board: Coordinated Online Information Network (COIN)

Initiative Description

The Yukon Water Board (YWB) has undertaken a project to establish a Coordinated Online Information Network (COIN) implementation, a natural resource information support system, to help guide oil and gas undertakings in the Yukon.

The Yukon is at the forefront of a very rapid expansion of resource extraction activities, fueled by increasing access to untapped arctic assets and the facilitated growth/expansion of northern economies. The various regional resources becoming increasingly available for commercial use include a broad range of minerals, petrochemicals, fibers, etc. The extraction and processing of each of these categories of resources require varying types and amounts of supporting infrastructures and consumables, including energy and water.

A pragmatic, albeit complicated, layered approach to resource extraction planning and licensing has evolved in the Yukon. The responsibility for commercial licensing of minerals and petrochemicals rests with a Yukon government department (Energy, Mines and Resources), whereas the oversight of water resources both necessary and potentially affected by such activities falls under the responsibility of a separate, quasi-judicial citizens board (Yukon Water Board). Enforcement of the provisions established by both groups is managed by another government department (Environment). This fusion of Yukon governance for resource extraction must be further harmonized with the First Nation Governments of the Yukon, as coordinated through the Yukon Environmental and Socio-economic Assessment Board (YESAB). And finally, all internal Yukon natural resource management governance systems must comply with Canada-wide and applicable multi-national accords (i.e. NAFTA, GATT).

COIN is a geospatial-based program with semantic search capacity supporting the Yukon's natural resource licensing and allocation procedures. COIN is designed to provide a seamless technical means for all parties interested (regulators and project proponents) in the adjudication of the Yukon's natural resources to readily access and assess relevant information regarding resource-related projects (e.g. energy, mining, etc.) within specific geographic regions.

Context and Need

According to the COIN Project Manager and COIN project information there are four key business problems the COIN project is aiming to resolve:

▪ ***Coordinating information sharing between governing entities (Data Collection)***: The recent evolution of the various Yukon and First Nation governing structures, relationships and agreements was accompanied by the development of separate information and advisory groups charged with specific and separate mandates. This structuring has led to the development and maintenance of isolated data and information systems that are designed to describe aspects of the same proposed project(s) and environmental settings, but for different purposes. However, since the scientific and engineering facts of a specific project are constant, the manner by which information is requested, stored and assessed is overly redundant and inefficient.

- ***Improving Geospatial and Data Quality Standards:*** Geospatially tagged data may be collected and made available to regulatory and public trusts from a wide variety of sources, using various degrees of quality assurance (QA), chain of custody and other methods to control or meet specific levels of precision and accuracy. In many instances, the QA of both the primary geospatial reference and associated attributes (e.g. water quality, flow, etc.) are not reported or are unknown. Integration of this type of poorly constrained data causes significant challenges in compiling, analyzing and assessing information resulting from the base layer of data.

- ***Increasing the comprehensive knowledge of quantity and status of managed resource(s) (Data and Information Processing):*** The inventory and status of natural resources within the Yukon is not yet known or estimated well enough to be managed as effectively as desired. This is to be expected with sub-surface extractable resources such as minerals and petrochemicals, where intensive exploration is required to define the reserves. But, surface and ground water resource quantity, quality and current allocations are more easily defined and tracked and should be managed securely to assure sustained availability of this resource. While current license provisions for extraction and use of minerals, petrochemicals and water resources include monitoring and reporting requirements, the information collected in this manner is not used effectively to incrementally define the managed resources.

- ***Integrating resource management and cumulative impacts (Data Synthesis and Integration):*** Given the existing disparate data and information collection and storage framework, there is little capacity to analyze and integrate spatial and temporal information regarding natural resource activities. Without such capacity, the governing bodies responsible for the resource sector have few metrics to assess the effectiveness of policies to promote resource extraction and/or protect valuable resources from degradation. Further, there is also limited capacity to either optimize activities when constructive synergies are present or to minimize impacts when antagonistic factors accumulate to affect the environment.

Governance and Collaboration

The YWB is the lead government department for the COIN initiative. The Yukon Government Energy Mines and Resources (EMR) is also involved as well as collaborators from the University of Alberta and the Laboratoire d'Informatique de Grenoble.

The COIN project manager cites the biggest advantage of working within a collaborative CGDI framework is surmounting the issue of selection of data standards. The project manager noted that individual Yukon Government, First Nation and NGO entities were forming information 'silos' with individual data shorthand systems evolving into separate and disparate naming and numbering systems. By invoking the professional and third party CGDI as the de-facto data format standard for the YWB, debate surrounding this issue has been eliminated.

It was also noted that access to NRCan and other geospatial hosted data sites comprising the CGDI provide the YWB with a wide range of high-quality and assured data sources. Meticulous data quality assurance of the type provided through the CGDI is rare in the Yukon and access to this inventory was thought to be critical to the management of local resources.

Additionally, the depth of experience and diversity of approaches of the internationally-based principal investigators, application experts and IT development team combined to enable a considerable degree of innovation and creativity brought to bear in this project. The COIN project manager noted the broader range of potential applications and approaches developed through COIN in using the CGDI is what provides the most benefit to the base data.

COIN's approach to governance allows for the gradual incorporation of proponent-supplied standardized data into a framework consistent with and accessible through the CGDI. The Yukon Water Board stipulates water license provisions for successful applicants. These license provisions now include a provision for water monitoring data in formats consistent with both CGDI and Yukon Government standards. This governance step is intended to assure the means of sustaining a CGDI compatible database management system (DBMS) structure from the YWB.

Application of Standards and Policies

Formal standards and policies to facilitate data sharing and integration derive from the open, evidentiary-based protocols already established for submission of materials in text format to the Yukon Water Board. The existing process for submission of 'evidence' and public intervention on a specific case file follows a format substantiated by the scientific process, tort law and/or traditional knowledge. The COIN program is extracting the geospatial and data segments of the case file and subsequent monitoring data submission process and managing that information in a digital format. Accompanying text narratives continue as the traditional means of describing a case file.

The standards, policies and tools necessary to fully inform collaborating parties are in the developmental process. The Yukon Water Board is endeavoring to modify, adapt and test its own practices and procedures first before promulgating those practices out to its affiliates. Further, since the YWB resides within a matrix of other departments without clear primacy of authority, the manner by which firm data policies are developed and adopted requires careful political buy-in.

The YWB development of framework data is being phased in gradually. The introduction of COIN into the Yukon initially provided more of an awakening regarding the shortcomings to existing data sources and lack of interoperability of Yukon DBMSs according to the COIN project manager. In many ways, the progress toward development of framework data can be considered considerable since organizations such as the YWB and others are now self-aware of their data protocols. However, it was noted that much work remains in developing appropriate pathways forward in this area.

Application of Tools and Technologies

A custom web-based, open, source data viewer has been developed. The COIN-HUB (http://lig-coin.imag.fr/COIN_PILOT_1_1/), was developed to facilitate data integration and sharing. The viewer pulls together all spatial data relevant for a Water Board Applicant to review their application in a manner similar to that of the YWB. The CGDI was noted to be instrumental in supporting this visualization tool by providing spatial data systematically through web services.

An example of the pilot data viewer along with some of the data layers available is shown in the Exhibit below:
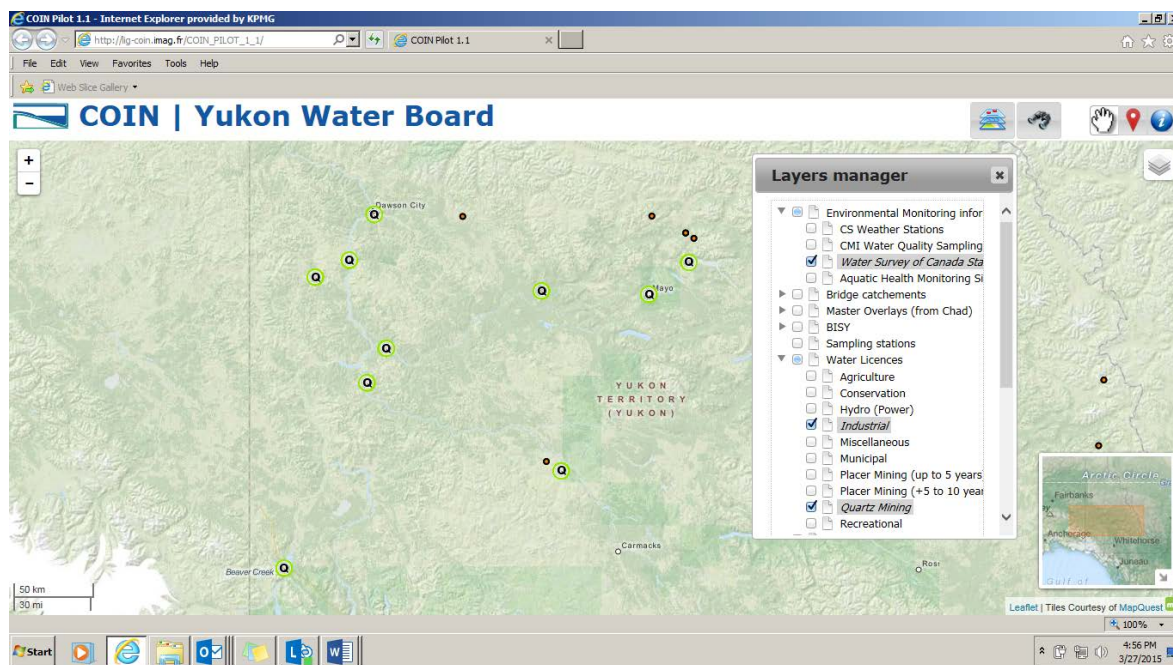
Benefits and Impacts

Some of the first uses of COIN were employed using CGDI spatial landscape (raster digital elevation maps; DEMs), combined with custom raster-based precipitation data (PRISM, Parameter-elevation Regressions on Independent Slopes Model; NOAA and EC) and vector-based hydrologic overlays and land tenure (First Nations claims) to determine flow paths and discharge rates affecting a Yukon Highways and Public Works bridge/culvert upgrade program and the Northern Cross Yukon Oil and Gas advanced exploration program. In both instances, the COIN project manager indicated the base geospatial layers proved invaluable in assessing the risks and potential magnitude of impacts of each program on the surrounding environment and specific First Nations holdings.

The project manager indicated that COIN is already assisting with water licensing for specific projects through enabling simultaneous consideration of multiple factors and potential impacts in order to conduct thorough and comprehensive assessments. When managed and displayed, the matrix style underpinnings of the CGDI (e.g. discrete raster grids) help facilitate a whole-board perception6 of the end users – something that has been strengthened through the project.

The COIN project manager noted that the greatest value of the CGDI is the consistent availability and access to high quality geospatial data sources and the confidence that the data sources are supported by the GoC. The metadata standards structure of the CGDI, that assure quality and accountability of the data, are also key to the utility and worth of the system.

Challenges

In a relatively isolated and large territory of ~ 30,000 people, human resource and institutional memory are nearly always the limiting factors affecting the development and maintenance of any advanced or innovative program as noted by the project manager. With economic growth and greater competition for trained resources, the local governance structure will continue to increase the use of supported scientific and technical fact to resolve issues.

International Arctic Spatial Data – The Arctic SDI Initiative

Background and History

According to the Arctic SDI Framework document, the first cross bordering geodata cooperation in the Arctic was the GIT Barents launched in the 1990's by the national mapping agencies in Finland, Norway, Russia and Sweden. The purpose was to increase the ability to use spatial information within the Barents Region by producing a common geographic database covering the entire region and to make data available to users by establishing an internet-based infrastructure aligned with the principles of the EU INSPIRE Directive (EU Infrastructure for Spatial Information). The GIT Barents Service (www.gitbarents.com) facilitates cross-border cooperation, primarily in the fields of environmental planning, monitoring and protection, land use, physical planning, transports, natural resource management and development of cross-border tourism.

From 2007 a Spatial Data Infrastructure covering the entire Arctic was frequently discussed at conferences and in the context of the Arctic Council activities. At the GeoNorth I conference in Yellowknife, Canada in August 2007 the Yellowknife Declaration took form exploring the Arctic SDI. Following a request from the National Mapping Agencies from the Arctic countries, the Arctic Council gave its formal support to the Arctic SDI initiative at its Senior Arctic Officials meeting in November 2009.

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[6] The recent evolution of the various Yukon and First Nation governing structures, relationships and agreements was accompanied by the development of separate information and advisory groups charged with specific and separate mandates. A pragmatic, albeit complicated, layered approach to resource extraction planning and licensing has evolved in the Yukon. There are a number of authorities with vested interest in water licensing for projects including: Yukon Department of Energy, Mines and Resources, Yukon Water Board, Yukon Department of the Environment, First Nation Governments of the Yukon, and the Yukon Environmental and Socio-economic Assessment Board (YESAB).

In October 2011 the Arctic SDI was launched by representatives from all eight national mapping agencies of the Arctic countries and from the Arctic Council CAFF Working Group.

Initiative Description

The Arctic SDI – Arctic SDI - is a cooperation between eight national mapping agencies including Canada, Finland, Iceland, Norway, Russia, Sweden, USA and Denmark. The aim of the Arctic SDI is 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 SDI received formal support from the Arctic Council[7] in November 2009. In October 2011, the Arctic SDI was launched by representatives from the eight national mapping agencies and the Arctic Council Conservation of Arctic Flora and Fauna (CAFF) Working Group. In February 2014 the Arctic SDI Board established the present governance, organization and operation of the Arctic SDI.[8]

The aim of the Arctic SDI is to jointly develop and administer an Arctic SDI over several phases. The initial phase includes the following components:

- Reference data as Web Map Services to establish a common image and vector base for the Arctic context at nominally 1:250,000-scale
- A searchable metadata-catalogue of map-able data resources (base maps and other geo-referenced thematic data and services)
- A Web portal as primary user interface to search the catalogue and enable visual analysis of multiple base maps, thematic maps, and geographic data
- Supporting tools, standards, operational policies and best practices.

Context and Need

The Arctic SDI Strategic Framework Document outlines the identified need for the Arctic SDI efforts:

> "There is a need for an Arctic SDI, which provides for the development of the necessary standards and framework to promote and encourage more efficient integration of and access to arctic related datasets. It would allow for a more robust management and manipulation of data for research, planning, policy-making and operational purposes and contribute to more informed policy and adaptation strategies in the region.
>
> A well-functioning exchange of spatial referenced data is an essential tool for successful conservation of the natural environment while allowing for economic development, at a circumpolar or regional circumpolar scale, especially for cross boundary activities. Furthermore, this infrastructure will foster integrated planning when developing the infrastructure, environment and economic activities and planning search and rescue operations.

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[7] The Ottawa Declaration of 1996 formally established the Arctic Council as a high level intergovernmental forum to provide a means for promoting cooperation, coordination and interaction among the Arctic States, with the involvement of the Arctic Indigenous communities and other Arctic inhabitants on common Arctic issues, in particular issues of sustainable development and environmental protection in the Arctic. http://www.arctic-council.org/index.php/en/about-us/arctic-council/about-arctic-council. Accessed March 29, 2015.

[8] The Arctic SDI. Arctic SDI Framework Document. Version 1.00/11, November 2014.

> Improved spatial related data handling includes the potential to provide tools that can clarify and explain indigenous peoples land use practices and thus improve presentation, communication and better integration of these issues."

One of the case study interviewees identified the need from a national mapping agency perspective to be the desire for increased use of spatial data from reliable sources as well as the increased use of their own holdings to help address challenges in the Arctic.

Governance and Collaboration

The eight national mapping agencies have signed a non-binding MOU which is the basis for the signatories to collaborate.

The governance and organization of the Arctic SDI consist of the Board, the National Contact Points and activities with responsible Lead Countries and Support Countries.
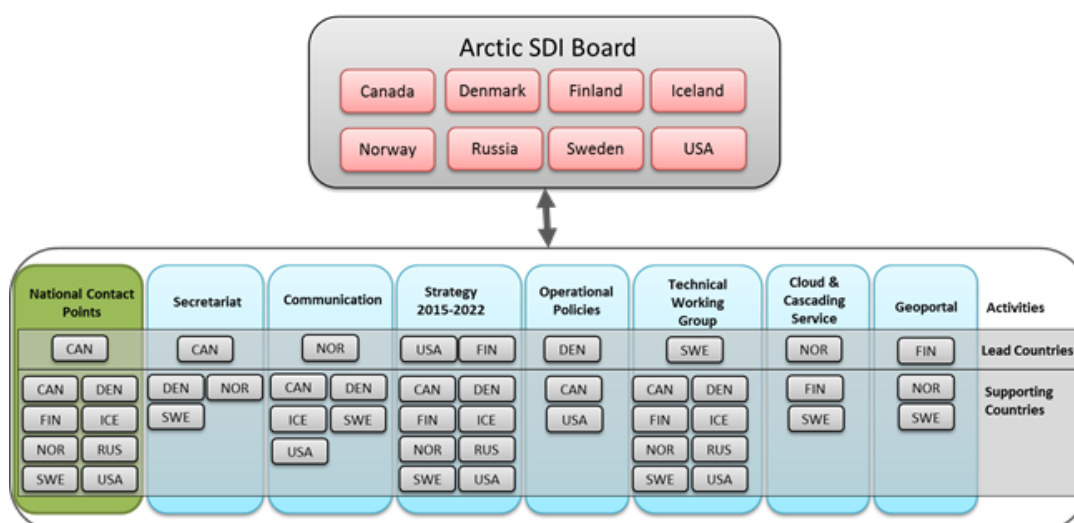
The decision-making body of the Arctic SDI is the Arctic SDI Board. The Chair of the Arctic SDI Board rotates every second year following the cycle of the Arctic Council chairmanship. The Chair is the board-member representing the National Mapping Agency from the same country that holds the Chair of the Arctic Council. The current cycle of Chair rotation has been defined as:

Term	Country	Term	Country
2014-2015	Canada	2021-2023	Russia
2015-2017	USA	2023-2025	Norway
2017-2019	Finland	2025-2027	Denmark
2019-2021	Iceland	2027-2029	Sweden

One of the advantages of the governance model employed by the Arctic SDI, as noted by one case study interviewee, was the rotating governance model appears to encourage ownership of the process by the different countries. The rotating Chairs tend to emphasize having a stake in the process and helps to ensure involvement. It creates a consciousness of the greater role, even though on a voluntary basis. Another advantage was noted to be the alignment with the rotating Chari of the Arctic Council. Having the same country driving both organizations at the same time creates the potential for a greater ability to provide resources and become more engaged.

Current collaborative activities for 2014-2015 with associated lead country have been allocated as follows:

Activity	Lead Country
Secretariat for the Chair of the Board and Chair of the National Contact Point	Canada
Communications, website	Norway
Technical working group	Sweden
Development of legal/admin operational policies	Denmark
Development of Arctic SDI strategy 2015-2020	USA
Establish and operate Arctic SDI Web Map Service	Norway
Arctic SDI web portal for reference map and thematic data, including the CAFF data	Finland

The case study interviewees noted that without a collaborative approach to the Arctic SDI, this kind of work would not be proceeding. The driving force is the people who are working in the arctic and the mapping agencies that have helped to build collaboration around this kind of organization. It was suggested that if undertaken by the private sector, different sources of information may be collected and posted on various websites but a real SDI would not be formed.

One case study interviewee identified the Arctic SDI as no just beneficial in the creation of seamless maps, but through the development of circumpolar standards in a common, collaborative way allows server information and basic core metadata components to apply to data sets. This is the first step towards ensuring better sharing of information that can be used for many purposes beyond analyzing and combining information for CAFF or the Arctic Council, but for future conduct and reuse in operations trying to merge information between states, for example supporting clean-up operations or imposing conservation measures. There is real potential for use by a broader range of organizations.

Application of Standards and Policies

The Arctic SDI has established a working group on operational policies. The objective of the Working Group is to develop legal/administrative operational policies on:

- Implementing Arrangements
- Licensing
- Property Rights
- Contracts
- Policies and legal framework

As Arctic SDI is in its first year of implementation, the Operational Policy Working Group has developed an Operational Policies Background Paper as well as the first version of operational policy text for the Arctic SDI Geoportal.

Standards are also being addressed and as one case study interviewee pointed out, most of the collaborating countries already have established SDIs and have adopted standards. Collaborating members had to think through how standards employed within their own SDIs would work together. In Europe, for example, INSPIRE legislation is a regulatory framework that had to be considered by the collaborating countries. Standards for metadata supporting the background map WMS service have been agreed upon.

Application of Tools and Technologies

The Arctic SDI Technical Working Group is responsible for:

- Infrastructure and technology
- Design, architecture and standards
- Data models and metadata
- Technical guidelines for establishing Arctic SDI Web Map Service, the Geo-portal and other services

The initial focus of the Arctic SDI has been on the development of a background map as the first technical step. The Arctic SDI Geoportal has been established with background map layers and thematic data provided by the CAFF working group. A Metadata Catalogue is available and as well as an established Web Map Reference Data Service at 1:250.000 for the base map. There are also tools in place for publishing metadata to a catalogue. Progressively, Arctic SDI intends to fill the catalogue with datasets and metadata for data and services, not only from the collaborating mapping agencies but also other stakeholders.

A screenshot of the Geoportal is provided below.
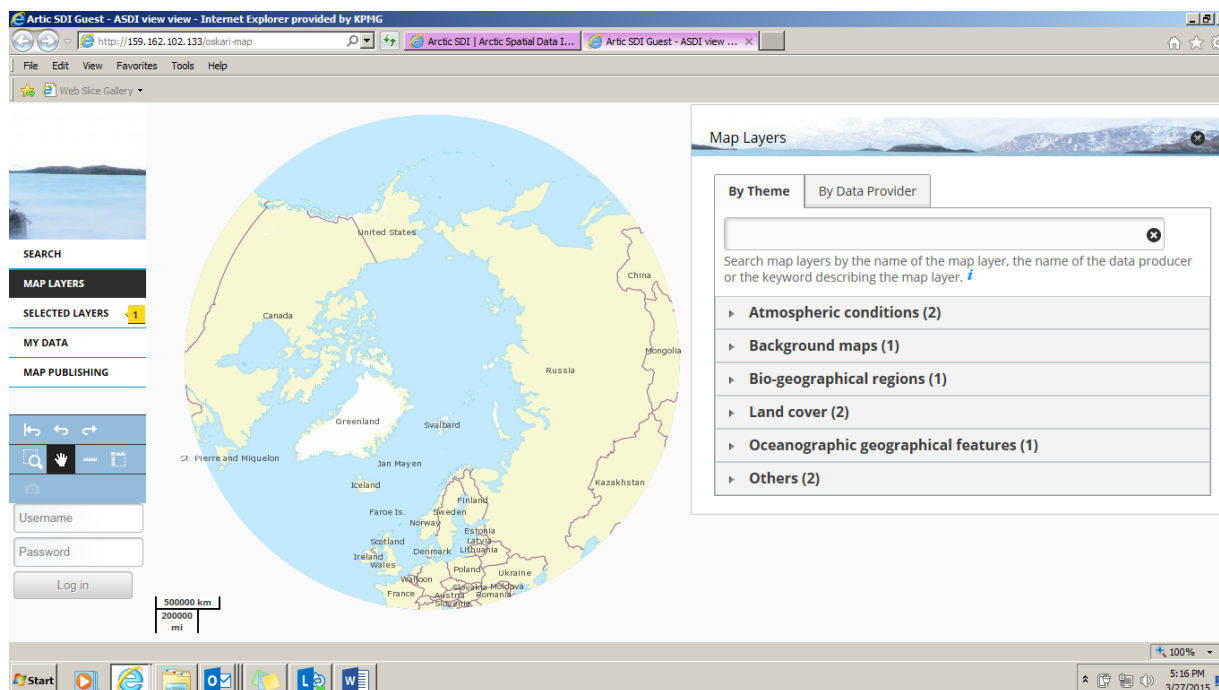
CAFF earth observation products currently available through the Geoportal include:

- Normalized Difference Vegetation Index and Enhanced Vegetation Index
- Land Cover Dynamics (Vegetation Phenology)
- Land Cover Type
- Land Surface Temperature
- Albedo
- Snow Covered Area
- Land Water Mask
- Sea Surface Temperature, Nighttime
- Marine Chlorophyll a
- Coloured Dissolved Organic Matter
- Marine Primary Productivity

Case study interviewees noted that the objective of Arctic SDI currently is to focus on specific use cases that can be used to collect specific information to help develop an application to increase the Arctic SDI one step at a time. It is very early days for the Arctic SDI in the area of tools and technologies. There was one example of application provided by case study interviewees where Arctic SDI worked with the CAFF on a special project related to monitoring land coverage change utilizing remote sensing data for circumpolar monitoring. Arctic SDI provided input and assigned the technical working group to work with CAFF to find way to make sure remote sensing products were interoperable and accessible. Arctic SDI provided CAFF with the technological knowledge and the ability to set framework data to serve and access remote sensing data via online mapping services.   One case study interviewee noted that without the input and expertise provide by the Arctic SDI technical working group, this project would have been much more difficult to do. The products of the CAFFs monitoring work can be accessed online via web map service and feeds to the Arctic SDI clearing house systems.   The CAFFs biodiversity data service, is now a thematic layer in the Arctic SDI. The case study interviewee indicated the Arctic SDI was extremely helpful in figuring out how to take remote sense data and make it easy accessible with other systems and any other potential users.

One of the next projects is being led by the US and is focused on creating a digital elevation model.

Benefits and Impacts

Some of the benefits noted by case study interviewees are:

- In terms of efficiencies gained by the collaborating jurisdictions in leveraging existing data, tools and technologies across the national SDIs so as not to re-develop assets. This is coupled with access to expertise that each country brings to the partnership.
- In relation to the specific CAFF project, standard maps made monitoring and assessment work easier. By creating standardized data and providing metadata that can be used and spread, monitoring programs are providing a canvass for researching and assessing various biodiversity trends across the arctic.
- In terms of knowledge transfer, the transfer of technical abilities to better serve and manage the CAFF datasets. This allows CAFF to provide information back to the Arctic SDI as thematic data that can be subsequently accessed by a broader audience.

Challenges

Two challenges noted by the case study interviewees were related to addressing relevance from two different perspectives. First, being able to find data and filter data from a national SDI for relevance to the arctic. There is no easy way to create an automatic mechanism to filter for relevant information. Second, is consideration of the movement internationally towards open data. This trend is progressing and all countries working with spatial information and other data have to deal with it. The issue is being able to serve all potential users in an open data context. Developers, for example, want raw data and have the technical ability and deeper knowledge to comprehend the information being provided. On the other hand, those without the technical expertise, for example in coding, and may need different tools to assist with their needs. It is important to consider both sides when advancing an SDI.

Appendix E - Acronyms

List of Acronyms	
AAA	Accurate, Authoritative and Accessible
AAFC	Agriculture and Agri-Food Canada
ACZISC	Atlantic Coastal Zone Information Steering Committee
Arctic SDI	Arctic SDI
ATIPP	Access to Information and Protection of Privacy
CACS	Canadian Active Control System
CBN	Canadian Base Network
CC	Cloud Computing
CCOG	Canadian Council on Geomatics
CDEM	Canadian Digital Elevation Model
CDSM	Canadian Digital Surface Model
CEOS	Committee on Earth Observation Satellites
CGDI	CGDI
CGCRT	Canadian Geomatics Community Round table
CGE	Canadian Geographic Education
CGSB	Canadian General Standards Board
CIG	Canadian Institute of Geomatic
CIP	Compliance and Implementation Plans
CITE	Compliance & Interoperability Testing & Evaluation
CNGO	Canada-Nunavut Geoscience Office (Nunavut SDI Initiative)
COINAtlantic	Coastal and Ocean Information Network for Atlantic Canada
CP-IDEA	Permanent Committee on SDI for the Americas
CSA	Canadian Space Agency
CSDI	Corporate SDI (Yukon SDI Initiative)
CSW	Centre for Sustainable Watersheds
DFO	Department Fisheries and Ocean Canada
EC	Environment Canada
ESS	Earth Sciences Sector (under Natural Resources Canada)
EU	European Union
EUROGI	European Umbrella Organization for Geographic Information
FCGEO	Federal Committee on Geomatics and Earth Observations
FES	Filter Encoding Standard
FGDC	U.S. Federal Geographic Data Committee
FGP	FGP
FOSS	Free and Open Source Software
FPT	Federal/Provincial/Territorial
GDA	Geodiscovery Alberta (Alberta SDI Initiative)
GEO	Group on Earth Observations

List of Acronyms	
GIIC	Geostandard Interdepartmental Implementation Committee
GIN	Groundwater Information Network
GIS	Geographic Information System
GML	Geography Markup Language
GNSS	Global Navigation Satellite System
GoC	GoC
GPS	Global Positioning System
GSDI	Global SDI
HAL	HAL
HPN	High Precision Networks
IACG	Inter-Agency Committee on Geomatics
INSPIRE	INfrastructure for Spatial Information in the European Community
IP	Intellectual Property
IPAWS	United States Integrated Public Alert and Warning System
ISO	International Organization for Standardization
IT	IT
KML	Keyhole Markup Language
LIO	Land Information Ontario (Ontario SDI Initiative)
MASAS	Multi-Agency Situational Awareness System
MASAS-X	MASAS-Information Exchange
MIB	Mapping Information Branch
MLI	Manitoba Land Initiative (Manitoba SDI Initiative)
MMG	Mass Market Geomatics
MNR	Ministry of Natural Resources (Ontario)
MOU	Memorandum of Understanding
NAP	North American Profile, in terms of ISO 19115
NASA	National Aeronautics and Space Administration
NFIS	National Forest Information System
NGO	Non-Governmental Organizations
NRCan	Natural Resources Canada
NRWN	National RailWay Network
NRN	National Road Network
NTS	National Topographic System
OGC	Open Geospatial Consortium
OGDE	Ontario Geospatial Data Exchange
OGL	Open Government Licence
OGP	Open Government Partnership
PAA	Program Activity Architecture
PWGSC	Public Works and Government Services Canada

List of Acronyms	
R&D	Research and Development
ROI	Return on Investment
SCC	Standards Council of Canada
SDI	SDI
SLD	Styled Layer Descriptor
SO	Strategic Objective
SSC	Shared Services Canada
SWE	Sensor Web Enablement
TBS	Treasury Board Secretariat of Canada
TIBITS	Treasury Board IT Standard
UN	UN
UN-GGIM	UN Committee of Experts on Global Geographic Information Management
UN-COPUOS	UN Committee on the Peaceful Uses of Outer Space
UNGEGN	UN Group of Expert on Geographical Names
USA NSDI	National SDI, United States of America
USGS	United States Geological Survey
UUL	Unrestricted Use Licence
VGI	Volunteered Geographic Information
VMR	Vision, Mission, and Roadmap
W3C	World Wide Web Consortium
WCS	Web Coverage Service
WFS	Web Feature Service
WMC	Web Map Context
WMTS	Web Map Tile Service
WMS	Web Map Service
WPS	Web Processing Service

Appendix F - Glossary

Terms and definitions as approved and accepted in the Spatial Data Infrastructure Manual for the Americas.

Term	Definition
Application Program Interface (API)	The interface (calling conventions) by which an application program accesses operating systems and other services. An API provides a means of developing custom user interfaces.
Catalogue	A single collection of metadata entries that are managed together.
Catalogue Service	A service that responds to requests for metadata in a catalogue and that complies with certain browsing or search criteria.
Data Integration	Data integration is the capability of combining data coming from different sources/providers. By combining data from different sources, users can get a better and wider understanding of a situation in a given context to support decision making for instance. In geographic information, two types of integration are considered: vertical and horizontal. Vertical integration is the ability to overlay different data sources within a given area, for example you can overlay the road network of Ottawa with a car accident layer in the same region to identify problematic road intersections. Horizontal integration is the ability to merge data of the same kind belonging to adjacent areas. For example you can merge the Quebec road network with the Ontario road network to get seamless coverage between provinces.
Encoding	A type of encoded data that represents characters as bytes, accomplished by converting each character (which includes letters, numbers, symbols and spaces) into a binary code.
Framework Data	Common base map data that provides spatial reference to physical features and other types of information that is linked to geography and provides a foundation for integrating other kinds of data.
Geographic Information System (GIS)	An information system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data related to positions on the Earth's surface. Both vector and raster GISs are available.
Geolinked Data	Data that is referenced to an identified set of geographic features without including the spatial description of those features. It is normally attribute data in tabular form (such as population counts) that refers to a known jurisdiction (such as provinces), where the elements (the provinces) are referred to by their unique identifier (such as the province name).
Geomatics	The science and technology of gathering, analyzing, interpreting, distributing and using geospatial data. Geomatics encompasses a broad range of disciplines, including surveying, global positioning systems, mapping, remote sensing and cartography.
Geomatics Sector	Includes federal, provincial/state and municipal departments, non-profit organizations, academic organizations (universities, colleges) as well as commercial organizations that supply and use data, services and resources of a geospatial nature.

Term	Definition
Geoportal	A type of Web portal used to find and access spatial information and associated geographic services (display, editing, analysis, etc.) via the Internet.
Geospatial Data	Data with implicit or explicit reference to a location relative to the Earth's surface.
Interoperability	The ability of different types of computers, networks, operating systems and applications to work together effectively, without prior communication, in order to exchange information in a useful and meaningful manner. There are three aspects of interoperability: semantic, structural and syntactical.
Layer	Basic unit of geographic information that may be requested as a map from a server.
Metadata	Information about data. Metadata describes how, when and by whom a particular set of data was collected, and how the data was formatted. Metadata is essential for understanding information stored in data warehouses.
Open Data	A philosophy and practice that makes data easily and freely available - without restrictions from copyright, patents or other mechanisms of control - by way of portals, metadata and search tools in order to enable reuse of the data in new and unforeseen ways. Open data relies on 1) a permissive licensing model that encourages reuse, 2) data discoverability, and 3) data accessibility.
Open Geospatial Consortium, Inc. (OGC)	A non-profit organization founded to address the lack of interoperability among systems that process geospatial data. The OGC is an international industry consortium of companies, government agencies and universities participating in a consensus process to develop publicly available geographic interface specifications that support interoperable solutions to "geo-enable" the Web, wireless and location-based services and mainstream IT.
Operational Policies	A broad range of practical instruments such as guidelines, directives, procedures and manuals that address topics related to the life cycle of spatial data (i.e., collection, management, dissemination, use) and that help facilitate access to and use of spatial information.
Semantics	In the spatial data context, semantics deal with representations of the geographical world as interpreted by human users or communities of practitioners. Defines the meaning of geospatial functions (e.g., the meaning of the input data, the capability of this function, the meaning of the output data).
Spatial Data Infrastructure (SDI)	The relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. It is provided for users and suppliers within all levels of government, the commercial sector, the non-profit sector, academia and citizens in general.

Term	Definition
Standard	Established by consensus and approved by a recognized body. A standard provides, for the common and repeated use of rules, guidelines or characteristics for activities or their results and is aimed at achieving the optimum degree of order in a given context. It is produced in the form of a published document and should be based on the consolidated results of science, technology and experience. It is also designed to promote optimum community benefits.
Thematic Data	Data sets that describe the characteristics of spatial features or provide information on specific topics or themes, such as forest types, water contamination, historical flood areas or disease patterns and trends.
Web Feature Service	An Internet-based service that allows clients to conduct data manipulation on geographic features, allowing for querying, retrieval and transactional (i.e., add, update or delete) operations. The WFS conforms to the OpenGIS Web Feature Server Interface specification.
Web Map Service	An Internet-based service that allows clients to display maps and/or images with a geographic component and whose raw spatial data files reside on one or more remote WMS servers. The WMS conforms to the OpenGIS Web Map Server Interface specification.

Appendix G - Federal, Provincial/Territorial & Municipal Data Themes

This is an update of the previous "Federal, Provincial/Territorial & Municipal Data Themes" Appendix D that come from the Assessment of the Canadian Geospatial Data Infrastructure (CGDI) document delivered on August 1, 2012.

A color code was used to show individual changes between 2012 and 2015. The color green is used to demonstrate a change from No to Yes and the color red is used to demonstrate a change from Yes to No. If there is no change, the text remains **black**. Additions or changes information will be colored in orange.

Acronyms in the data theme table:

DFO   Department of Fisheries and Oceans

ELC   Election Canada

SC   Statistic Canada

AAFC   Agriculture and Agri-Food Canada

AANDC   Aboriginal Affairs and Northern Development Canada

EC   Environment Canada

Data Themes	Data Custodian (list all that apply)	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries											
a) Marine Boundaries b) Electoral Boundaries (Federal Electoral District Boundary Files and Polling Division Boundary Files) c) Administrative Boundaries (Municipal, Aboriginal, and Geopolitical) d) Administrative Boundaries (Province/Territory, Economic Region, Census Division, Census Metropolitan Area / Census Agglomeration, Census Consolidated Subdivision, and Census Subdivision)	DFO ELC NRCan SC	Y Y Y Y	Y Y Y Y	Y Y Y Y	Y N Y Y	N Y Y Y	Y N Y N	a) End-User Licence Agreement 2010 New 2014-2015 End-User License Agreement b) Open Government Licence - Canada c) Open Government Licence - Canada d) Statistics Canada Open License Agreement Open Government Licence - Canada	2014-06-01	1:50 000 1:250 000 1:1 000 000 1:30 000 000	-GeoGratis DFO website (http://www.chs-shc.gc.ca/index-eng.asp) ELC website (http://www.elections.ca/home.aspx) Open Data (http://open.canada.ca/) SC website (http://www.statcan.gc.ca/start-debut-eng.html) Open Data (http://open.canada.ca/)

Data Themes	Data Custodian (list all that apply)	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Geographical Names	NRCan	Y	Y	Y	Y	Y	Y	Open Government Licence - Canada	2015-01-08	1:750 000 1:1 000 000 1:2 000 000 1:15 000 000	GeoGratis Open Data (http://open.canada.ca/)
Geodetic Network	NRCan	Y	Y	Y	Y	Y	N	Open Government Licence - Canada	2003-11-19		Open Data (http://open.canada.ca/)
Digital Elevation Data	NRCan	Y	Y	Y	Y	Y	Y	Open Government Licence - Canada		1:1 000 000	GeoGratis Open Data (http://open.canada.ca/)

Data Themes	Data Custodian (list all that apply)	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdiction al Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Land Cover	i) AAFC	Y	Y	Y	Y	Y	N	i) No-Fee Unrestricted Use Web Wrap Licence Agreement		i) 1:250 000 1:1 000 000 ii) 1:50 000 1:250 000 1:1 000 000 1:2 000 000 1:7 500 000 1:20 000 000 1:30 000 000	AAFC website (http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1226330737632&lang=eng) Open Data (http://open.canada.ca/)
	ii) NRCan	Y	Y	Y	Y	Y	Y	ii) GeoGratis Licence Agreement for Unrestricted Use of Digital Data Open Government Licence - Canada			
Hydro Network	NRCan	Y	Y	Y	Y	Y	Y	Open Government Licence - Canada		1:1 000 000 1:2 000 000 1:7 500 000 1:15 000 000 1:60 000 000	GeoGratis Open Data (http://open.canada.ca/)

Data Themes	Data Custodian (list all that apply)	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdiction al Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Road Network	i) NRCan ii) SC	Y Y	Y Y	Y Y	Y Y	Y Y	Y N	i) Open Government Licence - Canada ii) Statistics Canada Open License Agreement	2014-05-21	i) 1:1 000 000 1:10 000 000	GeoGratis SC website (http://www.statcan.gc.ca/) Open Data (http://open.canada.ca/)
Satellite Imagery	NRCan	Y	Y	Y	Y	Y	Y	Open Government Licence - Canada		1:50 000	GeoGratis Open Data (http://open.canada.ca/)
Road Addresses	SC	Y	Y	Y	Y	Y	N	Open Government Licence - Canada Statistics Canada Open License Agreement			GeoGratis SC website (http://www.statcan.gc.ca/) Open Data (http://open.canada.ca/)

Data Themes	Data Custodian (list all that apply)	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdiction al Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Cadastral Parcels	NRCan	N	Y	Y	Y	N	N	Open Government Licence - Canada			GeoGratis Open Data (http://open.canada.ca/)
Protected Sites											
a) Indian Reserve b) Oceans Management Areas c) Protected Areas	AANDC DFO NRCan	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	Y Y Y	a) Open Government Licence - Canada b) End-User Licence Agreement 2010 New 2014-2015 End-User License Agreement Open Government Licence - Canada		1:1 000 000	AANDC website (http://www.aadnc-aandc.gc.ca/eng/1100100010002) DFO website (http://www.chs-shc.gc.ca/index-eng.asp) GeoGratis Open Data (http://open.canada.ca/)

Data Themes	Data Custodian (list all that apply)	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdiction al Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Bathymetry	i) DFO ii) NRCan	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	i) End-User Licence Agreement 2010 New 2014-2015 End-User License Agreement ii) GeoGratis Licence Agreement for Unrestricted Use of Digital Data Open Government Licence - Canada			DFO website (http://www.chs-shc.gc.ca/index-eng.asp) Open Data (http://open.canada.ca/)
Geology	i) AANDC ii) AAFC	Y Y	Y Y	Y Y	Y Y	Y Y	N Y	i) None ii) No-Fee Unrestricted Use Web Wrap Licence Agreement Open Government Licence - Canada			AANDC website (http://www.aadnc-aandc.gc.ca/eng/1100100010002) AAFC website (http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1226330737632&lang=eng) Open Data (http://open.canada.ca/)
Data Themes	Data	Data	Metadata	Jurisdiction	Mechanisms	Data	Data	Access policies /	Publication	Scales available	List dissemination

	Custodian (list all that apply)	Model Exists (y/n)	Exists (y/n)	al Coverage (y/n)	for searching (y/n)	accessible via download (y/n)	accessible via web services (y/n)	Licensing restrictions available (y/n) (List all that apply)	Date	(list all that apply)	portal(s)
Statistical Units	-	-	-	-	-	-	-	-	-	-	-
Railway Network	NRCan	Y	Y	Y	Y	Y	Y	Open Government Licence - Canada		1:1 000 000 1:10 000 000	GeoGratis Open Data (http://open.canada.ca/)
Meteorological Data											
a) Climate b) Atmospheric Chemistry & Air Pollution	AAFC EC	Y Y	Y Y	Y Y	N Y	N Y	N Y	a) No-Fee Unrestricted Use Web Wrap Licence Agreement b) Government of Canada Open License Agreement Open Government Licence - Canada			AAFC website (http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1226330737632&lang=eng) -EC website (http://www.ec.gc.ca/scitech/default.asp?lang=En&n=AC4418A5-1)
Utility Networks	-	-	-	-	-	-	-	-	-	-	-

Alberta

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	N	N	-Standard License Agreement			-GeoDiscover Alberta Catalogue
Geographical Names	Y	Y	Y		N	N				
Geodetic Network	Y	Y	Y		N	N	-Subscription License Agreement			-GeoConnections Discovery Portal
Digital Elevation Data	Y	Y	Y		N	N	-Specialized License Agreement			
Land Cover	Y	Y	Y		N	N			1:10 000	
Hydro Network	Y	Y	Y		N	N			1:20 000	
Road Network	Y	Y	Y		N	N				
Satellite Imagery	N	-	-		-	-		-	-	
Road Addresses	-	-	-		-	-		-	-	
Cadastral Parcels	Y	Y	Y		N	N				
Protected Sites	Y	Y	Y		N	N				
Bathymetry	-	-	-		-	-		-	-	
Geology	Y	Y	Y		N	Y				
Statistical Units	-	-	-		-	-		-	-	
Railway Network	-	-	-		-	-		-	-	
Meteorological Data	-	-	-		-	-		-	-	
Utility Networks	Y	Y	Y		N	N			1:250 000	

British Colombia

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	Y	Y	-Non-Open Government License			-Geospatial Gateway
Geographical Names	Y	Y	Y		N	Y				
Geodetic Network	Y	Y	Y		N	Y				-Geographic Data Discovery Service
Digital Elevation Data	Y	Y	Y		N	Y			1:2 000 000	
Land Cover	Y	Y	Y		Y	Y			1:20 000	-GeoConnections Discovery Portal
Hydro Network	Y	Y	Y		N	Y			1:20 000	
Road Network	Y	Y	Y		Y	Y			1:20 000	
Satellite Imagery	Y	Y	Y		Y	Y				
Road Addresses	Y	Y	Y		N	Y				
Cadastral Parcels	Y	Y	Y		Y	Y				
Protected Sites	Y	Y	Y		Y	Y				
Bathymetry	-	-	-		-	-			-	-
Geology	Y	Y	Y		N	Y				
Statistical Units	-	-	-		-	-			-	-
Railway Network	-	-	-		-	-			-	-
Meteorological Data	Y	Y	Y		N	Y				
Utility Networks	-	-	-		-	-			-	-

Manitoba

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	N	Y	N	None		1:20 000	-GeoConnections Discovery Portal
Geographical Names	Y	Y	Y		Y	N			1:50 000	
Geodetic Network	Y	Y	Y		Y	N				
Digital Elevation Data	Y	Y	Y		Y	N				
Land Cover	Y	Y	Y		Y	N			1:1 000 000	
Hydro Network	Y	Y	Y		Y	N			1:20 000	
Road Network	Y	Y	Y		Y	N			1:1 000 000	
Satellite Imagery	Y	Y	Y		Y	N				
Road Addresses	N	-	-		-	-		-	-	
Cadastral Parcels	Y	N	Y		Y	N				
Protected Sites	Y	Y	Y		Y	N			1:20 000 1:50 000	
Bathymetry	-	-	-		-	-		-	-	
Geology	-	-	-		-	-		-	-	
Statistical Units	-	-	-		-	-		-	-	
Railway Network	-	-	-		-	-		-	-	
Meteorological Data	-	-	-		-	-		-	-	
Utility Networks	-	-	-		-	-		-	-	

New Brunswick

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	N	Y	N	- Service New Brunswick Data License Agreement			-GeoConnections Discovery Portal
Geographical Names	Y	Y	Y		Y	N				
Geodetic Network	Y	Y	Y		Y	N				
Digital Elevation Data	Y	Y	Y		Y	N				
Land Cover	Y	Y	Y		Y	N			1:10 000	
Hydro Network	Y	Y	Y		Y	N			1:10 000	
Road Network	Y	Y	Y		Y	N			1:10 000	
Satellite Imagery	Y	Y	Y		Y	N			1:10 000	
Road Addresses	Y	Y	Y		Y	N				
Cadastral Parcels	Y	N	Y		Y	N				
Protected Sites	Y	Y	Y		Y	N				
Bathymetry	-	-	-		-	-		-	-	
Geology	-	-	-		-	-		-	-	
Statistical Units	-	-	-		-	-		-	-	
Railway Network	-	-	-		-	-		-	-	
Meteorological Data	-	-	-		-	-		-	-	
Utility Networks	-	-	-		-	-		-	-	

Newfoundland and Labrador

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	N	-	-	Y	-	-	None	-	-	-Newfoundland and Labrador Water Resources Portal
Geographical Names	Y	N	Y		Y	Y				
Geodetic Network	-	-	-		-	-		-	-	
Digital Elevation Data	N	-	-		-	-		-	-	-GeoConnections Discovery Portal
Land Cover	N	-	-		-	-		-	-	
Hydro Network	Y	Y	Y		Y	Y			1:50 000	
Road Network	N	-	-		-	-		-	-	
Satellite Imagery	Y	Y	Y		N	Y			1:12 500	
Road Addresses	-	-	-		-	-		-	-	
Cadastral Parcels	N	-	-		-	-		-	-	
Protected Sites	Y	Y	Y		Y	Y				
Bathymetry	Y	Y	Y		Y	Y				
Geology	-	-	-		-	-		-	-	
Statistical Units	-	-	-		-	-		-	-	
Railway Network	-	-	-		-	-		-	-	
Meteorological Data	-	-	-		-	-		-	-	
Utility Networks	-	-	-		-	-		-	-	

Northwest Territories

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	N	Y	Y	Y	Y	None			-NWT Discovery Portal
Geographical Names	N	-	-		-	-		-	-	
Geodetic Network	N	-	-		-	-		-	-	- GeoConnections Discovery Portal
Digital Elevation Data	Y	Y	Y		Y	Y				
Land Cover	N	-	-		-	-		-	-	
Hydro Network	N	-	-		-	-		-	-	
Road Network	N	-	-		-	-		-	-	
Satellite Imagery	N	-	-		-	-		-	-	
Road Addresses	N	-	-		-	-		-	-	
Cadastral Parcels	N	-	-		-	-		-	-	
Protected Sites	N	-	-		-	-		-	-	
Bathymetry	N	-	-		-	-		-	-	
Geology	N	-	-		-	-		-	-	
Statistical Units	N	-	-		-	-		-	-	
Railway Network	N	-	-		-	-		-	-	
Meteorological Data	N	-	-		-	-		-	-	
Utility Networks	N	-	-		-	-		-	-	

Nova Scotia

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	N	Y	-Digital Geographic Data Use License		1:10 000	-Nova Scotia Geographic Catalogue
Geographical Names	Y	Y	Y		N	Y			1:10 000	
Geodetic Network	Y	Y	Y		N	Y			1:10 000	-GeoConnections Discovery Portal
Digital Elevation Data	Y	Y	Y		N	Y			1:10 000	
Land Cover	Y	Y	Y		N	Y			1:10 000	
Hydro Network	Y	Y	Y		N	Y			1:10 000	
Road Network	Y	Y	Y		N	Y			1:10 000	
Satellite Imagery	Y	Y	Y		N	Y			1:10 000	
Road Addresses	Y	Y	Y		N	Y			1:10 000	
Cadastral Parcels	Y	Y	Y		N	Y			1:10 000	
Protected Sites	Y	Y	Y		N	Y			1:10 000	
Bathymetry	-	-	-		-	-		-	-	
Geology	-	-	-		-	-		-	-	
Statistical Units	Y	Y	Y		N	Y			1:10 000	
Railway Network	Y	Y	Y		N	Y			1:10 000	
Meteorological Data	-	-	-		-	-		-	-	
Utility Networks	Y	Y	Y		N	Y			1:10 000	

Nunavut

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	N	-	-	N	-	-	None	-	-	None
Geographical Names	N	-	-		-	-		-	-	
Geodetic Network	N	-	-		-	-		-	-	
Digital Elevation Data	N	-	-		-	-		-	-	
Land Cover	N	-	-		-	-		-	-	
Hydro Network	N	-	-		-	-		-	-	
Road Network	N	-	-		-	-		-	-	
Satellite Imagery	N	-	-		-	-		-	-	
Road Addresses	N	-	-		-	-		-	-	
Cadastral Parcels	N	-	-		-	-		-	-	
Protected Sites	N	-	-		-	-		-	-	
Bathymetry	N	-	-		-	-		-	-	
Geology	N	-	-		-	-		-	-	
Statistical Units	N	-	-		-	-		-	-	
Railway Network	N	-	-		-	-		-	-	
Meteorological Data	N	-	-		-	-		-	-	
Utility Networks	N	-	-		-	-		-	-	

Ontario

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	N	Y	-Unrestricted Use License			-LIO Metadata Management Tool
Geographical Names	Y	Y	Y		N	Y			1:80 000	
Geodetic Network	Y	Y	Y		N	Y	-End User License Agreement			-Ministry of Environment GIS Portal for Conservation Authorities
Digital Elevation Data	Y	Y	Y		N	Y	-Ontario Parcel License		1:400 000	
Land Cover	Y	Y	Y		N	Y				
Hydro Network	Y	Y	Y		N	Y			1:100 000	-Ontario GeoPortal
Road Network	Y	Y	Y		N	Y				-Select Ontario
Satellite Imagery	Y	Y	Y		N	Y				
Road Addresses	Y	Y	Y		N	Y				-GeoConnections Discovery Portal
Cadastral Parcels	Y	Y	Y		N	Y			1:100 000	
Protected Sites	Y	Y	Y		N	Y			1:60 000	
Bathymetry	-	-	-		-	-		-	-	
Geology	-	-	-		-	-		-	-	
Statistical Units	-	-	-		-	-		-	-	
Railway Network	-	-	-		-	-		-	-	
Meteorological Data	-	-	-		-	-		-	-	
Utility Networks	-	-	-		-	-		-	-	

Prince Edward Island

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	N	Y	N	-License Agreement for GIS Data			-GIS Data Catalog
Geographical Names	Y	Y	Y		Y	N				
Geodetic Network	-	-	-		-	-	-Standard End-User License	-	-	-GeoConnections Discovery Portal
Digital Elevation Data	-	-	-		-	-	-Education, Research & Development License	-	-	
Land Cover	Y	Y	Y		Y	N			1:10 000	
Hydro Network	Y	Y	Y		Y	Y	-Value Added Service Provider License		1:10 000	
Road Network	Y	Y	Y		Y	N			1:10 000	
Satellite Imagery	Y	Y	Y		Y	N				
Road Addresses	-	-	-		-	-		-	-	
Cadastral Parcels	Y	N	Y		Y	N				
Protected Sites	Y	Y	Y		Y	N				
Bathymetry	-	-	-		-	-		-	-	
Geology	-	-	-		-	-		-	-	
Statistical Units	-	-	-		-	-		-	-	
Railway Network	-	-	-		-	-		-	-	
Meteorological Data	-	-	-		-	-		-	-	
Utility Networks	-	-	-		-	-		-	-	

Quebec

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	N	N	N		1:1 250 000	-Catalogue d'information géographique gouvernementale
Geographical Names	Y	Y	Y		N	N				
Geodetic Network	-	-	-		-	-		-	-	
Digital Elevation Data	Y	Y	Y		N	N			1:20 000 1:100 000	-GeoConnections Discovery Portal
Land Cover	Y	Y	Y		N	N			1:20 000 1:100 000	
Hydro Network	Y	Y	Y		Y	N			1:20 000 1:100 000	
Road Network	Y	Y	Y		N	N			1:20 000 1:100 000	
Satellite Imagery	Y	Y	Y		N	N			1:2 000 000	
Road Addresses	-	-	-		-	-		-	-	
Cadastral Parcels	Y	Y	Y		N	N				
Protected Sites	Y	Y	Y		N	N			1:3 000	
Bathymetry	-	-	-		-	-		-	-	
Geology	-	-	-		-	-		-	-	
Statistical Units	-	-	-		-	-		-	-	
Railway Network	-	-	-		-	-		-	-	
Meteorological Data	-	-	-		-	-		-	-	
Utility Networks	-	-	-		-	-		-	-	

Saskatchewan

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	Y	N	-Terms and Conditions of Use Agreement for All Users (for restricted and unrestricted data)			-GeoSask Metadata Search
Geographical Names	Y	Y	Y		Y	N				
Geodetic Network	-	-	-		-	-		-	-	-GeoConnections Discovery Portal
Digital Elevation Data	N	-	-		-	N				
Land Cover	Y	Y	N		N	Y				
Hydro Network	Y	Y	Y		Y	N				
Road Network	Y	Y	Y		Y (with license)	N				
Satellite Imagery	Y	Y	Y		Y	N				
Road Addresses	-	-	-		-	-		-	-	
Cadastral Parcels	Y	Y	Y		Y (with license)	N				
Protected Sites	Y	Y	Y		Y	N				
Bathymetry	-	-	-		-	-		-	-	
Geology	-	-	-		-	-		-	-	
Statistical Units	-	-	-		-	-		-	-	
Railway Network	-	-	-		-	-		-	-	
Meteorological Data	-	-	-		-	-		-	-	
Utility Networks	-	-	-		-	-		-	-	

Yukon

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	Y	N	-License Agreement for Public Use			-Data & Imagery Catalog
Geographical Names	Y	Y	Y		Y	N			1:1 000 000	
Geodetic Network	-	-	-		-	-	-License Agreement for Internal Use	-	-	-CSW Metadata Server
Digital Elevation Data	Y	Y	Y		Y	N			30m, 90m	-GeoConnections Discovery Portal
Land Cover	Y	Y	Y		Y	N			1:1 000 000	
Hydro Network	Y	Y	Y		Y	N			1:1 000 000	
Road Network	Y	Y	Y		Y	N			1:1 000 000	
Satellite Imagery	Y	Y	Y		Y	N				
Road Addresses	Y	Y	Y		Y	N			1:1 000 000	
Cadastral Parcels	N	-	-		-	-		-	-	
Protected Sites	Y	N	Y		Y	N				
Bathymetry	-	-	-		-	-		-	-	
Geology	-	-	-		-	-		-	-	
Statistical Units	-	-	-		-	-		-	-	
Railway Network	-	-	-		-	-		-	-	
Meteorological Data	-	-	-		-	-		-	-	
Utility Networks	-	-	-		-	-		-	-	

Municipalities

Edmonton

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	Y	N	-Open Data Terms of Use			-Open Data Catalogue
Geographical Names	N	-	-		-	-		-	-	
Geodetic Network	N	-	-		-	-		-	-	-GeoConnections Discovery Portal
Digital Elevation Data	N	-	-		-	-		-	-	
Land Cover	N	-	-		-	-		-	-	
Hydro Network	N	-	-		-	-		-	-	
Road Network	N	-	-		-	-		-	-	
Satellite Imagery	N	-	-		-	-		-	-	
Road Addresses	N	-	-		-	-		-	-	
Cadastral Parcels	Y	Y	Y		Y	N			1:1 000	
Protected Sites	Y	Y	Y		Y	N				
Bathymetry	N	-	-		-	-		-	-	
Geology	N	-	-		-	-		-	-	
Statistical Units	N	-	-		-	-		-	-	
Railway Network	N	-	-		-	-		-	-	
Meteorological Data	N	-	-		-	-		-	-	
Utility Networks	N	-	-		-	-		-	-	

Montreal

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	Y	N	-Licence d'utilisation des données ouvertes de la Ville de Montréal			-Catalogue de données
Geographical Names	N	-	-		-	-		-	-	
Geodetic Network	N	-	-		-	-		-	-	-GeoConnections Discovery Portal
Digital Elevation Data	N	-	-		-	-		-	-	
Land Cover	N	-	-		-	-		-	-	
Hydro Network	N	-	-		-	-		-	-	
Road Network	N	-	-		-	-		-	-	
Satellite Imagery	Y	Y	Y		Y	N				
Road Addresses	N	-	-		-	-		-	-	
Cadastral Parcels	N	-	-		-	-		-	-	
Protected Sites	N	-	-		-	-		-	-	
Bathymetry	N	-	-		-	-		-	-	
Geology	N	-	-		-	-		-	-	
Statistical Units	N	-	-		-	-		-	-	
Railway Network	N	-	-		-	-		-	-	
Meteorological Data	N	-	-		-	-		-	-	
Utility Networks	N	-	-		-	-		-	-	

Ottawa

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	Y	N	-Open License Agreement			-Data Catalogue
Geographical Names	N	-	-		-	-		-	-	
Geodetic Network	N	-	-		-	-		-	-	-GeoConnections Discovery Portal
Digital Elevation Data	Y	Y	Y		Y	N				
Land Cover	N	-	-		-	-		-	-	
Hydro Network	Y	Y	Y		Y	N			1:15 000	
Road Network	Y	Y	Y		Y	N				
Satellite Imagery	Y	Y	Y		Y	N			1:15 000	
Road Addresses	N	-	-		-	-		-	-	
Cadastral Parcels	N	-	-		-	-		-	-	
Protected Sites	Y	Y	Y		Y	N				
Bathymetry	N	-	-		-	-		-	-	
Geology	N	-	-		-	-		-	-	
Statistical Units	N	-	-		-	-		-	-	
Railway Network	N	-	-		-	-		-	-	
Meteorological Data	N	-	-		-	-		-	-	
Utility Networks	N	-	-		-	-		-	-	

Toronto

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	Y	Y	-Open Data License Version 2.0			-Data Catalogue
Geographical Names	N	-	-		-	-		-	-	
Geodetic Network	N	-	-		-	-		-	-	-GeoConnections Discovery Portal
Digital Elevation Data	N	-	-		-	-		-	-	
Land Cover	Y	Y	Y		Y	N				
Hydro Network	N	-	-		-	-		-	-	
Road Network	N	-	-		-	-		-	-	
Satellite Imagery	Y	Y	Y		Y	Y				
Road Addresses	N	-	-		-	-		-	-	
Cadastral Parcels	Y	Y	Y		Y	Y				
Protected Sites	Y	Y	Y		Y	Y				
Bathymetry	N	-	-		-	-		-	-	
Geology	N	-	-		-	-		-	-	
Statistical Units	N	-	-		-	-		-	-	
Railway Network	N	-	-		-	-		-	-	
Meteorological Data	N	-	-		-	-		-	-	
Utility Networks	N	-	-		-	-		-	-	

Vancouver

Data Themes	Data Model Exists (y/n)	Metadata Exists (y/n)	Jurisdictional Coverage (y/n)	Mechanisms for searching (y/n)	Data accessible via download (y/n)	Data accessible via web services (y/n)	Access policies / Licensing restrictions available (y/n) (List all that apply)	Publication Date	Scales available (list all that apply)	List dissemination portal(s)
Administrative Boundaries	Y	Y	Y	Y	Y	N	-Open License Agreement			-Data Catalogue
Geographical Names	N	-	-		-	-		-	-	
Geodetic Network	N	-	-		-	-		-	-	-GeoConnections Discovery Portal
Digital Elevation Data	Y	Y	Y		Y	N			1m, 2m 10m	
Land Cover	N	-	-		-	-		-	-	
Hydro Network	Y	Y	Y		Y	N				
Road Network	Y	Y	Y		Y	N				
Satellite Imagery	Y	Y	Y		Y	N				
Road Addresses	N	-	-		-	-		-	-	
Cadastral Parcels	Y	Y	Y		Y	N				
Protected Sites	Y	Y	Y		Y	N				
Bathymetry	N	-	-		-	-		-	-	
Geology	N	-	-		-	-		-	-	
Statistical Units	N	-	-		-	-		-	-	
Railway Network	N	-	-		-	-		-	-	
Meteorological Data	N	-	-		-	-		-	-	
Utility Networks	N	-	-		-	-		-	-	

Appendix H – Arctic SDI Web Services Inventory

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
ABBSC Arctic Breeding Bird Conditions Survey	http://pdx.axiomalaska.com/geoserver/wms?service=WMS&request=GetMap&layers=axiom:ABBCS_BreedingBirdConditionsSurvey	760	WMS	International	All Arctic	Sea, Bird, Fish, Geology, Habitat, Sediment, Shorezone, River, Oil, Gas, CAFF, Boundary, Forest, Productivity, Bathymetry, Alaska	http://portal.aoos.org/?v=rand&portal_id=3#module-metadata/ad7125ca-ea24-11e0-a21c-0019b9dae22b/ee8a2872-ea24-11e0-b750-0019b9dae22b	Thursday, March 12, 2015
ABBSC Arctic Breeding Bird Conditions Survey	http://pdx.axiomalaska.com/geoserver/wfs?service=WFS&version=1.0.0&request=GetFeature&outputFormat=application/json&typeName=axiom:ABBCS_BreedingBirdConditionsSurvey	745	WFS	International	All Arctic	Sea, Bird, Fish, Geology, Habitat, Sediment, Shorezone, River, Oil, Gas, CAFF, Boundary, Forest, Productivity, Bathymetry, Alaska	http://portal.aoos.org/?v=rand&portal_id=3#module-metadata/ad7125ca-ea24-11e0-a21c-0019b9dae22b/ee8a2872-ea24-11e0-b750-0019b9dae22b	Thursday, March 12, 2015
AOOS Arctic Data Integration Portal	http://pdx.axiomalaska.com/ncWMS/wms?service=WMS&request=GetMap&layers=IBCAO/z	1069	WMS	National	All Arctic		http://portal.aoos.org/?v=rand&portal_id=3#	Monday, March 02, 2015
Arctic_sdi	http://opencache.statkart.no/gatekeeper/gk/gk.open_wmts?Version=1.0.0&service=wmts&request=getcapabilities		WMS	International	All Arctic		http://kartverket.no/kart/gratis-kartdata/cache-tjenester/	Monday, March 23, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
Arctic_Voyage_Planning_Guide	http://geoportal.gc.ca/arcgis/services/Arctic_Voyage_Planning_Guide_ENG/MapServer/WMSServer?request=GetCapabilities&service=WMS	34	WMS	National	Canada	Canada, Arctic, Airports, Communities, Mines, Weather, Stations, Coastal, Harbour, Ice, Protected areas, Marine	http://open.canada.ca/data/en/dataset/97183f5e-1b0b-4700-a3c0-534a5efdfd24	Monday, March 02, 2015
Arctic_Voyage_Planning_Guide	http://geoportal.gc.ca/arcgis/services/Arctic_Voyage_Planning_Guide_ENG/MapServer/WFSServer?request=GetCapabilities&service=WFS	34	WFS	National	Canada	Canada, Arctic, Airports, Communities, Mines, Weather, Stations, Coastal, Harbour, Ice, Protected areas, Marine	http://open.canada.ca/data/en/dataset/97183f5e-1b0b-4700-a3c0-534a5efdfd24	Friday, March 20, 2015
ARMAP Arctic World Cities	http://arcticdata.utep.edu/arcgis/services/ARMAP_WorldCities_35N_EPSG3572/MapServer/WMSServer	1	WMS	International	All Arctic	Arctic, cities, world, location	http://armap.org/web-services/	Monday, March 02, 2015
ARMAP Arctic World Cities	http://arcticdata.utep.edu/arcgis/services/ARMAP_WorldCities_35N_EPSG3572/MapServer/WFSServer	1	WFS	International	All Arctic	Arctic, cities, world, location	http://armap.org/web-services/	Monday, March 02, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
ARMAP Field research projects	http://arcticdata.utep.edu/arcgis/services/ARMAP_FieldResearchProjects_45N_EPSG3572/MapServer/WMSServer	1	WMS	International	All Arctic	Research, Investigation, Biology, cryosphere, Education/Outreach, Oceans, Earth Science, Solid Earth, Biosphere, social science, Human Science, Geology, Legacy, meteorology, climate, oceanography, space physics, climatologyMeteorologyAtmosphere, oceans, geoscientificInformation, imageryBaseMapsEarthCover, location, NASA, National Science Foundation, proposal, communication	http://armap.org/web-services/	Monday, March 02, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
ARMAP Field research projects	http://arcticdata.utep.edu/arcgis/services/ARMAP_FieldResearchProjects_45N_EPSG3572/MapServer/WFSServer	1	WFS	International	All Arctic	Research, Investigation, Biology, cryosphere, Education/Outreach, Oceans, Earth Science, Solid Earth, Biosphere, social science, Human Science, Geology, Legacy, meteorology, climate, oceanography, space physics, climatologyMeteorologyAtmosphere, oceans, geoscientificInformation, imageryBaseMapsEarthCover, location, NASA, National Science Foundation, proposal, communication	http://armap.org/web-services/	Monday, March 02, 2015
ARMAP Site place names	http://arcticdata.utep.edu/arcgis/services/ARMAP_FieldResearchSiteNames_45N_EPSG3572/MapServer/WMSServer	1	WMS	International	All Arctic	Arctic,Logistics,Research,Investigation,geoscientificInformation,Location,National Science Foundation	http://armap.org/web-services/	Monday, March 02, 2015
ARMAP Site place names	http://arcticdata.utep.edu/arcgis/services/ARMAP_FieldResearchSiteNames_45N_EPSG3572/MapServer/WFSServer	1	WFS	International	All Arctic	Arctic,Logistics,Research,Investigation,geoscientificInformation,Location,National Science Foundation	http://armap.org/web-services/	Monday, March 02, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
CAFF Boundary	http://geo.abds.is/geoserver/Boundaries/wms?	12	WMS	International	All Arctic	CAFF, ABA, AMAP, Arctic, Zones, EcoRegions, Marine Areas, Lichen, Vegetation Productivity	http://geo.abds.is/geonetwork/srv/eng/main.home?uuid=54294151-9e15-4457-8a44-df2c0ec5ada5	Friday, March 06, 2015
CAFF data	http://dev.caff.is:8080/geoserver/arctic_sdi/wms?time=2013-08-01&	9	WMS	International	All Arctic	CAFF, Albedo, CDOM, Chlorophyll, Land Cover Type, Land Surface Temperature, Primary Productivity, Sea Surface Temperature, Snow Covered Area, Vegetation		Monday, March 02, 2015
CAFF Ecosystems	http://geo.abds.is/geoserver/Ecosystems/wms?	42	WMS	International	All Arctic	Amphibians, Birds, Bioclimate, Zone, Floral, Circumpolar, Lichen, Vegetation, Monitoring, Mammals, Treeline	http://geo.abds.is/geonetwork/srv/eng/main.home?uuid=7856ef8b-458f-4c2b-a95b-9ebc7a4cb217	Tuesday, March 31, 2015
CAFF Freshwater	http://geo.abds.is/geoserver/Freshwater/wms?	3	WMS	International	All Arctic	Lakes, Rivers, Freshwater	http://geo.abds.is/geonetwork/srv/eng/main.home?uuid=54294151-9e15-4457-8a44-df2c0ec5ada5	Friday, March 06, 2015
CAFF Indicators	http://geo.abds.is/geoserver/Indicators/wms?s	19	WMS	International	All Arctic	CAFF, Indicators, Birds, Fish, Mammals, Protected areas, Distribution	http://geo.abds.is/geonetwork/srv/eng/main.home?uuid=54294151-9e15-4457-8a44-df2c0ec5ada5	Friday, March 06, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
CAFF Marine	http://geo.abds.is/geoserver/Marine/wms?	2	WMS	International	All Arctic	CAFF, Marine, Accidents, Areas, Incidents	http://geo.abds.is/geonetwork/srv/eng/main.home?uuid=54294151-9e15-4457-8a44-df2c0ec5ada5	Friday, March 06, 2015
CAFF Species	http://geo.abds.is/geoserver/Species/wms?	21	WMS	International	All Arctic	Arctic, CAFF, Regions, Lakes, Caribou, Polar Bear, Flyways, Colonies, Bird	http://geo.abds.is/geonetwork/srv/eng/main.home?uuid=54294151-9e15-4457-8a44-df2c0ec5ada5	Friday, March 06, 2015
CAFF Terrestrial	http://geo.abds.is/geoserver/Terrestrial/wms?	3	WMS	International	All Arctic	CAFF, CBMP, Terrestrial, Mammals, Monitoring, Vegetation	http://geo.abds.is/geonetwork/srv/eng/main.home?uuid=54294151-9e15-4457-8a44-df2c0ec5ada5	Friday, March 06, 2015
CAFF WFS	http://geo.abds.is/geoserver/ows?service=wfs&version=2.0.0&request=GetCapabilities	112	WFS	International	All Arctic	Zones, Accidents, Birds, Fish, Mammals, Boundary, Arctic, Lake, Survey, CAFF, Flora, Fauna, Vegetation, Bear, Flyways, Colonies, Treeline, World, Time Series	http://geo.abds.is/geoserver/web/	Friday, April 10, 2015
Canadian Hydrographic Service	http://geoportail-geoportail.gc.ca/arcgis/services/Hydrographic_Charts_ENG/MapServer/WMSServer?	14	WMS	National	Canada	Navigation, Chart, Limits, Approach, Berthing, Coastal, Harbour, Hydrographic	http://open.canada.ca/data/en/dataset/c52fa839-2454-4709-b316-a6851e157558	Monday, March 30, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
Canadian Hydrographic Service	http://geoportal-geoportail.gc.ca/arcgis/services/Hydrographic_Charts_ENG/MapServer/WFSServer?	14	WFS	National	Canada	Navigation, Chart, Limits, Approach, Berthing, Coastal, Harbour, Hydrographic	http://open.canada.ca/data/en/dataset/c52fa839-2454-4709-b316-a6851e157558	Monday, March 30, 2015
Canadian Hydrographic Service - Levels of Service	http://geoportal-geoportail.gc.ca/arcgis/services/CHS_Levels_of_Service_ENG/MapServer//WMSServer?	1	WMS	National	Canada	Risk, Classification, Canada	http://open.canada.ca/data/en/dataset/91db3739-3db8-45ca-9a97-3d8a7ce77ae3	Monday, April 20, 2015
CCIN Polar Data	https://polardata.ca/geoserver/PDC_Metadata/wms?	1	WMS	Private	All Arctic	Research, Camp, Place, Location	https://www.ccin.ca/home/	Tuesday, March 17, 2015
Discomap 2012_NOISE_END_LAEA_Noise_Sources	http://noise.discomap.eea.europa.eu/arcgis/services/Noise/2012_NOISE_END_LAEA_Noise_Sources/MapServer/WMSServer?request=GetCapabilities&service=WMS	10	WMS	International	Europe	Noise, Sources, Rails, Roads, Airports	http://discomap.eea.europa.eu/pages/Server_noise_Folder_Noise.html	Wednesday, March 11, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
Discomap Ammonium	http://water.discomap.eea.europa.eu/arcgis/services/GroundwaterSoE/Ammonium/MapServer/WMSServer?request=GetCapabilities&service=WMS	1	WMS	International	Europe	Ammonium	http://discomap.eea.europa.eu/pages/Server_water_Folder_GroundwaterSoE.html#simpleInfo1093	Wednesday, March 11, 2015
Discomap Background_Dyna_WM	http://bio.discomap.eea.europa.eu/arcgis/services/Bio/BiogeographicalRegions_Dyna_WM/MapServer/WMSServer?request=GetCapabilities&service=WMS	3	WMS	International	Europe	Background, Biogeographical, Regions	http://discomap.eea.europa.eu/pages/Server_land_Folder_Background.html	Wednesday, March 11, 2015
Discomap Biogeographical Regions	http://bio.discomap.eea.europa.eu/arcgis/services/Bio/BiogeographicalRegions_Dyna_WM/MapServer/WMSServer?request=GetCapabilities&service=WMS	3	WMS	International	Europe	Background, Biogeographical, Regions	http://discomap.eea.europa.eu/pages/Server_bio_Folder_Bio.html	Wednesday, March 11, 2015
Discomap CDDA_Dyna_WM Protected area	http://bio.discomap.eea.europa.eu/arcgis/services/ProtectedSites/CDDA_Dyna_WM/MapServer/WMSServer?request=GetCapabilities&service=WMS	4	WMS	International	Europe	Protected, Area	http://discomap.eea.europa.eu/pages/Server_bio_Folder_ProtectedSites.html	Wednesday, March 11, 2015
Discomap Ecotones	http://bio.discomap.eea.europa.eu/arcgis/services/Bio/EcoTones_Dyna_LAEA/MapServer/WMSServer?	9	WMS	International	Europe	Forest, Ecotones, Crops, Transitions, Urban, Wetlands	http://discomap.eea.europa.eu/pages/Server_bio_Folder_Bio.html	Wednesday, March 11, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
Discomap EPRTR Diffuse Air	http://air.discomap.eea.europa.eu/arcgis/services/Air/EPRTRDiffuseAir_Dyna_WGS84/MapServer/WMSServer?	14	WMS	International	Europe	CO, NH3, Nox, PM10, SO2, Emissions, Industrial, Combustion, Transport, Agricultural, Mobile, Road	http://discomap.eea.europa.eu/pages/Server_air_Folder_Air.html	Wednesday, March 11, 2015
Discomap EPRTR Diffuse Emissions to Air	http://air.discomap.eea.europa.eu/arcgis/services/Air/EPRTRDiffuseEmissionsAir_Dyna_WGS84/MapServer/WMSServer?	32	WMS	International	Europe	CO, NH3, Nox, PM10, SO2, Emissions, Industrial, Combustion, Transport, Agricultural, Mobile, Road, Domestic, Aviation, Shipping	http://discomap.eea.europa.eu/pages/Server_air_Folder_Air.html	Wednesday, March 11, 2015
Discomap eudem_dem_1deg	http://image.discomap.eea.europa.eu/arcgis/services/Elevation/eudem_dem_1deg/ImageServer/WCSServer?request=GetCapabilities&service=WCS	1	WCS	International	Europe	Elevation, dem, Altitude	http://discomap.eea.europa.eu/pages/Server_image_Folder_Elevation.html	Wednesday, March 11, 2015
Discomap FloodsDirective UOM	http://water.discomap.eea.europa.eu/arcgis/services/Wise/FloodsDirectiveUOM/MapServer/WMSServer?request=GetCapabilities&service=WMS	4	WMS	International	Europe		http://discomap.eea.europa.eu/pages/Server_water_Folder_Wise.html	Wednesday, March 11, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
Discomap Groundwater_Determinands_WM	http://water.discomap.eea.europa.eu/arcgis/services/GroundwaterSoE/Groundwater_Determinands_WM/MapServer/WMSServer?request=GetCapabilities&service=WMS	1	WMS	International	Europe	Waterbase, Groundwater, Quality, Stations	http://discomap.eea.europa.eu/pages/Server_water_Folder_GroundwaterSoE.html#simpleInfo1093	Wednesday, March 11, 2015
Discomap Heavy_Precipitation	http://climate.discomap.eea.europa.eu/arcgis/services/Floods/Heavy_Precipitation_Dyna_LAEA/MapServer/WMSServer?request=GetCapabilities&service=WMS	2	WMS	International	Europe	Precipitation, Change, Summer, Winter	http://discomap.eea.europa.eu/pages/Server_climate_Folder_Floods.html	Wednesday, March 11, 2015
Discomap LifeProjects_WGS84	http://bio.discomap.eea.europa.eu/arcgis/services/Bio/LifeProjects_Dyna_WGS84/MapServer/WMSServer?request=GetCapabilities&service=WMS	5	WMS	International	Europe		http://discomap.eea.europa.eu/pages/Server_bio_Folder_Bio.html	Wednesday, March 11, 2015
Discomap Location of Streamflow Gauging Stations	http://water.discomap.eea.europa.eu/arcgis/services/WaterQuantitySoE/WISE_SoE_WaterQuantity_StreamflowStations_Dyna_WM/MapServer/WMSServer?request=GetCapabilities&service=WMS	5	WMS	International	Europe	Water, Watershed, River, Districts, Streamflow, Station	http://discomap.eea.europa.eu/pages/Server_water_Folder_WaterQuantitySoE.html	Wednesday, March 11, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
Discomap Natura2000Centers_WM	http://bio.discomap.eea.europa.eu/arcgis/services/Bio/Natura2000Centers_WM/MapServer/WMSServer?request=GetCapabilities&service=WMS	1	WMS	International	Europe		http://discomap.eea.europa.eu/pages/Server_bio_Folder_Bio.html	Wednesday, March 11, 2015
Discomap Nitrate	http://water.discomap.eea.europa.eu/arcgis/services/GroundwaterSoE/Nitrate/MapServer/WMSServer?request=GetCapabilities&service=WMS	3	WMS	International	Europe	Ammonium, Nitrate, Nitrite	http://discomap.eea.europa.eu/pages/Server_water_Folder_GroundwaterSoE.html#simpleInfo1093	Wednesday, March 11, 2015
Discomap Nitrite	http://water.discomap.eea.europa.eu/arcgis/services/GroundwaterSoE/Nitrite/MapServer/WMSServer?request=GetCapabilities&service=WMS	3	WMS	International	Europe	Ammonium, Nitrate, Nitrite	http://discomap.eea.europa.eu/pages/Server_water_Folder_GroundwaterSoE.html#simpleInfo1093	Wednesday, March 11, 2015
Discomap UrbanAtlasV2_WM	http://land.discomap.eea.europa.eu/arcgis/services/UrbanAtlas/UrbanAtlasV2_WM/MapServer/WMSServer?request=GetCapabilities&service=WMS	15	WMS	International	Europe	City, Center, Outline, Urban, Zone	http://discomap.eea.europa.eu/pages/Server_land_Folder_UrbanAtlas.html	Wednesday, March 11, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
Discomap WISESoE_OverviewOfSoEMonitStations	http://water.discomap.eea.europa.eu/arcgis/services/RiversLakesSoE/WISE_SoE_RL_Quality_SoEMonitoringStations_Dyna_WM/MapServer/WMSServer?request=GetCapabilities&service=WMS	3	WMS	International	Europe		http://discomap.eea.europa.eu/pages/Server_water_Folder_RiversLakesSoE.html	Wednesday, March 11, 2015
Discomap Years of life lost in EEA countries	http://air.discomap.eea.europa.eu/arcgis/services/AirWatch/Years_of_life_lost_in_EEA_countries_due_to_PM2_5_pollution_2005/MapServer/WMSServer?request=GetCapabilities&service=WMS	1	WMS	International	Europe	Life, Lost	http://discomap.eea.europa.eu/pages/Server_air_Folder_AirWatch.html	Wednesday, March 11, 2015
Environment Canada Geospatial Web Services	http://pubmap.on.ec.gc.ca/wms/ec-ows_en.asp?service=WMS&version=1.1.1&request=GetCapabilities	6	WMS	National	Canada	Environment, Air pollution, Acid rain, Climate, Ecosystems, Greenhouse, Toxic, Facility, Freshwater, Ozone, Fine particulate, Water, Monitoring, Smog	http://geodiscover.cgdi.ca/wes/RecordSummaryPage.do;jsessionid=AFED611EF259F628A4AC8B82EDE8389C.gdp1?uuid=DE08D7D0-FC5B-D189-78AB-17FBA97C0C02&recordLocale=en_US&view=summary&entryPoint=jsMap&mode=unmappable	Tuesday, March 17, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
Environment Canada Reported Observations of Aquatic Invasive Species	http://geoportail-geoportail.gc.ca/arcgis/services/Reported_Observations_Aquatic_Invasive_Species_ENG/MapServer//WMSServer?request=GetCapabilities&service=WMS	98	WMS	National	Canada	Invasive, Species, Plant, Flower, Fish, Aquatic, Snail	http://open.canada.ca/data/en/dataset/2010d0e2-b781-4c69-ba35-29c7bd4de2d3	Tuesday, March 17, 2015
Environment Canada Reported Observations of Aquatic Invasive Species	http://geoportail-geoportail.gc.ca/arcgis/services/Reported_Observations_Aquatic_Invasive_Species_ENG/MapServer//WFSServer?request=GetCapabilities&service=WFS	98	WFS	National	Canada	Invasive, Species, Plant, Flower, Fish, Aquatic, Snail	http://open.canada.ca/data/en/dataset/2010d0e2-b781-4c69-ba35-29c7bd4de2d3	Tuesday, March 17, 2015
ESRI Ocean Basemap	http://services.arcgisonline.com/arcgis/rest/services/Ocean_Basemap/MapServer/WMTS/1.0.0/WMTSCapabilities.xml	1	WMS	Private	All Arctic	Basemap, Esri, Bathymetry, Arctic, Ocean	http://services.arcgisonline.com/ArcGIS/rest/services/Ocean_Basemap/MapServer	Tuesday, March 17, 2015
ExactAIS Arctic Archive	http://gallery.exactearth.com/Proxy.ashx?request=GetCapabilities&service=WMS&version=1.3.0	13	WMS	Private	All Arctic	Arctic, Ship, Path, Vessel	http://gallery.exactearth.com/arctic.html	Tuesday, March 17, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
Finnish geo	http://gtkdata.gtk.fi/arcgis/services/GTKWMS/GTKWMS/MapServer/WMSServer?request=GetCapabilities&service=WMS	19	WMS	International	Iceland		http://www.paikkatietohakemisto.fi/catalogue/ui/metadata.html?lang=fi&metadataresourceuuid=6d2ba8fb-65dd-4957-aaac-23f770d34bd4	Monday, March 02, 2015
Fisheries and Oceans Canada (ESRI) Tides stations	http://geoportal.gc.ca/arcgis/services/tides_marees/allstations_toutestations/MapServer/WMSServer?req	2	WMS	National	Canada	Stations, Predictions, Tides		Tuesday, March 10, 2015
FMIARC Geospatial Server	http://erdas-apollo.fmi.fi/erdas-apollo/coverage_public/EAIM?	20	WMS	National	All Arctic			Tuesday, April 14, 2015
GeoBase Web Mapping Service	http://ows.geobase.ca/wms/geobase_en?VERSION=1.1.1	162	WMS	National	Canada	Aboriginal, Boundaries, Water, Drainage, Landmass, Elevation, Geopolitical, Hydrography, Landcover, Municipality, Toponym, Topographic, Road, Street, Railway, Places, Network		Thursday, April 09, 2015
GeoMet Geospatial Web Services (EC) WMS	http://geo.weather.gc.ca/geomet/?lang=E&service=WMS&request=GetCapabilities	113	WMS	National	Canada	Meteorology, Forecasts, Prognostics, Environment, Climate, Ice, Snow, Rain, Soil	http://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=C0D9B3D8-1	Friday, March 06, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
GESDIS Atmospheric Infrared Sounder (AIRS) Data Products	http://disc1.sci.gsfc.nasa.gov/daac-bin/wms_airs?service=wms&version=1.1.1&request=getcapabilities	88	WMS	National	World		http://disc.sci.gsfc.nasa.gov/services/ogc_wms/wxs_ogc.shtml	Tuesday, March 03, 2015
GESDIS Atmospheric Infrared Sounder (AIRS) Near-Real-Time	http://disc1.sci.gsfc.nasa.gov/daac-bin/wms_airsnrt?service=wms&version=1.1.1&request=getcapabilities	162	WMS	National	World		http://disc.sci.gsfc.nasa.gov/services/ogc_wms/wxs_ogc.shtml	Tuesday, March 03, 2015
GESDIS Ozone Monitoring Instrument (OMI) Data Products	http://disc1.sci.gsfc.nasa.gov/daac-bin/wms_omi?service=wms&version=1.1.1&request=getcapabilities	46	WMS	National	World		http://disc.sci.gsfc.nasa.gov/services/ogc_wms/wxs_ogc.shtml	Tuesday, March 03, 2015
GESDIS Tropical Rainfall Measurement Mission (TRMM) Gridded Rainfall Data	http://disc1.sci.gsfc.nasa.gov/daac-bin/wms_trmm?service=wms&version=1.1.1&request=getcapabilities	38	WMS	National	World		http://disc.sci.gsfc.nasa.gov/services/ogc_wms/wxs_ogc.shtml	Tuesday, March 03, 2015
GHRSST Global 1-km Sea Surface Temperature	http://upwell.pfeg.noaa.gov/erddap/wms/jpIG1SST/request	9	WMS	International	All Arctic	Composite, g1sst, ghrss, High-resolution, Ice, Lake, Land, Mask, Multi, Multi-sensor, Ocean, Sea, Surface, Temperature, Sensor	https://www.ghrsst.org/ghrsst/organisation/	Wednesday, March 18, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
GINA Base Map	http://wms.alaskamapped.org/bdl?	6	WMS	Private	All Arctic	Basemap, GINA, Real color, Satellite	http://www.alaskamapped.org/	Wednesday, March 11, 2015
GNWT Biologic and Ecologic	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/BiologicEcologic_LCC/MapServer/WMSServer?	65	WMS	National	Canada	Vegetation, Wetlands, Ecological Areas, Fire, Wildlife, Areas, Species, Risk, Animal, Plant	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
GNWT Boundaries	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/Boundaries_LCC/MapServer/WMSServer?	6	WMS	National	Canada	Administrative, Limits, Boundaries, Election, Province	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
GNWT Economy	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/Economy_LCC/MapServer/WMSServer?	16	WMS	National	Canada	Economy, Mineral, Mines, Oil, Gas, Coal, Wells, Pipelines	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
GNWT Elevation	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/Elevation_LCC/MapServer/WMSServer?	4	WMS	National	Canada	Elevation, CanVec, Contours	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
GNWT Environment	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/Environment_LCC/MapServer/WMSServer?	52	WMS	National	Canada	Environment, Protected, Area, Conservation, Sanctuary, Park, Site	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
GNWT Geoscientific	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/Geoscientific_LCC/MapServer/WMSServer?	5	WMS	National	Canada	Geoscientific, Esker, Sand	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
GNWT Imagery Base Land Cover	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/ImageryBaseLandCover_LCC/MapServer/WMSServer?	9	WMS	National	Canada	Imagery, Ortho, Vand Cover	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
GNWT In Land Water	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/InlandWater_LCC/MapServer/WMSServer?	15	WMS	National	Canada	Hudragrphy, Area, Lakes, Rivers, Geonames	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
GNWT Location References	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/MACA_LCC/MapServer/WMSServer?	21	WMS	National	Canada	Communities, Annotation, Building, Vegetation, Transportation, Elevation, Hydrography, Structure	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
GNWT Municipal & Community Affairs	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/PlanningCadastre_LCC/MapServer/WMSServer?	23	WMS	National	Canada	Aboriginal, Inuit, Conservation, Protected, Areas, Lands, Communities, Transportation	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
GNWT Planning Cadastre	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/PlanningCadastre_LCC/MapServer/WMSServer?	23	WMS	National	Canada	Aboriginal, Inuit, Conservation, Protected, Areas, Lands, Communities, Transportation	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
GNWT Search Service	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/SearchService/MapServer/WMSServer?	3	WMS	National	Canada	Geonames, Places, Population	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
GNWT Structure	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/Structure_LCC/MapServer/WMSServer?	15	WMS	National	Canada	Structure, Domestic, Waste, Extraction, Industrial, Lumber, Manmade, Mine, Navigation, Pipelines, Powerlines, Quarry, Enbridge	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
GNWT Transportation	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/Transportation_LCC/MapServer/WMSServer?	8	WMS	National	Canada	Transportation, Roads, Cutlines, Highway, Navigation, Railway, Runways	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
GNWT Utilities & Communication	http://apps.geomatics.gov.nt.ca/ArcGIS/services/GNWT/UtilitiesCommunication_LCC/MapServer/WMSServer?	14	WMS	National	Canada	Utilities, Communication, Hydro, NT Power, Transmission, NorthwesTel, Solar, Energy, Wind, Wells, Water	http://www.geomatics.gov.nt.ca/wms_chartop.aspx?i=1	Friday, March 20, 2015
Iceland and North European countries	http://discomap.eea.europa.eu/arcgis/services/Land/CLC2006_Dyna_WM/MapServer/WMSServer	15	WMS	International	Europe	Agriculture, Artificial surfaces, Contours, Forest, Waterbodies, Wetlands, Areas	http://freegisdata.org/place/102893/	Monday, March 02, 2015
IMR North Atlantic current	http://talos.nodc.no/cgi-bin/mapserv?map=wms/currents.map&	6	WMS	National	All Arctic	North Atlantic, Arctic, Current, Atlantic, Gulf Stream		Tuesday, April 14, 2015
Institute of Marine Research Norway	http://maps.imr.no:80/geoserver/wfs	534	WFS	National	All Arctic			Tuesday, April 14, 2015
Institute of Marine Research Norway	http://maps.imr.no/geoserver/vulnerable_areas/ows?SERVICE=WMS&REQUEST=GetCapabilities	24	WMS	National	All Arctic			Tuesday, April 14, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
NRCan Energy Fossil Fuels	http://gdr.ess.nrcan.gc.ca/wmsconnector/com.esri.wms.Esrimap/energy_e?	31	WMS	National	All Arctic	Coal, Gasoline, Extraction, Geologic, Geothermal, Hydrocarbon, Sedimentary, Organic, Matter, Wells, Offshore, Gases, Boundaries, Provinces, Mines, Oils		Tuesday, April 14, 2015
NRCAN GeoBase	http://ows.geobase.ca/wms/geobase_en	162	WMS	National	Canada	Aboriginal, Boundaries, Water, Drainage, Landmass, Elevation, Geopolitical, Hydrography, Landcover, Municipality, Toponym, Topographic, Road, Street, Railway, Places, Network	http://geogratis.gc.ca/geogratis/DevCorner?lang=fr#aGeoBase	Friday, March 27, 2015
NRCAN SCW Toporama	http://wms.ess-ws.nrcan.gc.ca/wms/toporama_en	16	WMS	National	Canada	Aeronautical, Boundaries, Constructions, Areas, Feature, Hydrography, Hypsography, Landforms, Limits, Power, Rail, Road, Network, Structures, Vegetation, Water, Soils	http://geogratis.gc.ca/geogratis/DevCorner?lang=fr#aGeoBase	Friday, March 27, 2015
NSIDC Atlas of the Cryosphere	http://nsidc.org/cgi-bin/atlas_north?service=WMS&request=GetCapabilities&version=1.1.1	95	WMS	National	All Arctic	Arctic, Cryosphere, Earth Science, Frozen Ground, Glaciers, Ice Extent, Ice Sheets, Northern Hemisphere, Oceans, Permafrost, Polar, Sea Ice, Sea Ice Concentration, Snow/Ice, Snow Cover, Snow Melt, Snow Water Equivalent	http://nsidc.org/data/atlas/ogc_services.html	Monday, March 02, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
NSIDC Atlas of the Cryosphere	http://nsidc.org/cgi-bin/atlas_north?service=WFS&request=GetCapabilities&version=1.1.0	19	WFS	National	All Arctic	Arctic, Cryosphere, Earth Science, Frozen Ground, Glaciers, Ice Extent, Ice Sheets, Northern Hemisphere, Oceans, Permafrost, Polar, Sea Ice, Sea Ice Concentration, Snow/Ice, Snow Cover, Snow Melt, Snow Water Equivalent	http://nsidc.org/data/atlas/ogc_services.html	Monday, March 02, 2015
Renewable energy atlas of Alaska - Woody Biomass & Wind	http://wms.proto.gina.alaska.edu/wms/aea	4	WMS	National	United States of America	Relief, Shade, Forest, Biomass, Bathymetry, Wind, Alaska	http://akenergyinventory.org/data/	Tuesday, March 10, 2015
SEDAC Socioeconomic Data and Applications Center	http://sedac.ciesin.org/geoserver/ows?service=wms&version=1.3.0&request=GetCapabilities	221	WMS	Private	All Arctic	SEDAC, Ecosystem, Agriculture, Biodiversity, Climate, Energy, Fisheries, Forests, Water, Ressources, Air, Health	http://sedac.ciesin.columbia.edu/maps/services#Global Agricultural Lands	Monday, March 02, 2015
Services de cartographie Web (WMS) pour les données du Sigéom	http://sigeom.mrn.gouv.qc.ca/SIGEOM_WMS/Request.aspx?	33	WMS	National	Canada	Mapping, Mine, Geochemical, Geophysical, Outcrop, Rock, Sediment, Drilling, Geology, Quebec, MRN	http://sigeom.mrn.gouv.qc.ca/signet/classes/I0000_serviceWeb	Tuesday, March 03, 2015
Svalbard Glacier Area Outlines	http://geodata.npolar.no/ArcGIS/services/CryoClim/glaciers/MapServer/WMSServer?request=GetCapabilities&service=WMS	3	WMS	National	Norway		http://geodata.npolar.no/	Wednesday, March 11, 2015

NAME	Web Services URL Link	Layer count	Service type	Source sector	Data coverage	Tags	General link (source)	Date of validation
USGS Alaska Science Center	http://pdx.axiomalaska.com/geoserver/wms?service=WMS&request=GetMap&layers=axiom:maternaldenlocations_1910_2010	806	WMS	National	World	Bird, Alaska, Airport, Harbors, Road, Communities, Aquatic, Preserves, Bathymetry, Fish, Coal, Oil, Habitat, CAFF, Arctic, Bioregions, Forest, Geology, Hydrology, River, Gas, Productivity, Sea, Water, Ressources	http://portal.aoos.org/?v=rand&portal_id=3#module-metadata/8c6e4cc6-4294-11e2-b19f-00219bfe5678/13a03d02-4296-11e2-88f7-00219bfe5678	Monday, March 23, 2015
World Database on protected areas	http://ec2-54-204-216-109.compute-1.amazonaws.com:6080/arcgis/services/wdpa/wdpa/MapServer/WMSServer?	3	WMS	Private	All Arctic	World, Protected areas	http://ec2-54-204-216-109.compute-1.amazonaws.com:6080/arcgis/rest/services/wdpa/wdpa/MapServer	Wednesday, March 11, 2015
WOUDC	http://geo.woudc.org/ows?service=WMS&version=1.3.0&request=GetCapabilities	19	WMS	National	World	Ozone, Ultraviolet, UV, TotalOzone, OzoneSonde, umkehr, gaw, wmo, Spectral, Stations, Instruments, Lidar, Multiband	http://woudc.org/about/data-access.php#ogc-wms	Friday, March 27, 2015
WOUDC	http://geo.woudc.org/ows?service=WFS&version=1.1.0&request=GetCapabilities	19	WFS	National	World	Ozone, Ultraviolet, UV, TotalOzone, OzoneSonde, umkehr, gaw, wmo, Spectral, Stations, Instruments, Lidar, Multiband	http://woudc.org/about/data-access.php#ogc-wms	Friday, March 27, 2015