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Geospatial Information Needs for Integrated Land/Marine Management

Workshop Report

PRI Project
Sustainable Development

Workshop Partner
GeoConnections
Natural Resources Canada

Canada



**Geospatial Information Needs for Integrated Land/
Marine Management (IL/MM)**

January 19-20, 2006

Workshop Report

PRI Project
Sustainable Development

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About This Report

The PRI contributes to the Government of Canada's medium-term policy planning by conducting cross-cutting research projects, and by harnessing knowledge and expertise from within the federal government and from universities and research organizations. However, conclusions and proposals contained in PRI reports do not necessarily represent the views of the Government of Canada or participating departments and agencies.

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Background

The January 2006 IL/MM Workshop

A national workshop on integrated land/marine management was held in Ottawa in January 2006 to explore, in detail, the role of geographic information to support an integrated approach to land, freshwater, and marine management.

GeoConnections defines integrated management to include land-use planning, environmental assessment within a planning context as well as environmental monitoring, and the development and use of indicators. The workshop examined how the Canadian Geospatial Data Infrastructure (CGDI) can be further developed and improved to facilitate these activities.

The meeting brought together over 60 key practitioners of integrated approaches to land, freshwater, marine, and municipal environments. They were able to speak to content requirements, as well as policy and technical issues. The results will provide valuable input to the criteria used in future GeoConnections partnership and funding announcements. The workshop agenda is found in Appendix A and the participant list in Appendix B. Before the workshop, a discussion paper on integrated landscape management was made available to workshop participants. The paper is presented in Appendix C.

Policy Research Initiative/Environment Canada Previous Activities

In February 2005, the Policy Research Initiative, with the support of Environment Canada, hosted a national workshop to develop a vision for a national integrated landscape management capacity. The workshop brought together over 60 experts who focused their discussions on policy, and technical and logistical limitations to, and requirements for, integrated landscape management (ILM) modelling. Strategies for addressing implementation gaps were also discussed and a national vision for ILM modelling was jointly crafted. Federal leadership was identified as a key requirement to implementing the vision.

Under the vision for ILM modelling, data capacity was identified as one of seven key requirements. Identified data issues included the need to devise and expand ways to collect and distribute information found in diverse formats effectively and, through various agencies, the need to develop data-sharing agreements, facilitate open access, and co-ordinate activities to fill critical data gaps.

Based on the vision developed during this workshop, Environment Canada is now taking steps to implement a new integrated landscape management modelling approach to influence sound decision making within its area of influence.

The Role of GeoConnections

GeoConnections is a renewed national partnership program led by Natural Resources Canada. The new five-year phase was launched on June 15, 2005, with

a budget of \$60 million and the goal to expand the use of the CGDI. This infrastructure was developed through \$150 million in federal/provincial/territorial government and private sector collaborations since 1999. The web-based infrastructure facilitates the discovery, access, and use of location-based data held by different organizations and orders of government. It consists of foundational reference data sets, freely available over the Internet; a suite of government policies and standards that ease information sharing, and a core set of standards-based technologies that promote interoperable data use.

GeoConnections is a funding program, which encourages the development of these standards, technologies, and information policies all designed to remove barriers to the sharing of geographically referenced information. The renewed program focuses on four thematic areas, one of which is environment and sustainable development. A key aspect of the new program is a focus on user-driven applications that meet the business needs of decision makers. More information on the current program can be found at www.geoconnections.org/CGDI.cfm/fuseaction/aboutGcs2005.welcome/gcs.cfm.

Delivery of the renewed GeoConnections program requires refining the broad scope of environment and sustainable development by first encouraging applications and services that will influence integrated land, freshwater, and marine management across Canada. GeoConnections believes that integrated location-based approaches provide significant opportunities to assemble diverse social, economic, cultural, and environmental geospatial data sets that collectively can provide a balanced foundation to influence sustainable development decision making. GeoConnections focuses this approach at the provincial and regional scale, and proposes to link the latter to the support of integrated community sustainability plans (ICSP). The merits and opportunities of such an approach need to be discussed and confirmed.

GeoConnections prepared a discussion paper that describes its initial intended approach to integrated land and marine management in more detail (see Appendix C).

Integrated Land/Marine Management Workshop Objectives

The workshop explored the role of information-sharing mechanisms, in particular those involving geographic data, to support land, freshwater, and marine planning, environmental assessment, and monitoring functions. Given new integrated planning requirements at both the provincial and community levels, GeoConnections is trying to determine how to best provide support. In particular, the workshop examined how the CGDI can be further developed and improved to facilitate integrated land/marine management decisions.

Participants were grouped into tables of six to eight, based on their thematic area of interest: marine (one table), municipal (one table), freshwater (two tables), terrestrial (four tables).

Panel Presentations

Panel presentations provided three different, yet converging perspectives on IL/MM.

Ruth Waldick (Environment Canada) outlined Environment Canada's vision for an integrated approach to understanding landscapes and developing a predictive capacity through modelling. Past failures have led to a recognition that there is a general requirement for the integration of science, decision making and response programs. Such integration requires a systematic approach applied at the landscape scale. Effective integration requires a movement away from fragmented, one-dimensional decision-making paradigms to holistic approaches that require measuring and balancing environmental, social, and economic measures.

Earlier workshops in 2005 on integrated landscape management modelling began exploring how a national capacity might be built to support integrated modelling and forecasting. A number of elements were identified to advance this capacity. In addition to the central requirement for leadership, the following features were cited:

- the need for an organizational framework for integration;
- ensuring long-term funding;
- developing a data network and capacity;
- developing knowledge capacity;
- developing a modelling network and capacity; and
- developing a structural capacity.

Various scenarios for implementation were also identified including a central modelling capacity, centres of excellence, provincial/regional centres, a central national co-ordination facility, and a highly distributed network.

A second perspective on IL/MM was presented by Bogdan Makuc (Infrastructure Canada). Bogdan linked Canada's quality of life to strong, vibrant, and sustainable communities. He defined Integrated Community Sustainability Plans as long-term plans, developed in consultation with community members that provide direction for a community to realize the sustainability objectives it has for the environmental, cultural, social, and economic dimensions of its identity. These plans are proposed to be developed by Canadian communities to support community sustainability and their capacity to plan for their future.

The ICSPs are seen as moving beyond traditional responsibilities to defining problems and issues differently and requiring changes to governance and organizations. This involves a community-based, proactive, and participatory process to achieve success. Challenges to implementing ICSPs include addressing issues of borders and traditional areas of responsibility, considering the goals and requirements of different generations; establishing momentum and commitment and ensuring efficiency of delivery.

A third perspective on IL/MM was presented by Jean Cinq-Mars, Chair of the Canadian Integrated Landscape Management Coalition. The group is an association of government, non-government, and industry representatives with a professional interest in integrated landscape management. The Coalition was created in 2003, with the mission to “advance and accelerate integrated landscape management in Canada by influencing key decision makers in the development and application of appropriate policies, practices and tools.”

Mr. Cinq-Mars stated that integrated landscape management is required, because current sector by sector approaches have proved inadequate to address the increased complexity of land-use decision making, the intensity of land use in many areas, and the need for preventive planning. Clearly, a systematic approach is required to implement integrated management as a practical method to achieve sustainable development principles.

The Canadian Integrated Landscape Management Coalition is poised to take leadership and influence the process, bringing the partners together to overcome the institutional structural and decision-making barriers. Key areas requiring attention are governance and decision-making structures, current operations on the landscape, and advancing the role of knowledge and science.

Group Discussion # 1 – Identifying Geospatial Data Set Needs

The first group discussion was aimed at determining priority data requirements of the users groups and themes represented at the meeting. The goal was to document priority geospatial data set requirements at the vision level, and to support regional land-use planning, and site-specific assessments. The responses indicated a mixture of each scale is required for decision making.

Specific priority data sets identified included the following.

Priority data sets identified by more than one community table	Relevance to Communities			
	Municipal	Land	Fresh-water	Marine
Atmospheric data		√	√	√
Land cover/land use	√	√	√	
Digital elevation modelling (sub-national accuracy)		√	√	
Socio-economic data		√		√
Soil and surficial geology		√	√	
Aquifer and groundwater		√	√	
Watershed			√	
Land ownership and governance	√	√	√	
Infrastructure assets – including critical infrastructure	√	√		
Protected areas		√		√
Other data sets identified				
Land-based impacts on oceans				√
Ocean-based impacts on land				√
Ocean column data				√
Point sources of pollution			√	
Non-point sources of pollution			√	
Basic chemical parameters		√		
Invasive species		√		
Topographic base	√	√		
Land parcel mapping (boundaries, ownership and geo-political boundaries)	√	√		
Aerial photography		√		
Building outlines (public and private)				
Road network	√	√		
Transportation behaviour (e.g., patterns of commuting)	√			
Air quality	√			
Easement assessment lands	√			
Data dealing with human interaction with land/marine		√		√
Natural disturbance regimes		√		√
Ecosystem zones, regions etc.		√		√
Economic data sets	√	√	√	√
Traditional knowledge		√		

Other Data-Related Issues

Crosscutting issues related specifically to data access, use, and sharing were raised in this discussion. These are documented below.

General data types, attributes and use requirements

- Common definitions associated with similar data types are needed (e.g., wetlands).
- Multiple scale data sets are required to set priorities.
- Time series data sets are critical, particularly those that represent more dynamic realms, such as atmospheric and ocean data.
- Data on ecological services/functions should be a priority.

- Data are needed to support multi-dimensional ecosystem management requirements.
- Cumulative effects modelling and monitoring has a critical requirement for data inputs.
- Consistent base maps are required.
- Core data sets that provide an international perspective would provide a broad context.
- Better and more consistent local data are required.
- An approach to integrating/aggregating local data to regional levels is needed by municipalities.
- Simplified interpretations of complex data are required (e.g., satellite imagery -> land cover).
- Agreement and implementation of data collection standards requires attention.
- Metadata would make historical data more usable.

Requirements for improved processes surrounding data management

- Create a national inventory of data holdings.
- Implement interoperability principles to improve accessibility of data.
- Improve data interpretation and modelling work.
- Develop interoperability of models manipulating data.
- Create a common framework to help set data priorities; perhaps a matrix of ecosystem components by each scale.
- Dismantle content silos.
- Develop approaches to data management in concert with emerging issues.
- Prioritize data needs based on key indicators.
- Involve both data holders and users (e.g., municipalities, conservation authorities) together for monitoring and modelling.
- Develop a common set of base data relevant for each scale (vision, planning, site level).
- Develop consistent and accountable biological, social, economic, and health data sets.
- Encourage consistent data gathering to support change detection.
- Facilitate the standards required to enable the integration of data sets.
- Recognize that municipalities require more accurate data.
- Foster leadership/policy (top down) for developing/following data standards.

Group Discussion # 2 – Discovering Constraints

Participants discussed constraints to discovering, accessing, using, and sharing geospatial information in support of IL/MM. Constraints tended to cross thematic lines and were grouped in six issues areas.

The following are the summarized comments. (*Constraints identified by more than one community table are italicized.*)

Constraints to using geospatial data to support decision making

Organizational culture issues

- *Lack of culture of good data management practices within organizations (data access policies).*
- *Knowledge skills and core competencies (government and academia links).*
- *Communication and awareness.*
- *Governance – decision making. Is this type of work worth investing in?*
- *Poor communication of geomatics back to main stream markets.*
- *Cumulative effects monitoring. Who is responsible for maintaining? Data should not be collected unless we will maintain it and there is a business purpose; advance notice and participation on how data are collected.*
- *Mistrust between data users and data providers.*
- *Retaining knowledge/knowledge management (storing analysis and data).*
- *Lack of vision.*
- *Information silos.*
- *Engaging municipalities.*
- *Horizontal activities are still very difficult.*
- *Cost recovery – business model of many agencies forces a cost recovery model for data, but this often creates barriers to access.*
- *Geomatics solutions not considered strong contributors to business solutions.*
- *Poor quality of data support by providers.*
- *Central co-ordination of geospatial solutions is lacking.*
- *If federal data are not bilingual, they cannot be officially shared.*
- *There has been poor communication of geomatics solutions into the mainstream.*

Cost recovery issues

- *Cost recovery policies of data suppliers inhibit use.*
- *Cost of getting fine resolution data is prohibitive.*

Legal issues

- *Policy and legal constraints (re: agreements).*
- *Liability disclaimers.*

Quality of data issues

- *Lack of data in digital format.*
- *Quality of data.*

Data standard issues

- *Lack of information management practices to create metadata to a standard.*
- *Lack of spatial and geo-reference standards.*
- *Common language and standard terminology.*
- *Common data schemas.*

Technical issues

- *The need for a data discovery tool.*
- *Time lags between data collection and use.*
- *Technology support is lacking.*

Constraints to using geospatial data to support decision making

- Data holdings are sometimes restricted to particular technologies.
- Lack of distributed systems of data exchange.
- Inadequate bandwidth constrains data accessibility for many remote data users.
- The Internet is inadequate for sharing some high-volume data sets (e.g., satellite data).

Ideas to Overcome Constraints

Participants were asked to identify the policy, technical, and content constraints preventing the efficient use of data for IL/MM purposes. Is anything missing? What are the priorities? What are your ideas to overcome the constraints?

Basic principles required to overcome constraints

- Corporate-wide policies re: data management sharing.
- Constraints cut across thematic boundaries.
- Data accessibility is in the long-term interest of all stakeholders.
- A positive climate of understanding between data suppliers and users is an overarching requirement.
- A greater reliance on web services and distributed data will facilitate greater data use and sharing.
- Central co-ordination is important.

Some specific activities were identified that could help begin the task of overcoming the barriers to geospatial data sharing in support of IL/MM. These include the following.

Activities required to overcome constraints

- Compile a comprehensive list of constraints.
- Drive a common set of geospatial metadata standards through contracting processes.
- Remove cost recovery policies.
- Build capacity through more academic community engagement.
- Develop institutional procedures for archiving data after project completion.
- Improve access to web services for geospatial data analysis.
- Encourage more feedback between data providers and data receivers.
- Foster knowledge/skills/core competencies to deploy tools and technologies.
- Bridge academia and government to address issues.
- Communicate/develop awareness of proper use/application of data.
- Promote awareness of value of data and information assets in decision-making processes.
- Develop best practices guides.
- Legislate a requirement to publish data/metadata.
- Include in contracts a requirement to provide data.
- Know what data people want and need.
- Provide technology support for contributing to the CGDI.

Group Discussion # 3 – The Path Forward: Recommendations for GeoConnections

Participants were asked to identify the priorities GeoConnections should focus on to overcome the barriers to data sharing in support of IL/MM.

Recommended Priorities for GeoConnections

Co-ordination

Create a forum to facilitate co-operation of groups with similar data needs (focus on co-ordination, communication, and capacity building). Become a broker to get information and data in and out of the federal government. Paint the big picture for users.

Communication and Marketing

Develop outreach activities that communicate the utility and credibility of the data and data sharing for decision making. Communicate to users the best practices regarding standards. Promote consistent awareness/understanding and application of national and international standards. Organize technical transfer workshops. Promote open-source software. Explain the vision of integrated geospatial data. Promote best practice approaches and communities of practice.

Data Discovery

Improve the national catalogue of available geospatial data (Discovery Portal search engine). Create a user-centred design of the Discovery Portal.

Content

Facilitate the collection of high-quality data that could be put to multiple uses. Link data sets to national indicator initiatives. Provide advice to users on data credibility. Develop memorandums of understanding with key agencies/jurisdictions to encourage consolidation of their data holdings and promote interoperability. “Stops on the Railroad” – facilitators, guidance, expertise.

Pilot Projects

For example, focusing in the land-water interface, identify issues re: data uses and integrating data for decision making. Look at the role of existing programs in these studies. Provide support to user-driven applications and harvest lessons learned.

Data Access Policies

Explore aspects of liberating public information collected with public dollars. Propose and implement policy and legislative mechanisms to overcome barriers. Get the agencies that are responsible or have ownership to be the co-ordinators for legislation.

Capacity Building

Facilitate geographic information system (GIS) analytical capacity for those who

need it. Discover user needs and respond with appropriate partnership opportunities. Improve capacity to host/archive data sets for those unable to maintain them (GeoGratis).

In addition, participants were asked to identify potential GeoConnections partners to advance the issues identified. There was general consensus that GeoConnections should play a leadership role, but that all stakeholders, from data suppliers to users, have an important role to play. In addition, partnering with academic community was seen as a strategic direction as well as building capacity among data user communities to enable more effective use and sharing of geospatial information.

GeoConnections Response to IL/MM Workshop Recommendations

GeoConnections thanks the attendees for their insightful responses. We reviewed the recommendations and will make commitments to address these as follows.

Coordination

GeoConnections will create forums to facilitate co-operation of groups with similar data needs. We will use both workshops and online forums to this end. We will strive to improve the flow of data into and out of the federal government by working through the InterAgency Committee on Geomatics – a 16-member horizontal co-ordination structure – to address technical and policy barriers to data sharing.

Communication and Outreach

GeoConnections has a communications team that prepares various marketing materials, including success stories, for the web and for display. They also participate in trade shows and conferences identified as strategically important by the thematic leaders. GeoConnections has developed a best practices guide to the dissemination of government data in Canada. The guide will be updated and more actively marketed. The recommendations for more active forms of education and technology transfer have been noted.

Data Discovery

The Discovery Portal will be completely overhauled with a user-driven approach. Requests for information from private sector solutions providers in the summer of 2006 will result in a request for proposal for the redesign in late 2006.

Content

GeoConnections will continue to identify and financially support the providers of key data of strategic importance to the various thematic areas to ensure it is available for multiple uses. Identification and prioritization of data sets through surveys, workshops, advisory committees, and the suggestions of thematic

communities is an ongoing activity. The need for an overarching strategy for indexing the credibility of key data sets will be fed into the requirements for the revamped Discovery Portal (see above). Memorandums of understanding will be developed with key federal/provincial agencies and others to this end.

Pilot Projects

GeoConnections accepts that partnering in pilot projects of strategic importance can be a step to improving national capacity for integrated landscape management. Working with partners interested in furthering ILM, GeoConnections will support a range of pilots that support integrated landscape management in 2006 and 2007 with a view to progress to full operational status by 2008.

Data Access Policies

GeoConnections recognizes that development and implementation of data access policies are crucial ingredients of a successful program. GeoConnections will work through various federal and national geomatics committees, the Department of Justice, the national funding agencies, and others to address directly the policy constraints to accessing data.

Capacity Building

A key aspect of the GeoConnections partnership program is to develop and enhance the capacity of rural, remote, and Aboriginal communities, regional health authorities, and non-governmental organizations to use geomatics and eventually the CGDI for decision making. Funding opportunities for user needs assessments will be offered in late summer 2006, followed by funding opportunities in late 2006 to support technology acquisition/training. The GeoGratis site will be revamped and released in late 2006 to improve capacity for hosting data sets on behalf of those who are unable to maintain them.

Appendix A

Geospatial Information Needs for Integrated Land/Marine Management Workshop

January 19-20, 2006

International Development Research Centre (IDRC)
250 Albert Street, Ottawa
Auditorium, 14th Floor

Purpose of the Workshop

- Explore in detail the role of geographic information to support integrated approaches to land, freshwater, and marine management.
 - Build on three conversation streams: that of the national Integrated Landscape Management Coalition, the Policy Research Initiative/Environment Canada Workshop Series, and encouragement of local/regional integrated community sustainability plans developed under the New Deal for Cities and Communities (NDCC).
 - Examine how the Canadian Geospatial Data Infrastructure (CGDI) can be further developed and improved to encourage applications and services that will facilitate integrated land/marine management decisions.
-

Day 1

8:00 Coffee, continental breakfast

A. Getting Started/Context

- 8:30 Welcome/Purpose Ian Campbell, *Policy Research Initiative*
Craig Stewart, *GeoConnections*
- Agenda Review
- How we will work together Warren Wilson - Facilitator
- 8:50 Panel – Current ILM Initiatives
- February 2005 Integrated Landscape Management Modelling Workshop Ruth Waldick, *Environment Canada*
 - Integrated Community Sustainability Planning Bogdan Makuc, *Infrastructure Canada*
 - Canadian Integrated Landscape Management Coalition Jean Cinq-Mars, *Chair of the Coalition*
- 9:50 Open Forum – Q & A
- Questions of Clarification
- 10:15 Health Break

B. Geospatial Data Needs to Support ILM

- 10:30 Discussion # 1 – Geospatial Data Set Needs
- What are the priority geospatial data set requirements...
 - at the vision level?
 - to support regional land-use planning?
 - to support site-specific assessments?
 - to support monitoring?
- 12:00 Lunch: Speaker Dale Rothman, The Macaulay Institute, United Kingdom
- 13:15 Constraints Tony Turner, *GeoConnections*
- Framing the discussion
- 13:30 Discussion # 2 – Discovering Constraints
- For the policy, technical and content constraints identified:
 - Anything missing?
 - What are the priorities?
 - What are your ideas to overcome the constraints?
- 14:30 Health Break
- ## **C. The Path Forward**
- 14:45 The Renewed GeoConnections Program Craig Stewart/Ian Jarvis
- Supporting ILM (Planning, Assessment, Monitoring)
 - Overview of ILM discussion paper
- 15:00 Discussion # 3 – GeoConnections Focus
- What priorities should GeoConnections focus on?
 - Who should GeoConnections partner with?
- 16:15 Wrap Up Discussion
- Any additional ideas that we've missed?
 - Any final advice?
- 16:45 Closing Comments – Day 1 Ian Campbell/Craig Stewart
- Next Steps
 - Framing Day 2 discussion
- 17:00 End

Day 2

Focus of Day 2 – Municipal Issues

Context: Cities and communities will increasingly be encouraged to develop and implement long-term sustainability plans. Three provincial governments already demand that communities adopt an official community plan. Additionally, the Government of Canada, through its New Deal for Cities and Communities (NDCC) promotes a more long-term, coherent, and participatory approach to planning to achieve sustainable communities. Municipalities are being asked to develop integrated community sustainability plans (ICSP) to address the economic, environmental, social, and cultural dimensions of community sustainability.

Purpose of Day 2

General: To further explore local-level planning requirements and areas where GeoConnections could provide support.

Specific: What do municipalities require to implement effectively integrated community sustainability plans or similar efforts? This should be framed within the context of information management aspects, especially geospatial data and their uses.

8:00	Coffee, Continental Breakfast	
8:30	Getting Started/Welcome	Craig Stewart, <i>GeoConnections</i>
D. Municipal Focus		
8:45	Panel Presentations <ul style="list-style-type: none">▪ Informing the debate<ul style="list-style-type: none">○ Federation of Canadian Municipalities○ A municipal example	Mary Jane Middelkoop, <i>FCM</i> Mike Gau, <i>City of Whitehorse</i>
	Open Forum – Q & A <ul style="list-style-type: none">▪ Questions of clarification	
10:15	Health Break	
10:30	Discussion # 4 – Municipal Focus Given our Day 1 discussion, and the municipal context... <ul style="list-style-type: none">▪ What additional geospatial tools, data, services, and policies are required to help develop and implement ICSPs and other planning instruments across Canada?	
12:00	Lunch	
13:00	Discussion Continued	
14:45	Closing Comments	Craig Stewart, <i>GeoConnections</i>

Appendix B: Participants List

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Appendix C

Canadian
Geospatial
Data
Infrastructure



Infrastructure
canadienne
de données
géospatiales



**Integrated Landscape Management
Opportunities for Applying
the Canadian Geospatial Data Infrastructure**

January 2006

GeoConnections
Natural Resources Canada
615 Booth St, 6th Floor
Ottawa, ON, K1A 0E9

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Purpose

This discussion document describes the potential role of spatial data infrastructure (SDI) in facilitating integrated landscape¹ management or ILM. This document is intended to catalyze interest and ground further discussion on the role that spatial data infrastructure can play toward improved land-use decision making that will contribute to sustainable development objectives. Specifically, this paper proposes that spatial data infrastructure provides an opportunity to integrate diverse data sets at various scales in a manner that facilitates ongoing access to current information from authoritative sources and thereby contributes in a practical way to more effective regulatory efficiency, and ecosystem-based management of Canada's land and waters.

The document will be used to position the GeoConnections program strategically between 2006 and 2010 to direct funding in support of sound environmental decision making and sustainable development. As GeoConnections undertakes consultations, it is expected that this document will evolve throughout 2006.

Background

At the World Earth Summit in 1992, 178 countries agreed to adopt Agenda 21, a comprehensive plan of action to move nations closer to environmentally sustainable development. Agenda 21 encouraged the implementation of an integrated approach to land issues as a key tool to help achieve sustainability. "By examining all uses of land in an integrated manner, it makes it possible to minimize conflicts, to make the most efficient trade-offs and to link social and economic development with environmental protection and enhancement, thus helping to achieve the objectives of sustainable development."²

It is widely accepted across Canada that sustainable development is a societal goal. Statements acknowledging that goal are found in federal and provincial throne speeches, municipal planning objectives, and industry vision statements. Furthermore, it is widely agreed that implementing sustainable development requires balancing environmental, economic, social, and cultural goals in an inter-jurisdictional context, in other words an integrated approach at several levels. In its ideal application, integrated planning for sustainable development considers these factors at various temporal and spatial dimensions. Since landscapes are spatial in extent, maps and, more recently, geographic information systems (GIS) have become indispensable tools to planning, assessment, and monitoring applications. The movement to Internet-based mapping through spatial data infrastructures provides an opportunity to re-examine how the integration of spatial information can be facilitated to support integrated management.

There is recent renewed interest in integrated landscape management in Canada. A nationally organized coalition of federal, provincial, academic, and private

¹ Landscape is used here as a short-hand term that encompass land, water, and marine environments.

² United Nations Agenda 21, Chapter 10.

sector practitioners consider ILM as a key implementation vehicle to achieve sustainable development (CILMC, 2005). Adopting principles found in related concepts, such as ecosystem management, the coalition advocates a whole landscape approach with mechanisms in place to assess and balance development options. The Coalition also advocates the need for new governance structures that will ensure integration across various decision makers on the landscape. Acknowledging that managing land for multiple uses is more complex than in the past, the paper argues that “ILM provides a solution to the complexities of resource and land use now faced by land resource managers and decision-makers” (CILMC, 2005: 5).

Federal resource departments are also beginning to embrace integrated approaches. Environment Canada is investigating integrated landscape approaches as a common mechanism to bind the diverse environmental themes, such as climate, water, and species, under its purview. Through several workshops (PRI, 2005) held in 2005, Environment Canada sought the advice of numerous experts to explore how ILM and ILM modelling can be applied to improve landscape planning and assessments. The workshops have resulted in recommendations in seven key areas: the development of ILM conceptual frameworks, the evolution of ILM modelling approaches, improved capacity for integrating information, improved capacity for training and knowledge transfer, improved stakeholder engagement processes, improved marketing and funding, and improved thematic or regional-based governance structures.

The focus on integrated management extends beyond terrestrial to coastal, marine, and ocean landscapes. The federal *Oceans Act* contains explicit provisions for ILM approaches. In September 2005, the federal Commissioner of the Environment and Sustainable Development found that the Department of Fisheries and Oceans (DFO) “had great difficulty moving from this conceptual definition [of integrated oceans management] to practical implementation” (Commissioner, 2005). With reference to three management areas, the Eastern Scotian Shelf (see Case Study #1), the Beaufort Sea, and the Pacific North Coast, the Commissioner noted that progress had been slow and recommended that DFO improve operational guidance on integrated management.

Integrated landscape management discussions are also focused on local approaches. Led by Infrastructure and Communities Canada, the federal government’s New Deal for Cities encourages the development of plans confluent with ILM principles in the course of renewing municipal infrastructure. Bilateral federal-provincial agreements encourage the development of these integrated community sustainability plans (ICSP) in the course of expending gasoline tax moneys transferred from the federal treasury. A wide range of municipalities and municipal associations developed customized approaches, suitable within their local context, to integrating cultural, social, environmental, and economic planning objectives within an inter-jurisdictional context.

Implementing Integrated Approaches

Sustainable development is applied in the real world where individual choices, trade-offs and decisions are made by those who own, manage, and have a stake in Canada's lands and waters. In Canada, the provinces, Aboriginal groups, and municipalities are the key administrators of Canada's natural resources. Adhering to federal and provincial legislation, governments plan, assess, and sanction the activities of industry, individuals, and governments themselves. Every day, hundreds of land-use decisions are made by planners, administrators, regulators, developers, resource industries, individuals, and politicians. To greater or lesser degrees, they evaluate the economic, social, and environmental merits of proposed changes on the landscape. These processes are influenced by various legislation, regulations, and policies and politics. Land-use planning thus becomes the front line where the principles of sustainability are played out. Arming the planning and regulatory agencies with the best tools and information available is arguably the most proactive way to assess development alternatives thereby influencing the decision-making processes that affect sustainability.

GeoConnections defines ILM as usually comprising four stages.

- Vision or forecast desired conditions for a land or seascape.
- Establish plans and objectives to attain/respect these desired conditions in a collaborative inter-jurisdictional context. When appropriate, these plans set thresholds for future development and account for cumulative effects of existing development (baseline).
- Undertake environmental assessments in the course of implementing specific development projects, within this planning context.
- Monitor actual changes on the landscape through the use of indicators and adapting management to ensure desired future conditions are attained.

By examining all uses and functions of the land in an integrated manner, it is possible to link economic, social, and cultural development alongside environmental protection and enhancements, to make the most efficient trade-offs, and minimize conflicts. An integrated approach influences visioning, planning, assessment, and monitoring of landscape processes and components. It includes consideration of the capabilities and limitations of landscapes to support various land uses in a sustainable manner. This approach is what the best planning processes incorporate – consideration of the long-term well-being of the whole system.

The Role of Geospatial Data in Integrated Landscape Management

As the development of Canada's resources takes place on its lands and waters, sustainability has an inherent geographical context. Maps are used to portray a variety of location-based information: land use, land cover, species ranges, forests set aside as carbon sinks, toxic sites, and development footprints to name a few. Added to this are economic and demographic information, as well as planning

information, such as zoning and cadastral data. Map-based, or geospatial³ information is a key aspect of sound decision making that is fundamental to the success of ILM.

Geospatial data are increasingly being used in the modelling of future desired conditions for Canadian landscapes. Modelling landscape options in what-if scenarios can influence management plans that are developed to achieve the desired outcomes. Integrated geospatial analyses can also aid the assessment of environmental impacts of development options against mapping of existing cumulative effects.

Spatial data and tools can also be used to aggregate project and local scales of analysis into broad summaries that have relevance to broader policies (vertical integration). Spatial data and information, when part of monitoring regimes, can also help objectively assess and integrate changes over temporal scales, including projections into the future. The climate change scenarios of Canada are one example of spatially explicit models of future projections based on integration of numerous geospatial inputs.

The Canadian Geospatial Data Infrastructure

Geospatial information is distributed across federal, provincial, territorial, municipal, non-governmental, private sector, and academic organizations, and fragmented by subject matter (e.g., water, air, biodiversity, population, health). A unifying structure is needed to link these data together. Spatial data infrastructure provides that structure. The growth of SDI is a phenomenon underway in 54 countries linked in a well-organized global network. These infrastructures involve more than merely connecting computers and geographic databases across the country. Typically, these efforts include:

- the development of interoperability standards in co-operation with domestic and international standards organizations;
- policy work on addressing security, privacy and licensing concerns as well as barriers introduced by the pricing of data;
- technology development with the private sector; and
- the building of national core framework data sets against which all other data sets may be geographically referenced. (Canada's national framework data sets include geodetic survey references, digital terrain models, road networks, named places, and satellite imagery.)

Canada is seen as a world leader in the development of spatial data infrastructure due to the establishment, in 1999, of the GeoConnections program. Over the past six years, GeoConnections supported the development of standards, core data sets, technologies, and policies in partnership with the private sector and every province and territory in the country. This \$150 million investment (\$60 million in

³ "Geospatial" is a technical term describing spatial information at the landscape or geographic scale as differentiated from spatial information at the architectural scale.

federal dollars) has resulted in the Canadian Geospatial Data Infrastructure that is well known in the geography circles but little known outside due to its technical nature. This infrastructure is the common backbone supporting development of national integrated systems, such as the National Forest Information System (NFIS), National Land and Water Information System (NLWIS), the evolving Canadian Information System for the Environment (CISE), a National Environmental Assessment Portal, and several regional marine systems. Regional and local applications include those developed by Pollution Probe (assessing regional water quality), the New Brunswick Lung Association (linking air quality and human health) and many others.

GeoConnections works through other partners to implement solutions that can benefit from the CGDI. For instance, Agriculture and Agri-Food Canada has established the National Land and Water Information System (NLWIS), a mechanism to support ILM practices within an agricultural context. GeoConnections works closely with the NLWIS to ensure the CGDI meets the system's needs as it in turn provides services in support of environmental farm planning. Rather than implementing solutions itself, GeoConnections is mandated to work through such partnerships in pursuit of mutual objectives.

In the 2005 federal budget, GeoConnections was renewed with a further \$60 million investment over five years. GeoConnections' mandate is to maintain and operate the CGDI while supporting its application in four priority areas: environment/sustainable development, public health, public safety, and Aboriginal well-being. Encouraging the assembly of web-based thematic layers and building the tools necessary to enable data sharing across the Internet is a strategic priority of the GeoConnections program.

Looking Ahead

The ILM Coalition has identified numerous characteristics of existing systems that act as barriers to the implementation of ILM. These include:

- information silos;
- lack of consideration of land and resources use, and changes over various temporal and spatial scales;
- lack of consideration and understanding of cumulative impacts of projects and activities;
- lack of agreed-upon measurable outcomes for landscape and resources;
- inconsistent policy implementation within the decision-making hierarchy; and
- an uneven regulatory environment (CILMC, 2005: 6-7).

These barriers are confluent with those identified by Environment Canada/Policy Research Initiative, the Commissioner of the Environment and Sustainable Development/DFO and those locally focused organizations undertaking integrated community sustainability plans.

Each actor has identified deficiencies related to information management. Given the importance of geospatial information to many stages/areas of ILM, the improvement in delivery of location-based information within an ILM context is an area of focus for GeoConnections. Scoping and clarifying the role of the CGDI in supporting partners engaged in ILM is an early interest of GeoConnections.

The GeoConnections Secretariat seeks guidance in several areas with regards to future program development to enhance web-based geospatial applications that support integrated land and water management. In particular, we are looking for feedback in the following areas.

- What are the key ILM outputs and activities that require geospatial information?
- What are the key types of geospatial information that are needed?
- How should this information be shared with others?
- What are the key barriers to using and sharing geospatial information?

For Further Information

To provide feedback to this document or discuss the role of the CGDI and the GeoConnections program in integrated landscape management, please contact:

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Integrated Land / Marine Management Case Study #1 Eastern Scotian Shelf Integrated Management (ESSIM) Initiative

The Eastern Scotian Shelf Integrated Management (ESSIM) Initiative is a collaborative ocean management and planning process being led and facilitated by the Department of Fisheries and Oceans under Canada's *Oceans Act*. The primary aim is to develop and implement an integrated ocean management plan for this large marine region. This multi-year, strategic level plan will provide long-term direction and a common basis for integrated, ecosystem-based and adaptive ocean management.

The ESSIM planning process involves a broad range of interests, including government, First Nations, ocean industry, and resource users, environmental conservation groups, coastal communities, and university researchers.

The supporting objectives of ESSIM are aimed at a balanced approach to achieving ecosystem, social, economic, and institutional sustainability. As determined by the mandate of the *Oceans Act*, the four overarching objectives of the Initiative are:

- integrate the management of all measures and activities affecting the ESSIM planning area;
- manage for conservation, sustainability and responsible use of ocean space and marine resources;
- restore and maintain natural biological diversity and productivity; and
- provide opportunities for economic diversification and sustainable wealth generation to foster social well-being for coastal communities and stakeholders.

Information Management Considerations

The eastern Scotian Shelf has been selected for the application of integrated ocean management, because it possesses important living and non-living marine resources, significant areas of high biological diversity and productivity, and increasing levels of multiple use and competition for ocean space and resources. Key ocean use interests and activities include fisheries, offshore oil and gas, shipping, maritime defence operations, submarine cables, science, research and development, recreation and tourism, potential offshore minerals development, and marine conservation. The boundaries of the current planning area comprise a mix of existing administrative and ecological considerations, combined with an offshore community of interest.

Effective oceans management is recognized as requiring systematic mapping and data collection. The ESSIM reports have identified barriers that have an impact on the capacity for ocean management. Among these are issues associated with sharing, access, and ownership of data. With more databases available, there is a trend to standardized geographic data and visualization tools. These tools need to be available in user-friendly ways to non-technical clients who require the information for decision making. Current constraints include:

- different formats that cannot be layered, displayed, and compared; and
- policy level needs with respect to access, sharing, and ownership of data holdings.

The ESSIM reports have suggested that various mechanisms should be pursued to address data concerns.

Source: <www.mar.dfo-mpo.gc.ca/oceans/e/essim/essim-intro-e.html>. Accessed August 2006.

Integrated Land / Marine Management Case Study #2 Muskwa-Kechika Integrated Management Initiative

The Muskwa-Kechika Management Area (M-KMA), situated in northeastern British Columbia is an area of land designated for varying levels of protection, conservation, and use (e.g., economic development, research, backcountry recreation, Alaska Highway travel). The M-KMA serves as a model for the future, enabling economic development while protecting a large, intact wilderness with very few roads.

The M-KMA is intended to establish a world standard for environmental sustainability and economic stability, serving as a model that balances human activities, such as resource extraction and tourism, with conserving its environmental values and wilderness state over time.

The Muskwa-Kechika Management Area intent, as stated in the M-KMA Act, is to:

"Maintain in perpetuity the wilderness quality, and the diversity and abundance of wildlife and the ecosystems on which it depends, while allowing resource development and use in parts of the M-KMA designated for those purposes, including recreation, hunting, trapping, timber harvesting, mineral exploration and mining, and oil and gas exploration and development." (M-KMA Act)

To ensure that land use and other human activities in the M-KMA are managed to a higher standard than elsewhere in the province and the world, the M-KMA Act and M-KMA Management Plan required the development of five local strategic plans. These plans provide direction to ensure appropriate management of activities and intensities of development for:

- wildlife (M-KMA Wildlife Management Plan - under development);
- oil and gas (pre-tenure plans - approved);
- recreation (Recreation Management Plan - under development);
- forestry (landscape unit objectives - ongoing development and approvals); and
- provincial parks (park management plan under development and at approval stages).

Information Management Considerations

Numerous activities require a commitment to information management to support an integrated ecosystem approach in the Muskwa-Kechika. These activities include developing an ecosystem approach, mapping habitat capability, managing for cumulative effects, and developing habitat suitability models for managing predator-prey ecosystems. As well, there is a commitment to environmental planning and conservation area design (CAD). Integrating traditional ecological knowledge (TEK) is a key aspect of this planning. For example a special research project provides for extensive research and study of TEK, as well as ways in which it may be gathered and incorporated into mainstream or science-based processes of planning. This project makes use of geospatial tools, such as GIS, while developing methodologies to incorporate this vital knowledge into land-use planning and management processes. These methodologies will be applicable throughout all regions of the Muskwa-Kechika Management Area.

Source: <www.muskwa-kechika.com>. Accessed August 2006.