A Spatial Referencing Policy for the Province of Nova Scotia

Policy Document

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1.0 Purpose

The positioning user community in Nova Scotia is very diverse. They come from different sectors (industry, government, and general public) with different applications and accuracy requirements. The growth in the use of satellite positioning systems, GIS, and the integration and exchange of geospatial data have made it necessary to review and formalize a new spatial referencing policy for the Province.

The specific purpose herein is to document the policies regarding spatial referencing in Nova Scotia and provide direction as to the operational requirements to support and facilitate these policies. Through the documentation of formal policies the Province is providing an enabling infrastructure upon which all subsequent geo-spatial, primary and or thematic, databases are built/supported.

In addition to documenting the specific policies which help to govern the Nova Scotia Coordinate Reference System the reader is also provided with an understanding of the terminology and practices that must be undertaken to support this infrastructure. As well, as can be found in Appendix A, a historical overview is also provided so as to help the reader understand the evolution of this corporate coordinate reference system.

1.1 Why a reference coordinate system

Describing an individual's position/location, or that of a topographic feature or object, on or near the surface of the earth with a level of certainty and in a simple numerical way is one of the basic requirements for databases and applications with a geospatial context. Today, primarily due to Global Positioning System (GPS) technology, one sees positioning at work in more applications than ever. Agencies mapping topographic features; engineers and surveyors designing and laying out new structures; vehicles with navigation capabilities; cell phones with location capability; environmental planning/management tasks; boundary demarcation; etc. are but some examples where positioning is applied.

The most convenient way to describe the position of a point or feature on or near the surface of the earth is with a "well-defined" coordinate system – a coordinate system with a defined origin, orientation of the axes, and scale. This will enable a position described in that coordinate system to be stated uniquely as an unambiguous set of numbers – the basics of this concept is seen in the two-dimensional rectangular coordinate system learned in grade school to plot coordinates on a piece of paper. Here though, one is dealing with the "real world" which is three-dimensional, or

four dimensional when time has to be considered and it must be related to the earth rather than a piece of paper. Such a coordinate system becomes a reference coordinate system and forms part of a spatial reference system or reference system.

The task of determining a position is called positioning or some may use the term spatial referencing. Spatial referencing and, the use and exchange of geospatial data can be greatly facilitated if a common reference system is used. Within the Province there are many geospatial applications where positioning and the use of a common reference coordinate system is very important. The provision of a reference coordinate system at the provincial level and access to it in fact, has been a mission/mandate of the province since at least the mid 1960's. It is one of the fundamental infrastructure components required in the management of the Province's geographic information, as well as serving as a reference system to the positioning community operating at large within Nova Scotia.

1.2 What is a reference coordinate system

A reference coordinate system is essentially one in which the origin, the orientation of the axis and the scale have been defined. The category of coordinate system of interest here is the terrestrial one (as opposed to a celestial one or orbital one) as they are defined with respect to the earth and are designed to describe the position of points on or near the surface of the earth. They are fixed to earth, spin with the earth and revolve with the earth.

In today's terminology a distinction is made (by some) between the conceptual definition of a coordinate system and, the practical realization of that coordinate system through observations. The term reference system is used to refer to the complete conceptual definition of how a coordinate system is formed. It defines the origin, orientation of the system axes and also includes the underlying fundamental mathematical and physical models used in the treatment of observed quantities. A practical realization of the reference system on the other hand is known as a reference frame. It materializes ("realizes") the coordinate system into something tangible and accessible by positioning users. It consists of a set of identifiable, accessible physical points (ie. frame points) with precisely determined coordinates in a specific coordinate system at a specific epoch.

The reference frame serves as the physical set of points with associated coordinates from which the position of other points and features may be determined or to which other points and features are ultimately spatially referenced. Thus the reference frame provides the geometrically consistent physical structure that is the foundation for positioning tasks and to which the spatial component of real world features can be referenced.

Since very specialized procedures are used to determine the position of the frame points, there usually is only a relatively sparse set of such points established within the system. These points are used to connect other surveys and establish geodetic control networks, thereby extending the reference frame and making the reference system more widely applicable to the positioning user.

Today with the use of GPS technology it is also possible for users to access the reference system without directly occupying the monumented network points - the GPS satellites are in effect a reference frame. However, GPS must be used appropriately if the derived positions are to be referenced to the reference system used by the province.

In Canada the task of providing the spatial reference system and making it accessible is carried out by the federal and provincial geodetic agencies in a cooperative and structured fashion (see Figure 1.0) At the provincial level, the Nova Scotia Coordinate Reference System (NSCRS) is the all encompassing term used to describe the collection of reference systems and their

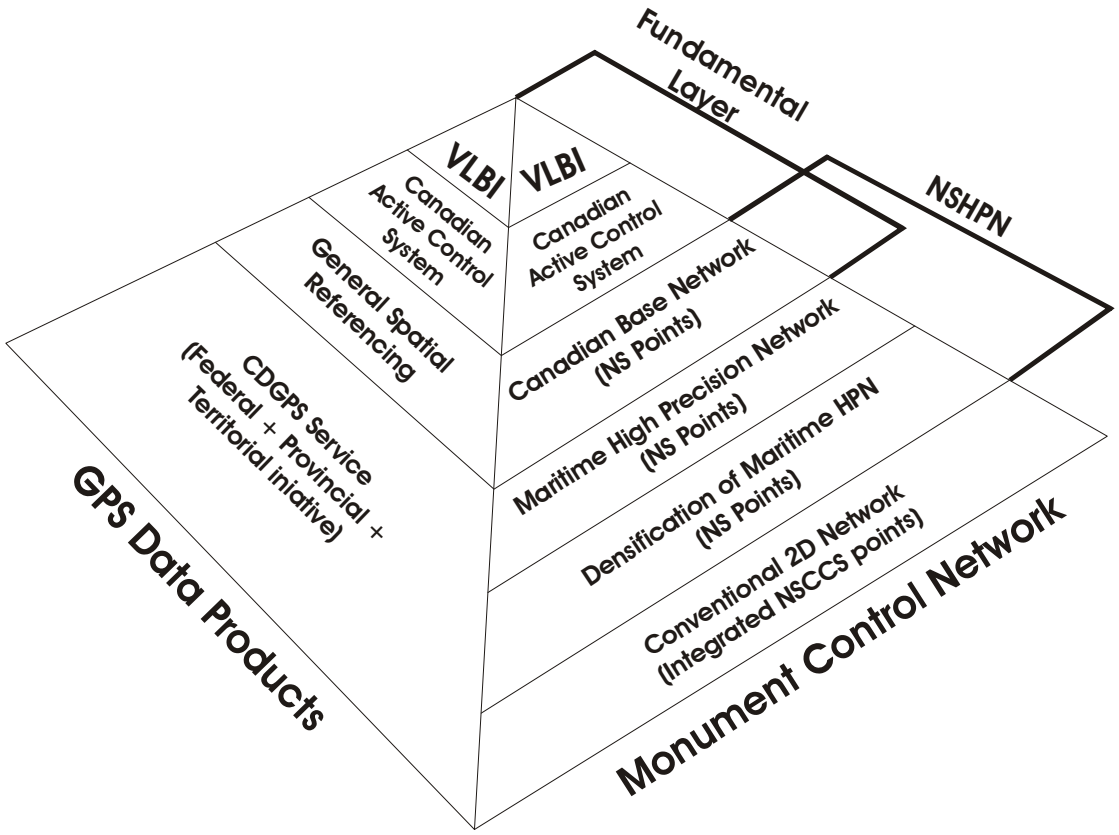

Figure 1.0 Hierarchy of Canadian Spatial Reference System from the NSCRS Perspective

associated realizations (past, present and future), related data, geodetic software, other geodetic components and associated products and services, which together constitute the Provincial spatial reference standard and its supporting infrastructure. This establishes and maintains the provincial reference frame and provides for a quantitative description of positions in Nova Scotia : the reference frame of the NSCRS is integrated with, and is an extension of, the national reference frame belonging to the Canadian Spatial Reference System (CSRS).

The NSCRS is an enabling geomatics infrastructure providing spatial context to the Province's primary and thematic databases. A well documented, and maintained, reference coordinate system provides credibility to geographic data holdings and allows people to associate their data within the real world. A reference coordinate system when properly applied, facilitates the production of quality geographic products to be generated for the end user.

2.0 Nova Scotia's Policies Related to Spatial Referencing

Given the diversity in geomatics activities within the Province of Nova Scotia and the growth in technologies deployed to support such an industry, these policies are provided for the benefit of all geomatics practitioners in, or who do business within, Nova Scotia.

2.1 Introduction [1]

In fiscal 2003/04 Service Nova Scotia and Municipal Relations (SNSMR) initiated an extensive consultation process with a large cross section of users of the NSCRS including government departments and agencies, businesses and general users. The purpose of this consultation was to review the needs of the positioning user community and to determine what steps needed to be taken to formally adopt a series of policies and management strategies so as to enhance the delivery of the NSCRS program.

SNSMR's business plan continues to strengthen government's commitment to seeing a documented and approved set of policies related to spatial referencing. SNSMR's Business Plan notes that it is responsible for ensuring results in the following areas *[excerpt from SNSMR 2004/05 Business Plan]*:

- Collaboration with internal and external partners to evaluate and improve the quality and effectiveness of government services.
- Policy development for the Department in the areas of data privacy, security and access and integrity of data holdings.
- Customer and stakeholder satisfaction with SNSMR services.
- Effective and positive relationships with other levels of government, provincial departments and agencies and the private sector.

It is based upon these commitments that the spatial referencing policies contained within this document are presented.

As identified in the consultation process, the reference coordinate system for Nova Scotia must be or do all of the following:

[1] In preparing the content for this policy document it has become evident that terminology surrounding Nova Scotia geodetic infrastructure has evolved. The terminology employed here is intended to be the foundation terminology upon which Nova Scotia will continue to promote, support and build from this point forward. A Glossary of Terms and Terminology is provided at the end of this document so as to assist with the changes.

- simple to use;
- accurate, reliable, and consistent for surveying;
- stable over the long term;
- achievable with a minimum of hardship for users; and
- provide for an accommodation of future eventualities.

But as well the management of the system, i.e. the policies and management strategies must also consider these criteria.

The Province must ensure that the integrity of the reference system is addressed both in the immediate and the longer term. It must also ensure that the reference frame itself is maintained to a high enough quality so that it is capable of supporting a wide range of applications, with accuracy requirements ranging from the low to the high end of the spectrum.

2.2 Policies

The policies related to spatial referencing are categorized to include Operational Policies and Technical Policies (for reference frame and map projections). These policies come as a direct result of the in depth consultation efforts in fiscal 2003/04. During that consultation there were areas where stakeholders thought policies were necessary or beneficial. In reviewing the material, it has been determined that some issues are not specifically of a policy nature but are a business process or strategic issue and thus have not been incorporated in this document. Please refer to Appendix B which correlates the findings from the *Final Report for the Study of the Official Adoption of the NSCRS* [September 2003] and the policies presented here.

2.2.1 Operational Policies:

Policy 1.0 Administration

The NSCRS will continue to be administered by Service Nova Scotia and Municipal Relations, through Registry and Information Management Services, specifically the Geographic Information Services Section. The Nova Scotia Geomatics Centre will be the agent responsible for this administration.

Policy 2.0 Operational Approach

SNSMR, through the Geographic Information Services and specifically the Nova Scotia Geomatics Centre will develop and deliver an Operational Strategy related to the NSCRS . Subject matter within the strategy will include, but will not be limited to: communications; training; specifications; and services.

Policy 3.0 Consultation: Engaging Stakeholders

The Province will establish a consultation process to engage stakeholders involved in the use of spatial referencing. This process will be initiated when:

- NSCRS standards need to be addressed, e.g. when a new realization is being considered.
- Regulations governing spatial referencing are altered.
- Policies governing spatial referencing require updating.

Policy 4.0 Communications: Opening Dialogue

The Province will ensure operations related to the delivery of the NSCRS are communicated to the geomatics community of Nova Scotia. They will further ensure that positioning practitioners have a means upon which they can provide input into the delivery of the NSCRS. This may include delivery of an annual communications plan and the specific actions against such a plan e.g. information seminars, industry trends, etc.

Policy 5.0 Standards: Federal - Provincial

The Province will continue to operate within the context of the CSRS and where applicable will adopt national standards and specifications for the NSCRS.

2.2.2 Technical Policies (Geodetic Reference Standard):

Policy 6.0 Geodetic Reference System

The Province will implement NAD83(CSRS) as the spatial reference frame standard within the NSCRS. Specific NAD83(CSRS) versioning will be communicated as part of the deliverables from Policy 2.0

Policy 7.0 Monitoring Change

The Province will monitor all changes to the reference frame that might impact the NSCRS and will inform the positioning user community when changes are detected.

Policy 8.0 Coordinate Transformation Services

The Province will deliver coordinate transformation services so as to ease the conversion burden experienced when transforming data from one projection and reference frame to another. This service may include, but is not limited to:

- training workshops
- software tools (e.g. web enabled solutions)
- advisory services
- and will target a variety of data dissemination methods

Policy 9.0 Nova Scotia Coordinate Control System (NSCCS) Network

The Province will provide the NAD83(CSRS) horizontal coordinates and absolute accuracy estimate (95% confidence level) for the Nova Scotia Coordinate Control System(NSCCS) network of control points. The coordinates and absolute accuracy estimate will be derived from an adjustment in which the acceptable, existing conventional observation data from this network is integrated with the Nova Scotia High Precision Network (NSHPN). Control points within the NSCCS network with insufficient and/or unacceptable observations will be removed from the adjustment and thus will not obtain NAD83(CSRS) coordinates. Situations leading to this are:

- after removal of unacceptable observations, there is insufficient observations remaining to properly define the point
- insufficient observations to define the point to begin with
- unresolved adjustment / observation issues in an area of the network, leads to removal of all control points within that portion of the network.

Policy 10.0 Vertical Reference System

The Canadian Geodetic Vertical Datum of 1928 (CGVD28) will continue as the Province's vertical reference standard for the near term. The Province is committed to monitoring developments with the vertical reference system, in association with the Geodetic Survey Division of Natural Resources Canada.

Policy 11.0 Nova Scotia High Precision Network (NSHPN)

The NSHPN will be the set of points at the provincial level, defining the NAD83(CSRS) reference frame for the NSCRS. The physical maintenance of this network remain the responsibility of the Department of Service Nova Scotia and Municipal Relations

Policy 12.0 Error Ellipse Information

The Province will publish the error ellipse information for any NAD83(CSRS) coordinate for control points within the NSCRS.

Policy 13.0 Metadata

The Province will publish collection and product level metadata pertinent to the Province's spatial reference system. This metadata will be documented against the provincial metadata standard and will be made available within the Nova Scotia Metadata repository.

2.2.3 Technical Policies (Map Projections):

Policy 14.0 Small Scale Map Projections

The Province adopts the Universal Transverse Mercator (UTM) Map Projection, and NAD83(CSRS), as the standard map projection and reference frame, to be used in the Province of Nova Scotia for all Primary Database Mapping at scales of 1:10,000 and smaller (scales smaller than 1:10,000 would include scales at 1:25,000; 1:50,000 ; 1:500,000; etc.). Thematic data custodians will apply the same standard where appropriate.

Policy 15.0 Large Scale Map Projections

The Province adopts the Nova Scotia 3 degree Modified Transverse Mercator Map Projection (NSMTM), and NAD83(CSRS), as the standard map projection and reference frame, to be used in the Province of Nova Scotia for all Primary Database Mapping at scales larger than 1:10,000. (scales larger than 1:10,000 would include scales at 1:5,000; 1:2,000; 1:1,000; etc.) Thematic data custodians will apply the same standard where appropriate.

Policy 16.0 Grid Shift Files

The Province will distribute the grid shift file for transformations between ATS77 and NAD83 (CSRS).

APPENDIX A

A Historical Perspective on the Nova Scotia Coordinate Reference System

The history of establishing the national reference coordinate system which was used in Nova Scotia can be dated back into the 1900's. Figure A.1 provides a very high level snap shot of the developments of the reference system for Nova Scotia.

The reference coordinate system for the Province of Nova Scotia was initiated in March 1968 under the Atlantic Provinces Surveying and Mapping Program (APSAMP). During the first five years of operation the Province placed a total of 8000 control points throughout the developed areas of the Province. By 1981 some 23000 control points were established in the Province thus completing the control network of its day. This network became known as the Nova Scotia Coordinate Control System (NSCCS).

In 1982, following the establishment of the 23000 control points, a maintenance program for the system was established. The maintenance program was managed jointly for all three Maritime Provinces through the Land Registration and Information Service (LRIS) Program. Between 1993 and 1998 the Province established the Nova Scotia High Precision Network (NSHPN) and which today contains 153 points, observed by GPS and based upon NAD83(CSRS).

In 1994 the LRIS Program ended, leaving responsibility for the control system in the hands of the individual Provinces. Today(2005) the system in Nova Scotia is managed by Nova Scotia Department of Service Nova Scotia and Municipal Relations, under the administration of Geographic Information Services and more specifically the Nova Scotia Geomatics Centre (NSGC).

Geographic Information Services has been mandated to develop, maintain and distribute corporate geographic information assets. The NSCRS is one of those corporate assets but more importantly it is the “foundation” upon which all other corporate databases are built. Geographic Information Services thus manages and delivers the NSCRS in consultation with the positioning user community of Nova Scotia.

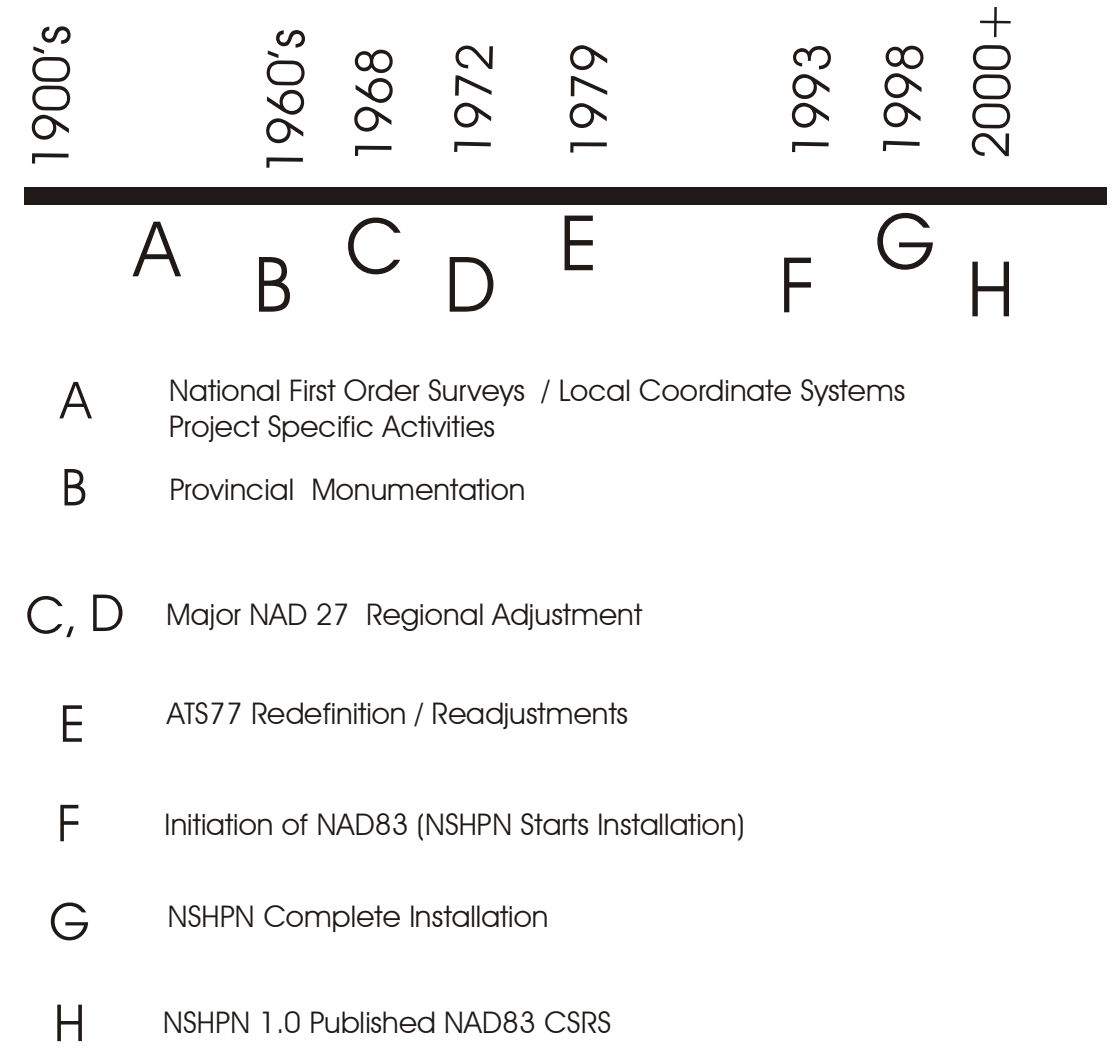

Figure A.1
History of the Reference System for Nova Scotia

In recent history the Province has looked to formalize its reference system and its spatial referencing activities. The document *A Coordinate Referencing Policy for the Province of Nova Scotia* was released in November 1995 and contains recommendations and draft policy statements regarding coordinate referencing for the Province of Nova Scotia. It was in essence the initial formulation of the administrative strategy to deal with two major developments in positioning that emerged in the early 1990's. They were, (1) the increasing use of GPS technology and (2) the upgrade being made

by geodetic agencies related to their reference frame standard and subsequent compatibility with GPS use. Many of the recommendations and policy statements contained in the 1995 document were based on recommendations from an earlier report, *The Report of the Task Force on Control Surveys in the Maritime Provinces* [1993].

In the 1995 work, the term Nova Scotia Coordinate Reference System (NSCRS) was introduced as the all-encompassing term used to describe the coordinate reference system proposed for the province. The NSCRS concept is very broad in scope and encompasses a number of spatial reference components. The 1995 document outlines the function of the NSCRS as being: to serve as the reference or foundation for all provincial positioning uses and to be the reference upon which the spatial component of provincial geospatial databases are based. One of the recommendations was to upgrade the spatial reference frame used for the NSCRS to NAD83 and more specifically the NAD83(CSRS) realization. A completion date was not set, as there was preparation work to be done and other factors to take into account before setting such a date, one being user acceptance/readiness.

Nova Scotia has been working with the federal government along with other provinces and now has in place a network of control points with NAD83(CSRS) coordinates. There also is a grid shift file (NS778301.gsb) for use in transforming between ATS77 and NAD83(CSRS). A GPS correction service known as the Canada-wide Differential Global Positioning System (CDGPS) Service is now in place. The CDGPS was developed by the ten provinces, the Government of Nunavut, and the Government of Canada. It provides GPS corrections based on NAD83(CSRS). Also in the Atlantic region is the Canadian Coast Guard differential correction service. Thus there is broad access to NAD83(CSRS) within the province.

Since 1979, the de facto reference frame standard, for the province, has been the Average Terrestrial System of 1977 (ATS77). It superseded the NAD27 frame. The provincial map projection utilized with it and in which most provincial corporate geospatial data is maintained is the Nova Scotia MTM projection. Two zones, 4 and 5, with slightly extended zone boundaries beyond the 3° band at the eastern and western extremities of the province are required for provincial coverage (see Figure A.2). While ATS77 was a significant improvement over NAD27, it is not the reference frame currently used for the Canadian Spatial Reference System (CSRS) nor is ATS77 compatible with GPS where WGS84 is used. This makes work more complex when exchanging geospatial data with other jurisdictions or integrating GPS position data with ATS77 based position data.

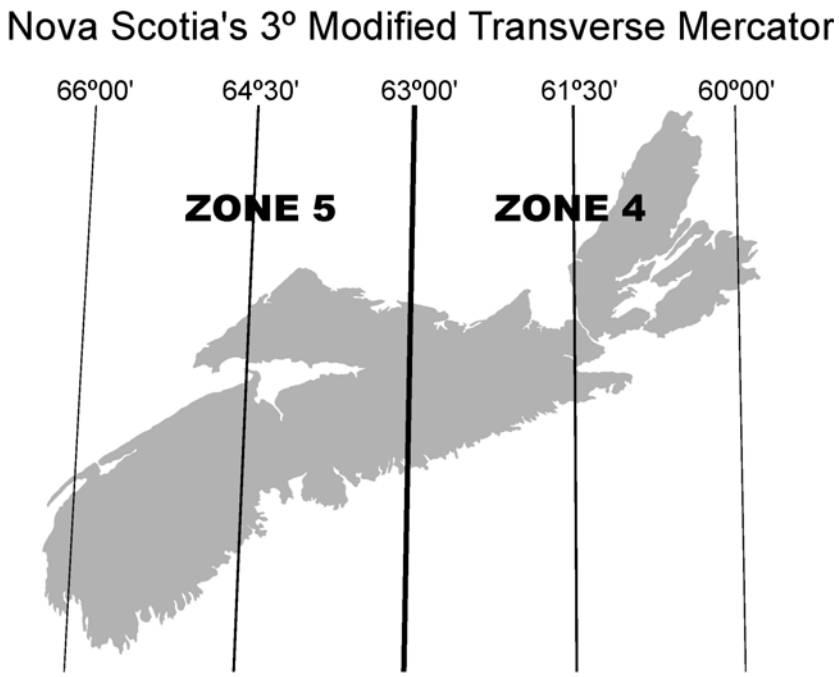

Figure A.2 MTM Zones for Nova Scotia

These various activities (back room processes, improvements to the system, extensive user consultations, etc.) supported the move to formalize the NSCRS. Such action will provide a reference system compatible with GPS and ease the burden when exchanging geospatial data with other jurisdictions. The positioning user community supports the move forward in the application of this reference system and much of the infrastructure is now in place.

APPENDIX B

Policy Matrix

The following matrix attempts to align the recommendations arising from the *Final Report for the Study on an Official Adoption of the NSCRS [Sept, 2003]* with the policies the Province of Nova Scotia is hereby implementing :

Policy (Refer to Section 2.2 of this document)	**Recommendation from the "Official Adoption of the NSCRS" (Refer to Section 5 of that document)**
1.0 Administration of Policy	was not raised specifically by study
2.0 Operational Approach	1, 5, 8, 9
3.0 Consultation: Engaging Stakeholders	1, 2, 3
4.0 Communications: Opening Dialogue	1, 2, 3
5.0 Standards and Specifications	was not raised specifically by study
6.0 Geodetic Reference System	6
7.0 Monitoring Change	1, 7
8.0 Coordinate Transformation Services	8, 9
9.0 Nova Scotia Coordinate Control System (NSCCS)	10, 11
10.0 Vertical Reference System	was not raised specifically by study
11.0 Nova Scotia High Precision Network (NSHPN)	was not raised specifically by study
12.0 Error Ellipse Information	11
13.0 Metadata	was not raised specifically by study
14.0 Small Scale Map Projections	12
15.0 Large Scale Map Projections	13
16.0 Grid Shift Files	8, 9
Note: Not covered in this policy document	4, 14

APPENDIX C

Terminology

Definitions / Acronyms

The following Appendix presents a standard set of definitions for NSCRS related policy material. In cases where other source definitions differ, the definitions contained within will supercede others.

Communication is vitally important to managing the coordinate reference system. Since 1968 not only has technology changed within the Nova Scotia coordinate reference system but so has the terminology. In some instances it has been imperative that a term or concept be renamed/ newly referenced so as to attempt to bring clarity of thought within the positioning community.

ATS77 (Average Terrestrial System 1977) - ATS77 is a geocentric coordinate system defined by GSD in 1977 for the Maritime provinces. It is a conceptualization of a conventional terrestrial reference system using the ATS77 reference ellipsoid. The ATS77 reference frame was realized by a set of coordinates in the ATS77 system. The coordinates were obtained from the 1979 Maritime Redefinition and Readjustment of the combined three provincial geodetic networks then in existence. ATS77 is now known to be offset from the true geocenter by about 5 m.

Canadian Spatial Reference System (CSRS) - The collection of procedures, models, conventions, standards, objects, observatories and related data, which are logically combined together and used in Canada to establish and maintain the national reference frame. It provides for a quantitative description of positions, motions, and gravity in space and time and, includes a description of the physical environment. Through it, it is possible to determine from observations the coordinates of the frame points that define the reference frame(s) and, to improve the adopted coordinate values as new observational data and techniques are accumulated and/or implemented. It ensures continuity of the national reference frame and its compatibility with international standards, as well as serving as a "source" in the development and maintenance of a global spatial reference frame.

Collection Level Metadata - information related to an overall collection of products. (compare with Product Level Metadata)

Control System - term that has historically been used, to describe a system of coordinates for control points. Many positioning users have viewed this set of coordinates for control points as a datum, as they are being held fixed and used as the reference for subsequent computations. This has led to much confusion about the definition of the term "horizontal datum". The "textbook" definition is a reference surface; i.e., a reference ellipsoid appropriately positioned with respect to the Earth's surface. The control points and their set of coordinates would be equivalent to the modern concept

of "reference frame".

Coordinate frame – a set of rectangular axes (or other geometrical construction) with respect to which the position of a point may be specified.

Frame Point - is one of the points from the set of physical points that serve to realize a reference system. It is at these points where comprehensive and accurate observations are made that are then used to determine the point's position (coordinates) in accordance with the principles and specifications of the reference system and thereby realize it - i.e. takes the reference system from something conceptual in nature and makes it real, tangible and accessible.

Grid Shift File - a data file containing an estimate, at regularly spaced grid intervals across an area of interest, of the coordinate shift between two sets of coordinates. It represents a model that can be used for performing transformations between two reference frames.

Map Projection

(1) is the orderly transfer (mapping) of the position of points or objects from the ellipsoidal surface representing the earth to corresponding points on a flat surface, i.e. a map plane.

(2) the mathematical mapping (transformation) that projects points or objects on the reference ellipsoid representing the earth, to horizontal positions on a two dimensional mapping surface such as a cylinder or cone that can be developed (ie. laid flat) into a plane.

MTM (Modified Transverse Mercator) - a Transverse Mercator map projection system used by Nova Scotia to transfer (map) NAD27 positions from the ellipsoid to a plane coordinate system.

NAD27 (North American Datum 1927) - A ***non-geocentric*** coordinate system used for North America (Canada, United States and Mexico). It is a conceptualization of a Geodetic reference system using the Clarke 1866 reference ellipsoid as the best-fitting surface. Astronomic observations were used to position and orient the ellipsoid at a single datum point in the central U.S. (Meades Ranch). The origin of this system is offset by approximately 250 m from the geocentre. The original realization of this system was obtained from an adjustment done between 1927 and 1932 using all geodetic networks then in existence. New points and networks were added in subsequent years by holding fixed the coordinates of any existing control points. In later years this led to unacceptable distortions in many areas and regional readjustments were performed to obtain a more homogeneous set of coordinates. One of these readjustments was performed for Nova Scotia in 1972 and is known as the 1972 Nova Scotia Readjustment. The resulting coordinates are designated NAD27 for Nova Scotia. Today, such a set of coordinates would be considered a regional reference frame.

NAD83 (North American Datum 1983) - A geocentric coordinate system introduced in 1986 for North America, Central America (i.e., from Greenland to Panama), the Caribbean Islands and

Hawaii. It is a conceptualization of a conventional Terrestrial reference system using the GRS80 reference ellipsoid. The origin of this system is offset by approximately 2 m from the geocentre. The first realization of the system was obtained from the July 1986 Continental Adjustment, using conventional survey data, Transit satellite Doppler data and VLBI data spanning the countries listed above. Subsequently, a regional adjustment was performed by GSD to integrate the primary (Federal) and secondary (Provincial) horizontal networks of Eastern Canada. This adjustment was completed in 1989 and is known as the Eastern Secondary Integration Helmert Block Adjustment (SIHBA). Only the Federal horizontal network data was included from Nova Scotia. This set of coordinates (realization) is designated NAD83(Original) for Nova Scotia, however, it is not a realization that was used for any provincial networks.

NSCCS (Nova Scotia Coordinate Control System) - The network of Nova Scotia control points and their coordinates initially referenced to the NAD27 coordinate system and subsequently, in 1979 referenced to the ATS77 coordinate system. The actual number of control points used in the two situations is different, as some points did not exist or are not included in the respective adjustments. Overall there are approximately 23000 control points. Today, the two sets of control points and coordinates are each considered a reference frame.

NSCRS (Nova Scotia Coordinate Reference System) - The collection of geodetic components (past, present and future), related data, standards, guidelines, and geodetic software used by Nova Scotia to define, establish and maintain the provincial reference frame and the associated products and services that, when taken together provides for a quantitative description of positions in Nova Scotia. The provincial reference frame is integrated with and is an extension of the national reference frame. The provincial reference frame is actually comprised of the following layers (network hierarchy) of control points:

- the Canadian Base Network (CBN) points in Nova Scotia
- the Maritime High Precision Network (MHPN) points in Nova Scotia
- the MHPN Nova Scotia densification points

NSHPN (Nova Scotia High Precision Network) - the unified three-dimensional network of control points in Nova Scotia observed with high precision using GPS. The network has a nominal point spacing of 25 km, and is connected to the Canadian Base Network (CBN) and the Maritime High Precision network(MHPN). The term NSHPN is often used to refer collectively not only to the network of Nova Scotia densification points of the MHPN, but also to include the Nova Scotia points from the CBN and MHPN as well.

NSMTM (Nova Scotia 3° Modified Transverse Mercator) – a Transverse Mercator map projection system used by Nova Scotia to transfer (map) ATS77 positions from the ellipsoid to a plane coordinate system. The same map projection is also used with NAD83 for large scale mapping applications.

Plane Coordinate System – a two-dimensional (plane) rectangular coordinate system based upon a particular projection of the points from the reference ellipsoid onto the plane surface. The

axes of the 2D coordinate frame are oriented such that the positive direction of one points toward the north and the positive direction of the other, points toward the east.

Positioning - the act / task of determining the position of a feature or object.

Product Level Metadata - Information about individual maps/products contained within a collection, or standing alone. (compare with Collection Level Metadata)

Reference Coordinate System - a coordinate system with a defined origin, orientation of the axes, and scale.

Reference frame - a set of physical points with precisely determined coordinates in a specific coordinate system that provides a realization of a terrestrial reference system. It serves to define, or realize a particular coordinate frame. The reference frame provides the geometrically consistent physical structure that is the foundation for positioning tasks and to which real world features can be spatially referenced. The term reference frame is often used as if it were synonymous with the coordinate frame that it defines.

UTM - Universal Transverse Mercator – a worldwide system of Transverse Mercator cylindrical mapping projections. Each projection zone is 6° wide and the central scale factor is 0.9996, however, these parameters may be varied in some jurisdictions. The central meridians are at longitudes 3°, 9°, etc, east and west of Greenwich. For the northern hemisphere a false easting of 500,000m and a false northing of 0m is used. In Nova Scotia the projection is often used for small scale mapping applications, and for projects requiring complete provincial coverage on one mapping plane.

Acronyms

Acronyms	Definition
ATS77	Average Terrestrial System of 1977
CBN	Canadian Base Network
CDGPS	Canada-wide Differential Global Positioning System
CGVD28	Canadian Geodetic Vertical Datum of 1928
CSRS	Canadian Spatial Reference System
GPS	Global Positioning System
GSD	Geodetic Survey Division
HPN	High Precision Network
MTM	Modified Transverse Mercator
NAD27	North American Datum of 1927
NAD83	North American Datum of 1983
NSCCS	Nova Scotia Coordinate Control System
NSCRS	Nova Scotia Coordinate Reference System
NSGC	Nova Scotia Geomatics Centre
NSHPN	Nova Scotia High Precision Network
SNSMR	Service Nova Scotia and Municipal Relations
UTM	Universal Transverse Mercator
VLBI	Very Long Baseline Interferometry
WGS84	World Geodetic System of 1984

APPENDIX D

Reference Material

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