



NAD83 (North American Datum 1983)

Government of Ontario IT Standards (GO-ITS)

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CORPORATE ARCHITECTURE BRANCH
TECHNICAL STANDARDS SECTION**

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Foreword

Government of Ontario Information & Technology Standards are the official publications on the standards, guidelines, technical reports and preferred practices adopted by the Information Technology Standards Council under delegated authority of the Management Board of Cabinet. These publications support the Management Board Secretariat's responsibilities for coordinating standardization of Information and Technology in the Government of Ontario. Publications that set new or revised standards provide policy guidance and administrative information for their implementation. In particular, they describe where the application of a standard is mandatory and specify any qualifications governing its implementation.

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Introduction

Applicability

Government of Ontario IT Standards and Enterprise Product Standards apply (are mandatory) for use by all ministries/clusters and to all former Schedule I and IV provincial government agencies under their present classification (Advisory, Regulatory, Adjudicative, Operational Service, Operational Enterprise, Trust or Crown Foundation) according to the current agency classification system. Additionally, this applies to any other new or existing agencies designated by Management Board of Cabinet as being subject to such publications.

Kindly refer to

http://intra.pmed.mbs.gov.on.ca/mbc/pdf/Agency_Establishment&Accountability-Dir.pdf for a list of provincial government agencies with their classification under the current classification system, as well as their previous Schedule under the former Schedule system.

Requirement Levels

GO-ITS documents may combine **mandatory** and **non-mandatory** information as necessary to effectively describe the requirements of a standard.

It is important to indicate clearly when a requirement is mandatory.

Where indicated throughout this standard, the terms 'must' and 'should' will be interpreted as follows:

Must; is mandatory (new standards are not retroactive, but new standards must be complied with at the next procurement/project opportunity)

Should; is best practice, already vetted, advantage to use, expedites approval process

Purpose of the Standard

This standard describes the North American Datum 1983 (NAD83) as the standard horizontal geodetic datum to be used for all geospatial referencing activities. NAD83 has two realizations (coordinate sets): a regularly used or common realization known as NAD83 (Original) and a GPS high-precision realization known as NAD83-CSRS (Canadian Spatial Reference System). If transformation between the North American Datum 1927 (NAD27) and the North American Datum 1983 (NAD83) is required, the standard of the National Transformation version 2 (NTv2) shall be used. This standard is not specific to a single ministry or agency.

Adopting NAD83 as a provincial GO-ITS standard (both NAD83 (Original) and NAD83-CSRS) will:

- a) provide a standard horizontal geodetic datum for referencing geospatial information,
- b) provide a standard horizontal geodetic datum that is compatible with modern positioning techniques (eg. the Global Positioning System (GPS)),
- c) enhance awareness that geospatial information is referenced to a horizontal geodetic datum,
- d) enhance awareness that geospatial information is not directly compatible unless the data is consistently referenced to one horizontal geodetic datum, and
- e) help ensure the integrity of geospatial information while promoting the sharing and exchange of data across ministries, agencies, and between the public and private sectors.

Recommended Versioning and/or Change Management

The impact on organizational arrangements, staff, customers and service delivery can be summarized as follows. OPS staff, clients and users need to be aware that geospatial information is primarily related to the NAD83 datum or alternatively the NAD27 datum. If transformation between NAD27 and NAD83 is required the NTV2 methodology must be applied to accomplish this task so that the data is resident on the NAD83 datum which is the standard.

To ensure the project is completed in a cooperative way, with the least possible disruption the ITIL change management process which is a standard within the LRC will be applied.

Staff will be informed and involved by providing feedback to their managers who will in turn forward this feedback to the GSWG through the Chair. Staff will continue their daily use of GIS software to transform coordinates.

Staff will be trained by reviewing documentation regarding NAD83 which is available from Provincial Georeferencing, MNR and on the Geographic Information (GI) Portal and federal web-sites. Presentations will be provided to groups as required.

Ongoing change will be managed through the ITIL Change management process that is a standard within the LRC.

Contact Information

	Contact 1	Contact 2
<i>Name</i>	J. Morgan Goadsby	Brian J. Maloney
<i>Organization/ Ministry</i>	MNR	MNR
<i>Division</i>	SIRD	SIRD
<i>Branch</i>	Information Resources Management Branch	Information Resources Management Branch
<i>Section/ Unit</i>	Geographic Information Ontario, Provincial Georeferencing	Geographic Information Ontario
<i>Office Phone</i>	(705) 755-2132	(705) 755-2204
<i>E-mail</i>	morgan.goadsby@mnr.gov.on.ca	brian.j.maloney@mnr.gov.on.ca

Type of Standard

Select the appropriate category for this standard.

Check One	Type of Standard
	Implementation or Process Standards – requirements or specifications, which may include best practices and guidance, for the implementation of a technology or the performance of an activity related to the use of technology, applicable throughout the provincial government. (e.g. mandatory O/S configuration requirements, security procedures, change management procedures, web page design requirements etc.).
√	Information Standard – specifications for a data format (e.g. XML schema, metadata, and/or related data models)
	Technical Standard - networking and communications specifications, protocols, interfaces (API's) (e.g. standards adopted from recognized standards development organizations such as W3C, OASIS or IETF such as TCP/IP, XML, SOAP, etc.)
	Architecture Standard – application patterns, architecture and standards principles governing the design and technology decisions for the development of major enterprise applications
	Product Standard – an enterprise-wide product which is mandatory for use such as a single corporate-wide application, which all ministries and agencies use to record and access their HR information.

Publication

Please indicate if this standard should be restricted to publishing on the Internal (Intranet) IT Standards web site or whether it is intended for publishing on the public (Internet) Government of Ontario IT Standards web site.

Check One	Publish as Internal or External
	Internal Standard
√	External Standard

Acknowledgements

Provide a list of individuals and stakeholder groups that contributed to the development of this standard, including those who helped write the standard and provided subject expertise as well as those groups or individuals contacted for input/comments. (see next table for list of governance bodies and other groups that had input)

Development Team

Name	Cluster/Ministry	Branch
J. Morgan Goadsby	LRC/MNR	Information Resource Management Branch
Anne Trudell	LRC/MNR	Science Information Branch
Dr. Carey Gibson	LRC/MNR	Information Resource Management Branch
Melanie Blamire	LRC/MNR	Information Resource Management Branch
Shawn Kelleher	LRC/MNR	Information Resource Management Branch
Ron Berg	Transportation/MTO	Engineering Standards Branch
Peter Hanmore	LRC/MNR	Information Resource Management Branch
Colleen Melanson	LRC/MNR	Information Resource Management Branch
Dr. Laura Kingston	Transportation/MTO	Engineering Standards Branch
Dennis Gertridge	LRC/MNR	Information Resource Management Branch
(All members of the	LRC/OPS	Geomatics Standards Working Group (GSWG))

Reviewers: in addition to the development team members listed above, please list others contacted for input/comments in the table below:

Check	Area	Date: (month/year)
<input type="checkbox"/>	Technical Standards Unit, Corporate Architecture Branch, OCCTO	May 2005
	Corporate Architecture Branch (CAB Architects), OCCTO	
	Infrastructure Development Branch & iSERV, OCCSD	
	Corporate Security Branch, OCCS	
	Strategy, Policy, Planning and Management Branch (SPPM, OCCS)	
<input type="checkbox"/>	Corporate ACT and Domain Working Groups	July 2004
	– Information Architecture Domain (IADWG)	
	– Technology Architecture Domain (TADWG)	
	– Application Architecture Domain (AADWG)	
	– Security Architecture Working Group (SAWG)	
<input type="checkbox"/>	Cluster ACT/ARB (for cluster standards promoted to corporate standards)	April 2004
	ITSC members (<i>provide name</i>)	
<input type="checkbox"/>	Interministerial Committee on Land Information (ICLI) Working Group	June 2003
<input type="checkbox"/>	Information Resources Management Branch – Branch Leadership Team	May 2003
<input type="checkbox"/>	Interministerial Committee on Land Information (ICLI) Working Group Member Ministeries (8 Ministeries) – Education, Health, North Development and Mines, Agriculture and Food, Environment, Municipal Affairs and Housing, Justice (OPP), Transportation, and Natural Resources	January – Feb, 2004
<input type="checkbox"/>	Ontario Road Network (ORN) Stakeholders List (50 Members)	January – Feb., 2004
<input type="checkbox"/>	Ontario Geospatial Data Exchange (OGDE) Members – Technical Reps. (110 Members)	January – Feb., 2004

Impacts to Standards

List any existing GO-ITS that may be impacted or associated with this standard.

GO-ITS #	Describe Impact	Recommended Action (or page number where details can be found)
GO-ITS 29	ORN already uses NAD83 as the standard geo-referencing system.	None
GO-ITS 45.2 NTV2	The NTV2 Standard prescribes the methodology to transform coordinate/geo-spatial information from NAD27 (the old datum) to NAD83 (the new standard datum/reference system).	None - Complimentary to
GO-ITS 45.3 Ontario Specification for GPS Control Surveys	The Ontario Specification for GPS Control Surveys sets the standards for the use of high-precision GPS to build onto the control survey reference framework in the NAD83 reference system.	None – Complimentary to
GO-ITS 72	Geo-spatial Metadata Standard has field for (geodetic) datum.	None
GO-ITS 24	Omnibus Standard lists GO-ITS used by industry in Ontario. NAD83 is already the de facto standard used by the geomatics industry.	Add GO-ITS 45.1 NAD83 to list of GO-ITS used by Ontario Industry.

Impacts to Existing Environment

List any significant impacts this standard may have on the existing I&IT environment.

Application(s) or Infrastructure Impacted	Describe Impact	Recommended Action (or page number where details can be found)
GIS Systems	NAD83 datum option already built in	None

NAD83 (North American Datum 1983)

Abstract

This standard describes the North American Datum 1983 (NAD83) as the standard horizontal geodetic datum to be used for all geospatial referencing activities. NAD83 has two realizations (coordinate sets): a regularly used or common realization known as NAD83 (Original) and a GPS high-precision realization known as NAD83-CSRS (Canadian Spatial Reference System). If transformation between the North American Datum 1927 (NAD27) and the North American Datum 1983 (NAD83) is required, the standard of the National Transformation version 2 (NTv2) shall be used. This standard is not specific to a single ministry or agency.

Category

This is a mandatory standard.

Only NAD83 is to be used as the horizontal geodetic datum to reference geospatial information. Geospatial information is information that is derived from or related to geospatial activities. For the purposes of this standard, geospatial activities include, but are not limited to: geodetic control surveying, cadastral surveying, engineering surveys, topographic surveys, photogrammetric activities, mapping, charting, and the production of digital mapping information and GIS information. NAD83 has two realizations (coordinate sets) known as NAD83 (Original) which is commonly used and NAD83-CSRS, the high-precision GPS realization. If transformation between the NAD27 datum and the NAD83 datum is required to bring geospatial information in compliance with this standard, the companion standard of the National Transformation version 2 (NTv2) shall be used

Related Documents

NAD'83 Redefinition in Canada and the Impact on Users, 1988, Papers for the CISM Seminars, Edited by John R. Adams, The Canadian Institute of Surveying and Mapping, Ottawa, ON

This is a collection of papers dealing with the issues of different agencies in Canada in working towards implementing NAD83.

Moving to NAD83 the new address for georeferenced data in Canada, 1990, Papers for the CISM Seminars, Edited by D. Craig Barnes, The Canadian Institute of Surveying and Mapping, Ottawa, ON

This is a collection of papers dealing with the issues of different agencies in implementing NAD83 within Canada.

NAD83 Implementation Team Report, Recommended Policies and Procedures regarding the North American Datum of 1983 (NAD83), Ontario Ministry of Natural Resources, 1992

This report summarizes the work of the NAD83 Implementation Team (NIT), and recommends policies and procedures for implementing NAD83 in Ontario through the leadership of the MNR addressing both internal and external user/client requirements.

Position yourself on a solid foundation – CSRS, Pamphlet on NAD83-CSRS (Canadian Spatial Reference System) published by the Geodetic Survey Division of Natural Resources Canada (NRCan) in cooperation with the Canadian Geodetic Reference System Committee members.

This is a bilingual pamphlet briefly describing the high-precision realization of NAD83 known as NAD83-CSRS (Canadian Spatial Reference System).

Elements of the NAD83 Communications Package

- NAD83 and NTV2 Background

A brief discussion of the background and history related to NAD83, who is using this datum, and the development of the National Transformation version 2 (NTv2).

- (Draft) Report on the Conversion of NRVIS to NAD83

Includes the information contained in the above document concerning the history and background on NAD83 and the NTV2. Also includes the detailed testing procedures and processes developed to move the MNR Natural Resources and Values Information System (NRVIS) GIS from NAD27 to NAD83 using the NTV2 as implemented within ARCInfo version 7.

- National Transformation and ESRI Family of Products

One page document describes how the current family of ESRI Products incorporates and uses the National Transformation version 2 (NTv2) for conversion from NAD27 to NAD83.

- *NAD83 Pamphlet*

A general information pamphlet concerning NAD83 and conversion to this datum.

- *NAD83-CSRS Pamphlet*

A general information pamphlet concerning the enhanced and highly accurate form of the NAD83 datum based upon high-accuracy GPS measurements known as NAD83-CSRS (Canadian Spatial Reference System).

Specifications

North American Datum of 1983, NOAA Professional Paper NOS 2, National Geodetic Information Center, NOAA, Rockville, MD, December 1989

This official report from the United States government describes the defining parameters for NAD83.

Mathematical Models for Use in the Readjustment of the North American Geodetic Networks, Dr. Robin R. Steeves, Geodetic Survey of Canada, Technical Report Number 1, Geodetic Survey of Canada, Energy, Mines and Resources Canada, April 1994

This report from the Geodetic Survey of Canada describes the defining parameters and related information regarding NAD83 from a Canadian perspective.

The Geodesists Handbook, Journal of Geodesy, Vol. 70, No. 12, October 1996

This document provides the defining parameters for the GRS80 reference ellipsoid upon which NAD83 is based.

Accuracy Standards for Positioning, Version 1.0

This document provides positioning standards from Geodetic Survey Division of Natural Resources Canada that support the use of the NAD83-CSRS reference system.

Realization and Unification of NAD83 in Canada and the U.S. via the ITRF, M. Craymer, R. Ferland, R. Snay, Geodetic Survey Division, Natural Resources Canada, Revised March 11, 1998.

This document describes how the standardized transformation parameters were derived to relate NAD83-CSRS to the ITRF.

Integration of Local Surveys into the Canadian Spatial Reference System, Michael R. Craymer, Geodetic Survey Division, Natural Resources Canada, Revised May 25, 1998.

This document describes different approaches to integrating local geodetic control surveys with the Canadian Spatial Reference System.

Qualifications

This standard does require organizations to ensure that all their geospatial information holdings are referenced to NAD83. The NTV2 standard must be followed to convert from NAD27 to NAD83. Any organization which is implementing this standard must do so in accordance with the technical information and specifications as provided in Specifications and Related Documents above and in the NAD83 Business Case (Appendix "A").

Implementation

The effective date of this standard is 2005/06/14.

Compliance with this standard will be achieved by referencing geospatial information to NAD83 in either the NAD83 (Original) form for the majority of users needs, and to NAD83-CSRS for high-precision GPS users needs. Any new geospatial information must be referenced to NAD83. When transforming geospatial information from NAD27 to NAD83 the National Transformation version 2 (NTv2) methodology must be used as incorporated in major GIS vendors packages or as a stand-alone software package. The NTV2 stand-alone package is available from Provincial Georeferencing, Geographic Information Ontario, MNR, or the NRVIS web site (or in the future, the GI (Geographic Information) Portal).

Where to obtain copies

Copies of related documents may be obtained from:

Provincial Georeferencing, GIO, MNR
300 Water Street
Peterborough, ON K9J 8M5
Email: morgan.goadsby@mnr.gov.on.ca

Or

Geodetic Survey Division
Natural Resources Canada
615 Booth Street
Ottawa, ON K1A 0E9
Email: information@geod.nrcan.gc.ca
Tel: (613) 995-4410

Errata

Created: April 08, 2005

Updated: Month Day, Year

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- Approved by Corporate Architecture Review Board June 14, 2005

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Appendix A: NAD83 Business Case

**North American Datum 1983
(NAD83)
BUSINESS CASE**

for GO-ITS Publication

Land and Resources Cluster
Geomatics Standards Working Group

March 02, 2004
Version 1.4

**A Business Case
for the
North American Datum 1983 (NAD83)**

Version Number 1.4

Date: 2004/March/02

1.0 Executive Overview

1.1 Project Description

Standard Proponent/Standard Manager/Owner

Name: Morgan Goadsby
Title: Coordinator, Provincial Georeferencing
Office: 2nd Floor, North Tower, 300 Water Street, Peterborough
Phone: (705) 755-2132
E-mail: morgan.goadsby@mnr.gov.on.ca

Standard Sponsor

Name: Brian Maloney
Title: Surveyor General and Manager, GIO
Office: 2nd Floor, North Tower, 300 Water Street, Peterborough
Phone: (705) 755-2204
E-mail: brian.j.maloney@mnr.gov.on.ca

Standard

The North American Datum 1983 (NAD83) is a horizontal geodetic datum which defines a reference system of latitudes and longitudes determining positions for geospatial activities in North and Central America. For purposes of this standard, geospatial activities include, but are not limited to: geodetic control surveying, cadastral surveying, engineering surveys, topographic surveys, photogrammetric activities, mapping, charting, and the production of digital mapping information and GIS information.

Justification Statement

Unacceptably large distortions in the previous North American Datum 1927 (NAD27) coordinates necessitated their readjustment onto a redefined horizontal geodetic datum. NAD83 is a modern geodetic geocentric reference system adopted by Canada, the United States, Greenland and Mexico. As such, it is an international project to redefine the horizontal control survey datum and readjust the coordinates of all control surveying and mapping datums in North and Central America.

Value Proposition

The official adoption of NAD83 will increase the effectiveness, efficiency and quality of:

- a) GPS data capture,
- b) GPS based vehicle navigation and fleet management activities,
- c) 911 emergency response using GPS technology integrated with current and accurate computer-based maps (on NAD83),
- d) recreational based GPS activities (e.g. geo-caching),
- e) hunting and fishing with GPS technology integrated with accurate and current mapping on a compatible datum (NAD83),
- f) precision farming using GPS technology,
- g) search and rescue activities,
- h) forest fire mapping and response using GPS,
- i) surveying and mapping activities, and
- j) mining location surveys.

The adoption of NAD83 as the standard for referencing geospatial data sets will permit internal and external clients to acknowledge, comprehend and understand the reference system (datum) employed by the LRC and OPS.

The NAD83 standard will promote geomatics standards at the provincial level while responding to and cooperating with the Canadian government's decision to adopt NAD83.

Stakeholders – Primary

OPS

Ministry of Transportation (MTO)
Ministry of Environment (ENE)
Ministry of Natural Resources (MNR)
Ministry of Northern Development and Mines (NDM)
Ministry of Municipal Affairs and Housing (MAH)
Ministry of Health and Long-Term Care (MOH)
Ministry of Tourism and Recreation (MTR)
Ministry of Consumer and Business Services (CBS)
Ministry of Education (EDU)

Ministry of Training, Colleges and Universities (TCU)
 Ministry of Attorney General (MAG)
 - Ontario Provincial Police (OPP)
 Ministry of Agriculture and Food (OMAF)
 Conservation Authorities

Federal

Natural Resources Canada (NRCan)
 Transport Canada
 Department of Fisheries and Oceans (DFO)
 NAV Canada
 Department of National Defense (DND)
 Statistics Canada
 Elections Canada
 Environment Canada
 Parks Canada

Stakeholders – Secondary

GIS Software Vendors
 Geomatics Information Association Canada (GIAC)
 Mapping / Surveying / Engineering firms
 Forest Industry - Sustainable Forestry License (SFL) holders
 - Forestry Information Manual (FIM)
 Precision Farming
 Mining Industry
 Utilities - Hydro
 - Gas
 - Phone
 - Cellular
 Municipalities

1.2 Standard Purpose and Objectives

Adopting the North American Datum 1983 (NAD83) as a provincial (GO-ITS) standard will:

- a) provide a common horizontal geodetic datum for referencing geospatial information,
- b) provide a horizontal geodetic datum that is compatible with modern positioning techniques (e.g. the Global Positioning System (GPS)),
- c) enhance awareness that geospatial information is referenced to a horizontal geodetic datum,
- d) enhance awareness that geospatial information is not directly compatible unless the data is consistently referenced to one horizontal geodetic datum, and
- e) help ensure the integrity of geospatial information while promoting the sharing and exchange of data across ministries, agencies, and between the public and private sectors.

1.3 Standard Management Information

1.3.1 Project Management Overview

In April of 1991, the Ministry of Natural Resources announced a phased approach to the adoption of NAD83. In support of this phased approach the NAD83 Implementation Team (NIT) was formed involving representation from MNR, MTO, MCCR and Teranet. The NIT consulted with over 35 different OPS and private sector agencies in Ontario regarding the implementation of NAD83. The overwhelming response was in favour of adopting NAD83. Subsequently NAD83 has become the default standard for georeferencing in Ontario.

Provincial Georeferencing, MNR provides coordinate information on the NAD83 datum. The Ontario Land Information Warehouse (OLIW) provides many forms of geospatial information on the NAD83 datum. Many other major OPS GIS and geospatial information systems are also providing data referenced to the NAD83 datum.

1.3.2 Project Budget/Resources Overview

Since NAD83 is already a de facto standard across the provincial government and has been formally adopted by the Canadian Federal Government, many municipalities, the geomatics and GIS sectors, and many private sector agencies, the costs to formally adopt and implement NAD83 will be minimal. The National Transformation version 2 (NTv2) which supports transformation from NAD27 to NAD83 is available free of charge from Geodetic Survey Division (GSD) of Natural Resources Canada (NRCan) and Provincial Georeferencing, MNR, and is directly incorporated in major GIS packages.

2.0 The Case for the Standard

2.1 Current Situation

NAD83 is the default horizontal geodetic datum for georeferencing in Ontario, Canada and North America. Most of Ontario's geospatial data holdings were created in or already have been converted to NAD83. The few geospatial data holdings that remain in NAD27 can readily and economically convert to NAD83 from NAD27 using the NTv2 methodology (embedded in many GIS applications).

2.2 Rationale for Standard

The North American Datum 1927 (NAD27) contains unacceptably large distortions that are no longer tolerable with today's modern terrestrial and space-based positioning systems. A much more accurate and consistent system is required for the reference framework in order to support the demands of modern digital mapping, engineering, and positioning activities.

The North American Datum 1983 (NAD83), which is based upon the Geodetic Reference System 1980 (GRS80) reference ellipsoid, is a modern definition of a horizontal geodetic datum that is compatible with Global Positioning System (GPS) technology. The geodetic control networks of North America have been recomputed on this modern reference surface resulting in a much more accurate and consistent georeferencing system.

The United States and Canadian federal governments have both officially adopted NAD83. Through by-laws, many municipalities in Ontario now require legal surveys to be tied into their monumented NAD83 control networks.

Officially recognizing NAD83 in Ontario will ensure that government agencies are consistently referencing their geospatial data holdings to one modern datum that is:

- a) GPS compatible;
- b) used by the vast majority of local and federal government agencies; and
- c) used by the majority of the private sector geomatics firms.

The benefits of NAD 83 include:

- a) a nearly distortion-free, homogeneous coordinate system spanning Ontario, Canada and North America;
- b) a geocentric datum identical with that used for satellite positioning systems that will be used for a myriad of positioning and navigation applications;
- c) providing almost direct access to the NAD83 reference frame through ties to Canadian Active Control System (CACS);
- d) a high-accuracy, GPS based realization known as NAD83-CSRS that will support high-accuracy applications; and,
- e) sharing of data and resources between ministries, municipalities, utility companies and conservation authorities.

The goals of NAD 83 Conversion are:

- a) to define a nearly distortion-free set of coordinates for survey markers that are to be used as the basis for mapping and other geographically referenced applications, including GPS and related satellite systems; and,
- b) to upgrade the accuracy of coordinates on established horizontal control points which are the foundation for base and thematic mapping, engineering works and other geographically referenced applications.

2.3 Relationship to Government Policy

The MNR is the lead agency in creating, developing, promoting, and maintaining geomatics standards on behalf of the OPS. The NAD83 standard will be closely linked to the National Transformation version 2 (NTv2) standard which provides a standardized methodology for conversion between NAD27 and NAD83.

By the early 1990s there was widespread demand and support for the adoption of NAD83. In response to this, on April 18, 1991 the Ministry of Natural Resources announced its intention to adopt a phased approach toward complete conversion to NAD83 within the province. MTO has been phasing in NAD83 over the last 10 years, and it is now the datum required for MTO projects. Today, NAD83 is the de facto standard for Ontario. Most major geospatial data holdings in both the public and private sectors already exist in NAD83.

This GO-ITS is for the North American Datum 1983 (NAD83). It seeks to promote uniformity across ministries and to improve communication among ministries and agencies, and from the government to the broader public sector and other external partners while retaining the flexibility for ministries to pursue program specific objectives.

2.4 Value Proposition Analysis

The official adoption of NAD83 will increase the effectiveness, efficiency and quality of:

- a) GPS data capture;
- b) GPS based vehicle navigation and fleet management activities;
- c) 911 emergency response using GPS technology integrated with current and accurate computer-based maps (on NAD83);
- d) recreational based GPS activities (e.g. geo-caching);
- e) hunting and fishing with GPS technology integrated with accurate and current mapping on a compatible datum (NAD83);
- f) precision farming using GPS technology;
- g) search and rescue activities;
- h) forest fire mapping and response using GPS;
- i) surveying and mapping activities; and
- j) mining location surveys.

The adoption of NAD83 as the standard for referencing geospatial data sets will permit internal and external clients to acknowledge, comprehend and understand the reference system (datum) employed by the LRC and OPS.

The NAD83 standard will promote geomatics standards at the provincial level while responding to and cooperating with the Canadian government's decision to adopt NAD83.

2.5 Impact on Stakeholders

NAD83 and NTV2 Stakeholder Consultation

- ICLI Working Group Member Ministries
 - Education, Health, Northern Development and Mines, Agriculture and Food, Environment, Municipal Affairs and Housing, Justice (OPP), Transportation, and Natural Resources

- ICLI Working Group Response
 - of the eight ministries involved in ICLI (besides MNR), all eight have provided responses on behalf of their ministries and they are all in favour of NAD83 and the NTV2 becoming GO-ITS
 - two ministries asked about the time-frame for conversion of legacy systems still on NAD27

- ORN Stakeholder Response from List of 50 Members
 - All 50 members have been contacted
 - about 10% response rate
 - responses have all been very positive
 - NRCan- CTI (Sherbrooke) indicates full support for initiative
 - Niagara Region has already adopted NAD83 and NTV2 and have reviewed all documentation provided and have no concerns with them becoming provincial standards

- OGDE Technical Reps Response from List of 107 Members
 - just over 100 technical reps in OGDE
 - about 15% response rate
 - responses have all been positive
 - Lake Simcoe Region CA has been using both NAD83 and NTV2 for last 4 years; fully agree with their adoption as standards
 - Lower Trent Conservation has been using NAD83 and the NTV2 and approve of these as accepted standards
 - Grand River CA has no concerns with adopting NAD83 and the NTV2 as provincial standards; they are the de facto standards already in use by them

- Summary of Impact of Proposals
 - NAD83 and the NTV2 are already the de facto standards for Ontario
 - the NAD83 datum and the NTV2 for conversion between datums are already built into major GIS vendor packages and are readily available
 - impacts upon the OPS and our clients will be very minimal
 - some agencies dealing with legacy based systems may have to accelerate their plans to move them to NAD83 using the NTV2 methodology

3.0 Information about the Proposed Standard

3.1 The Standard's Scope

3.1.1 The Standard Purpose

The North American Datum 1983 (NAD83) will be the standard horizontal reference datum for all geospatial referencing activities in Ontario. NAD83 supports two realizations or coordinate sets: a commonly used realization known as NAD83 (Original) and a high-accuracy, GPS based realization known as NAD83 Canadian Spatial Reference System (NAD83-CSRS).

The purpose of NAD83 is to upgrade the accuracy of coordinates on established horizontal control points that are the foundation for base and thematic mapping, engineering works and other geospatial applications. Modern electronic angle and distance measurement devices along with Global Positioning System (GPS) have enabled geodetic surveyors to define the coordinates of control stations with much greater accuracy than was possible when NAD27 was first developed. Virtually all control survey projects are now undertaken using GPS technology.

Some of the advantages of NAD83 include:

- a) a more accurate and nearly homogeneous coordinate system throughout Canada and Ontario;
- b) a horizontal geodetic datum compatible with that used for the satellite positioning systems such as the Global Positioning System (GPS) which is utilized extensively for surveying, positioning and navigation in both Ontario and worldwide;
- c) providing almost direct access to the NAD83 reference frame through ties to the Canadian Active Control System (CACS); and
- d) allowing ministries, municipalities, utility companies and conservation authorities to share data and resources.

3.1.2 Planned Outcomes

Only this standard (NAD83) shall be used when relating geospatial information to a horizontal reference system (datum). It is the purpose of this standard to require geospatial information to be related to one geodetic datum, that is NAD83. Transformation from NAD27 to NAD83 can be achieved by employing the NTv2 methodology.

End users will be required to reference all geospatial information to the NAD83 reference system by relating their work to control survey markers or other known points available on the NAD83 datum.

3.1.3 Standard Description

North American Datum 1983 (NAD83) is a modern definition of a horizontal geodetic datum providing a global best fit. As such it is a geocentric system and is compatible with modern positioning methods, specifically GPS. NAD83 represents a significant step forward for georeferencing and the geodetic control reference systems of this continent. It includes both the redefinition of the reference ellipsoid and the readjustment of the control survey networks on this reference surface. The reference ellipsoid adopted for NAD83 is the same as the one defined for the Geodetic Reference System 1980 (GRS80), which has a semimajor axis of **a = 6378137 metres** and a derived semiminor axis of **b = 6356752.3141 metres**.

NAD83 is also much more consistent than NAD27, its predecessor, due to the fact that all available geodetic control observations from across the continent were adjusted using Helmert Blocking techniques, which are essentially mathematically equivalent to adjusting all of the control survey networks simultaneously. This results in a much more consistent set of coordinates describing the positions of the geodetic control monuments. The analysis and recomputation of the survey networks spanned more than twenty years beginning in the early seventies and included the networks within Canada, the United States, Greenland, Mexico and some Caribbean nations.

NAD83 has been the de facto standard for Ontario for many years. Coordinates for almost all horizontal control stations in COSINE (COntrol Survey INformation Exchange) database in Ontario are available from Provincial Georeferencing, MNR and are available for download from the COSINE On-Line web-site. Coordinates are also available from Geodetic Survey Division of NRCan and from their web-site. NAD83 is a recognized datum in major GIS vendor packages.

Because of its consistency and compatibility with modern positioning techniques, it is anticipated that refinements to NAD83 will be much less extensive than the changes between NAD27 and NAD83. The difference between NAD27 and NAD83 is seen as changes in the coordinates describing the locations of the control survey monuments. In Ontario geographic coordinates (latitudes and longitudes) can change by as much as 15 metres. For UTM mapping plane coordinates changes of about +200 metres in Northing and +/- 30 metres in Easting can occur.

NAD83-CSRS is the improved realization of NAD83 for Canada. NAD83 has been the adopted datum for spatial positioning in North America, but the wide use of high precision GPS surveys since then has required a more rigorous definition of NAD83 in terms of network scale, ellipsoidal heights and crustal motion. NAD83 is a geocentric system, but due to the use of more accurate positioning techniques now available, it is known that the placement of the GRS80 reference ellipsoid for NAD83 (Original) is offset by about 1 metre from the best realization of the geocentre that we know today. NAD83-CSRS is a GPS based realization of the International Terrestrial Reference Frame (ITRF) based upon the GRS80 reference ellipsoid. Since ITRF is the most accurate and well-defined geocentric reference frame, Canada and the U.S. have

collaborated to determine a common transformation between NAD83-CSRS and ITRF. This transformation is done using continuously operating GPS stations, which are known as the Canadian Active Control System (CACS).

NAD83-CSRS can be described as an integrated geocentric reference system, which is continuously improved and maintained in collaboration with federal, provincial and local governments, industry and user communities. Observations carried out at 5 sites in Canada contribute to the ITRF system. The CACS is the 2nd most important layer of the Canadian Spatial Reference System (CSRS). It assures the national reference system's stability, accuracy and compatibility with international standards. It also provides the means for end users of GPS to directly integrate their spatially referenced data to the highest accuracy form of NAD83, known as NAD83-CSRS.

Because NAD83-CSRS is a GPS based high-accuracy realization of NAD83, only a sparsely spaced GPS network of about three to five thousand stations will eventually be available in Ontario. There are over 100,000 stations in NAD83 (Original) presently available from the provincial geodetic database COSINE (**C**ontrol **S**urvey **I**nformation **E**xchange). Thus, if a control station is common to both realizations of NAD83, two different sets of coordinates will be available for that station on the NAD83 datum. For any one project, only one realization of the NAD83 datum should be used and clearly identified.

3.2 Implementation Plan

3.2.1 Project Management Arrangements

Responsibility Chain: Dennis Gertridge/Ron Berg/Morgan Goadsby → GSWG → LRC ACT → LRC ARB → OPS ACT → ITSC → OPS ARB

Costs of Standard: Costs to support development in Ontario as a GO-ITS will be funded by Provincial Georeferencing, Geographic Information Ontario (GIO) and the Land Information Ontario (LIO) initiative.

Costs of using the standard should be negligible. Costs associated with transformation of data, from NAD27 to NAD83, will be minimized by using the proposed NTV2 standard methodology. The NTV2 is available free of charge from Provincial Georeferencing, MNR and the Geodetic Survey Division of Natural Resources Canada. The NTV2 is built into many major GIS vendor packages.

Standard Proponent/Standard Manager/Owner

Name: Morgan Goadsby
Title: Coordinator, Provincial Georeferencing
Office: 2nd Floor, North Tower, 300 Water Street, Peterborough
Phone: (705) 755-2132
E-mail: morgan.goadsby@mnr.gov.on.ca

Standard Sponsor

Name: Brian Maloney
Title: Surveyor General and Manager, GIO
Office: 2nd Floor, North Tower, 300 Water Street, Peterborough
Phone: (705) 755-2204
E-mail: brian.j.maloney@mnr.gov.on.ca

3.2.2 Proposed Budget

The NAD83 datum is already defined and realized for North America. As a datum option it is recognized in all GIS packages. Therefore the costs to implement NAD83 are negligible.

3.2.3 Proposed Timeframe and Milestones

- April 09, 2003: presentation of business case and standard to GSWG
- May 15, 2003: finalize business case and standard with GSWG
- May 26, 2003: presentation to BLT
- February 20, 2004: conclude stakeholder consultation
- April 07, 2004: presentation to LRC ACT

3.2.4 Internal Change Management and Training

The impact on organizational arrangements, staff, customers and service delivery can be summarized as follows. OPS staff, clients and users need to be aware that geospatial information is primarily related to the NAD83 datum or alternatively the NAD27 datum. If transformation between NAD27 and NAD83 is required the NTV2 methodology must be applied to accomplish this task so that the data is resident on the NAD83 datum which is the standard.

To ensure the project is completed in a cooperative way, with the least possible disruption the ITIL change management process which is a standard within the LRC will be applied.

Staff will be informed and involved by providing feedback to their managers who will in turn forward this feedback to the GSWG through the Chair. Staff will continue their daily use of GIS software to transform coordinates.

Staff will be trained by reviewing documentation regarding NAD83 which is available from Provincial Georeferencing, MNR and on the Geographic Information (GI) Portal and federal web-sites. Presentations will be provided to groups as required.

Ongoing change will be managed through the ITIL Change management process that is a standard within the LRC.

3.2.5 Communications

The strategy for identifying and consulting with internal and external stakeholders, informing them of progress and changes, and managing the external impact of the project can be summarized as follows:

- a) contact with Interministerial Committee on Land-related Information (ICLI) Working Group Members and member ministries,
- b) contact with the Ontario Road Network (ORN) Stakeholders List, and
- c) communicate with other MNR or MTO contacts as appropriate.

3.2.6 Maintenance

The NAD83 standard will be maintained through the standards maintenance process that is being developed by ITSC.

The NAD83 standard will be enforced through the standards enforcement process that is being developed by ITSC. OPS or LRC partners will be required to comply with OPS or LRC standards as part of data-sharing or other contractual agreements.

Client advice and support will be provided through the LIO website at <http://www.lio.gov.on.ca>, through the GI Portal, the GI/GIS community of practice, and the ORN contact list.

3.2.7 Risk Assessment

The risks associated with adoption of NAD83 are:

- a) incompatible data-sets,
- b) errors in integrating in-compatible datasets,
- c) transformation of curves within CAD datasets,
- d) enhancement of the NTv2 to address the high accuracy version of NAD83 known as NAD83 Canadian Spatial Reference System or NAD83-CSRS is not yet complete in Ontario, and
- e) software vendors including the NTv2 methodology or updates to the NTv2 methodology (to address NAD83-CSRS, for example) within their packages may not be examined as rigorously by NRCan as in the past.

3.2.8 Risk Management

The risks of adopting NAD83 can be mitigated by:

- a) ensuring through communications that users are aware that NAD83 is the only official horizontal geodetic datum for Ontario,
- b) ensuring through communications that users are aware that NAD83 can be realized as NAD83 (Original) or NAD83-CSRS (two different coordinate sets),
- c) ensuring through communications that users are aware of NAD27 and NAD83 datums and that the NTV2 is the OPS standard for transformation between those datums,
- d) identifying to CAD users that there are issues with curves and providing appropriate cautions,
- e) ensuring human and fiscal resources are sufficient to complete project with NRCan to enhance the NTV2 to address NAD83-CSRS, and
- f) maintaining contact with NRCan and formally notifying them of the plan to adopt NTV2 within Ontario and the appropriate levels of support required.