CGDI FRAMEWORK DATA DEFINITION

A working definition prepared by the GeoConnections Framework Data Node

1 INTRODUCTION

The concept of a framework data set lies at the heart of the CGDI. This common framework is intended to reduce duplication and improve the interoperability of geomatics data sets. This paper spells out what is meant by framework data, and what kinds of data sets are targeted and funded by the Framework Data Node (see Terms of Reference).

CGDI framework data is the set of continuous and fully integrated geospatial data that provide context and reference information for the country. Framework data are expected to be widely used and generally applicable, either underpinning or enabling most geospatial applications. Although continuity and cross-linkages are specific goals, information in this form is not immediately available, and most framework data will have to evolve in order to reach this definition. (See APPENDIX 1 for further information about the integration of framework data.)

Framework data take three principal forms:

1. Alignment layers;
2. Land Feature/Form layers; and,
3. Conceptual layers.

Alignment layers include geometric controls required to adequately position geospatial information. By themselves, these layers do not have representations of physical, economic or social phenomena, as will other framework layers or application specific layers, but these layers are critical to the reliability and use of all other layers.

Land Feature/Form layers contain well-defined and readily observable natural or man-made physical features that are not subject to interpretation or speculation. These layers include many of the same features that are visible on topographic maps, such as roads, rivers and elevation. Although useful for some applications by themselves, they are also used to provide reference information for the conceptual layers.

Conceptual layers are the frameworks that society develops and uses to describe and administer the country. These layers complement a vast amount of application-specific data. They are often interpreted from observations of physical, economic or social factors, and include features such as municipal boundaries, federal electoral districts, and ecological areas. Inclusion of any specific type of boundary under this layer is subject to its availability over large areas of the country, its geometric integration to alignment layers, and a consensus among major stakeholders on the importance of the ubiquity of the data.

Some general characteristics of CGDI framework data are indicated below.

- All framework data sets will need to comply with certain standards regarding the content structure and semantics as well as for the metadata that describes it. Priority is given to international standards.

- In order to satisfy urgent needs for framework data, data sets will be offered as soon as they become available. This implies that some may only be available locally until completion of the GeoConnections program.
- Some data sets may not have national coverage, but will be available in particular areas due to their importance as the base data for other information and applications (e.g., forestry roads for their economic importance).
- Framework data for a specified spatial resolution and geographic area will be unique.
- Framework data comprises features that are composed of a geometric representation and their related attributes. Moreover, attributes are those which can provide context and reference information for the country; namely those that can either underpin or enable most geospatial applications (as mentioned in section 1 INTRODUCTION). When applicable, toponymy is one specific attribute of the features that compose the framework data.

The remainder of this document describes how the issue of data resolution is addressed, and then identifies the individual layers that are part of the CGDI framework data.

A number of appendices are included with this document. These appendices are:

i. Integration of framework data, APPENDIX 1
ii. Spatial resolution and CGDI framework data, APPENDIX 2and,
iii. Framework data status, APPENDIX 3

2 RESOLUTION OF FRAMEWORK DATA

Each portion of the framework has a specified resolution, normally the resolution at which it was acquired, and a range of scales to which it is suited. Although eventually it might be possible to maintain just a single representation of any particular feature, for ease of use the CGDI framework data is currently stored and maintained at two separate resolutions, as shown in Table 1 below.

Table 1: CGDI spatial resolutions

Resolution	Accuracy	Recommended scale for display	
		Largest	Smallest
National	1 km	750,000	7,500,000
Regional	250 m and better	10,000	750,000

These two resolutions have the following characteristics:

National resolution
The standard reference layers chosen at this resolution are based on the 1:1M product maintained by the National Atlas of Canada. Much of this data was either derived from or aligned to the Canadian portion of the VMAP level 0 data set (originally DCW) as adjusted and distributed by the national Atlas of Canada. The nominal scale of this data is 1:1,000,000, and the accuracy is approximately 1 km.

Regional resolution
Framework data at a regional resolution consists of data produced by a wide variety of organizations from federal, provincial, and in some cases, municipal

levels. These data sets are maintained at a variety of accuracies, typically ranging from 250m down to around 1m. Normally the resolution used as the standard will be the most detailed resolution of mapping available for that area. Horizontal integration is a requirement between adjacent regional data sets.

Although the eventual intent is to maintain a single unique geometry at this resolution, it is recognized that during the development process an incremental approach may be required (see APPENDIX 1).

APPENDIX 2 contains an explanation of why the CGDI supports two separate framework resolutions. The development of two separate resolutions, which must be based on compatibility and interoperability, has a number of implications. These implications are addressed in further detail in APPENDIX 2.

3 TYPES OF FRAMEWORK DATA

This section provides descriptions of the layers defined as framework data.

Although this document separates geospatial data into a variety of layers**, this is not intended to prescribe how the data will be developed, stored, maintained, or distributed**. Furthermore, the participants who develop the individual layers will determine the standards for the geometry and the attributes to be included for each layer.

3.1 Alignment Layers: Horizontal and vertical control

3.1.1 Canadian Spatial Reference System

This layer includes the geodetic control points as well as the active control systems that allow observations to be related to geodetic reference systems as defined by those geodetic control points. Real-time and post-mission processing systems that link positioning systems to the Canadian Spatial Reference System (CSRS) are also included (for example, the Canada-wide Differential GPS Correction Service).

The horizontal and vertical location of these points is known to a high degree of accuracy, but they are not visible on imagery, unless targeted on the ground or symbolized on maps. Although not directly used by most of the geomatics community, these points are fundamental to the correct positioning of the entire framework.

3.1.2 Data Alignment Layer

These points are highly visible features such as the intersections of roads. They are known to a lesser degree of accuracy than the Geodetic Control Points, but they are easy to identify on most maps and imagery. These points can be used to align data sets derived from base maps of different sources, vintages and scales. Not all points will be suitable at both resolutions.

3.2 Land Feature/Form Layers: Well defined and observable features

These layers are all expected to be available for the different resolution; urban areas would have regional and national resolution data available, while most rural and northern areas would only have national resolution information available.

3.2.1 Roads
Streets and numbered roads are included in this layer. In some areas resource extraction roads may also be included in this layer. For continuity, entities like ferry routes are also included. Moreover, a review of the *CGDI Ground Transportation Study* will have to be done when it becomes available.

3.2.2 Railroads
Both current and abandoned railway lines are included in this layer.

3.2.3 Transmission Systems
This layer consists of electrical transmission lines and pipelines that are visible features of the landscape and help to register other information.

3.2.4 Structures
This layer consists of significant man-made structures such as bridges, airport terminals, lighthouses, ferry terminals, ports and dams.

3.2.5 Hydrography
This layer consists of rivers, lakes, glaciers, snowfields and coastlines. Both terrestrial and marine features are included in this layer.

3.2.6 Elevation
DEM data that cover both the terrestrial and marine portions of Canada is included in this layer.

3.2.7 Imagery
This layer is visual reference imagery.

3.3 Conceptual Layers: Interpreted boundaries

These boundaries delineate a wide variety of jurisdictions and responsibilities. Boundaries included in the framework are in general usage, or are of interest to multiple sectors of society.

The conceptual layers of the CGDI framework are:

3.3.1 International Boundaries
The current international boundaries including marine international boundaries.

3.3.2 Provincial Boundaries
The current provincial and territorial boundaries will be maintained at the national and regional resolutions.

3.3.3 Electoral Districts
Federal and provincial electoral boundaries will be maintained at the national and regional resolutions.

3.3.4 Municipalities
Counties, regional municipalities, urban municipalities and/or rural municipalities will all be maintained at the regional and national resolutions. Not all boundaries will be available at a national resolution.

3.3.5 DND Properties
The external boundaries of the Department of National Defense (DND) properties will be maintained at the regional and national resolutions.

3.3.6 Indian Reserves (First Nations)
The external boundaries of Indian Reserves (First Nations) will be maintained at the regional and national resolutions. Not all boundaries will be available at a national resolution.

3.3.7 Crown Subdivisions
Original Crown subdivisions, including lots and concessions, sections and quarter sections and similar land parcel information will be maintained at the regional resolution.

3.3.8 Parks
The boundaries of national and provincial parks will be maintained at the regional and national resolutions. Not all boundaries will be available at a national resolution.

3.3.9 Ecological Units
All five levels of the ecological framework (ecozones, ecoprovinces, ecoregions, ecodistricts and soil landscapes) are included for the terrestrial areas. Ecozones and ecoregions are the only ones currently developed for the marine areas. This layer will be maintained at the national resolution.

3.3.10 Watersheds
These boundaries will be maintained at the national and regional resolutions. The national resolution will include down to the sub-sub-watershed level.

3.3.11 Toponymy
The contents of the Canadian Geographic Names Database (CGNDB)are included as part of the conceptual framework for the country. Toponymy attached to other framework layers may be used to derive portions of this national toponymic data set.

APPENDIX 1

INTEGRATION OF FRAMEWORK DATA

In order to make the framework data usable, coherence and integration have to be ensured. Down the road, as the subsets of data themes get included in the framework**,** the desired evolution of data integration could be achieved on four different levels of integration. The approach is incremental so that each level is based on the previous ones. Accordingly, the last level is the most demanding, but offers the greatest integration.

1. Spatial reference system

All horizontal and vertical coordinates of data themes that form the layers of the framework have to be based on the Canadian Spatial Reference System. This is the minimum requirement.

2. Scales of data themes

All data sets of the same scale and themes have to be horizontally integrated. Data sets having the third dimension (3D) and Digital Elevation Models (DEM) are vertically integrated.

3. Geometric identifiers

Each geometric representation has its unique identifier. This number is used for maintenance (revision) purposes. It is also used to ensure that all users' applications refer to the same feature. The identifier is unique per data theme and per scale.

4. Unique geometry

One --and only one-- identifier and set of geometries is maintained for each feature.

Going beyond the level of a unique geometry is not expected within the scope of the existing GeoConnections program.

APPENDIX 2

SPATIAL RESOLUTION AND CGDI FRAMEWORK DATA

There are four principal reasons why the CGDI framework is developed at two different spatial resolutions:

1. Resolution and accuracy concerns

The CGDI respects the requirement to work at different scales. Some data sets are only collected at very broad scales, and data acquisition methods also have an impact on the accuracy of the data collected, as does existing cartographic license, so translation to a larger scale may be misleading or impossible.

2. Data generalization concerns

Content and geometry varies from the largest to the smallest scale. As we go to small scales, some features disappear (e.g., fire hydrants) and some representations are changed (a road represented as a polygon at large scales will be represented as a line at small scales). Although automated generalization routines can be used to filter data and reduce data densities to make information suitable for use at a smaller scale, there are currently practical limits to the effectiveness, reproducibility and usefulness of data generated with an automated approach.

3. Data storage and exchange concerns

Smaller scale takes less storage space, is easier to communicate over the Internet and speeds up rendering and analysis.

4. Expense

Collection of larger scale information is exponentially more expensive and cannot be justified across the country. Specific regions and locations may warrant the added cost of higher accuracy and detail.

APPENDIX 3

FRAMEWORK DATA STATUS

The following table shows the anticipated source and availability of framework data layers at different resolutions.

	Regional	National
Alignment		
CSRS	Available	Aligned to the CSRS
Data Alignment Layers	Available More points needed?	Needs to be created
Land Feature/Form		
Roads	Some work initiated NTDB + ?	Needs work (National Atlas 1:1M)
Railroads	NTDB + ?	Needs work (National Atlas 1:1M)
Transmission systems	NTDB + ?	Future version of National Atlas 1:1M ?
Structures	NTDB + ?	National Atlas ? StatCan ?
Hydrography	NTDB + ?	Ready National Atlas 1:1M
Elevation	NTDB + ?	Not determined (Hydro 1k/ Gtopo30 DTED1 SRTM Shuttle Radar)
Imagery	Landsat 7 in preparation	Not determined (Radarsat, AVHRR, GLCC)
Conceptual		
Provinces	NTDB ? + ?	National Atlas 1:1M
Electoral Districts	Elections Canada ? + ?	Elections Canada ? National Atlas ?
Municipalities	StatCan or NTDB ? + ?	StatCan
Indian Reserves	NTDB+Legal Surveys	Legal Surveys
Crown subdivisions	NTDB ? + ?	Not applicable
Parks	NTDB ? + ?	National Atlas?
Ecological units	Not applicable	In preparation (AAFC and Environment)
Watersheds	Provincial ministries?	In preparation (Environment)
Toponymy	Found as attributes on other layers	Linked to Canadian Geographic Names database (with upgrades); NIMA GNDB

List of acronyms:

Alta env.:	Alberta Environment
DPT:	Department of Provincial Treasury, Prince Edward Island
DGSL:	Department of Government Services and Lands, Newfoundland
NRCan:	Department of Natural Resources Canada
GSD:	Geodetic Service Division, NRCan
MSB:	Mapping Services Branch, NRCan
DFO:	Department of Fisheries and Oceans
Stats:	Statistics Canada
Elections:	Elections Canada
MRNQ :	Ministère des ressources naturelles du Québec
OMNR:	Ontario Ministry of Natural Resources
Sasks PMC:	Saskatchewan Property Management Corp.
GDBC:	Geographic Data British Columbia
LRI:	Land and Resources Information, Yukon
DRWE:	Department of Resources, Wildlife and Economics, Northwest Territories
DSD:	Department of Sustainable Development, Nunavut
NSGC:	Nova Scotia Geomatics Centre
NSHMA:	Nova Scotia Housing and Municipal Affairs

Framework Data Themes and their sources Regional Resolution