



**GeoNOVA**

## **Final Report**

**Nova Scotia Coordinate Referencing System (NSCRS)**

**Future Policy Strategy**

**November 17, 2011**

**Submitted to: Service Nova Scotia and Municipal Relations  
Geographic Information Services**

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## Executive Summary

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Interpretation Resources Consulting Inc. (IR) is pleased to submit this Report to Service Nova Scotia and Municipal Relations (SNSMR) for the Nova Scotia Coordinate Referencing System (NSCRS) Future Policy Strategy.

The overall objective of this project was to provide SNSMR with information about the present state of Coordinate Referencing in the Province and what direction the Department needs to focus on over the next 3 to 5 years. This Strategy Review is timely also in order to help the expected new Coordinate Control Officer more easily transition into their new responsibilities and duties.

One of the requirements for this project was to identify appropriate contacts both within Nova Scotia as well as some outside jurisdictions to determine present coordinate referencing conditions and future requirements and programs that are planned. This proved to be a major challenge and took more time than originally planned. In the final analysis however many more appropriate contacts were identified who supplied pertinent and valuable information for the Strategy Review.

In order to be as effective as possible in obtaining information from the various contacts it was necessary to have a standard set of questions from which to draw from. These questions were used as a guide as not all of the questions would apply to every contact. A questionnaire was developed and is attached as Appendix B.

Another necessary step in the Coordinate Referencing Strategy was to review various documents which dealt with coordinate referencing issues. These documents included the 1995 Coordinate Referencing Policy; the 2003 Jacques Whitford Study; the 2006 Draft Spatial Referencing Policy v 2.0.6; Canadian Height Modernization Study, 2006; Nova Scotia Geomatics Industry Assessment, ACOA 2008; Potential for an Active Control Network in New Brunswick, 2003; and the Canadian Geodetic Referencing System Committee (CGRSC) minutes for 2010 and 2011. The CGRSC minutes for 2011 are attached as Appendix A.

On September 15, IR was able to sit in on a CGRSC conference call which provided very useful information. The discussion for this meeting centered on NAD83 (CSRS) and various versioning issues, Height Modernization, Precise Point Positioning on line service, and RTK Service providers and levels of validation for them.

With all of the information collected and analyzed, 15 recommendations were made. These recommendations will provide Management with the necessary information to develop a Strategic Coordinate Referencing Road Map and Implementation Plan, with which to move forward, over the next few years.

## **1.0 Introduction**

The Nova Scotia Coordinate Referencing System (NSCRS) database is the primary source for all land related measurements and the location of geographic information in the province, providing the framework for all provincial topographic, property, and thematic mapping programs in Nova Scotia. The reference frame is a set of physical points along with their precisely determined coordinates in a specific reference coordinate system. In Nova Scotia, there are two sets of reference frames, the High Precession Network containing 155 points based on NAD83 (CSRS) datum and a 2<sup>nd</sup> Order Network containing approximately 23,000 points based on the ATS77 datum.

The user community of these control reference systems in Nova Scotia is very diverse. They come from a variety of sectors including industry, government and the general public with different applications and accuracy requirements. Since the inception of the Spatial Referencing Program in 1994, the physical reference markers on the ground for the 2<sup>nd</sup> Order Network have been minimally maintained. It was not known what state they were in or if in fact they are meeting the needs of the present or future user community.

The NSCRS is administered by Service Nova Scotia and Municipal Relations (SNSMR) through the Information Management Services Division. The Department agreed to produce NAD83 (CSRS) values on the 2<sup>nd</sup> Order Network of points for the spatial referencing user community and SNSMR has been working towards that endeavor over the last three years. However the Coordinate Control Officer in charge of the network and doing the adjustment has since retired. A replacement process is in progress and it is expected to be filled before March 31, 2012. The work surrounding the adjustment, which is in the latter stages of completion, is highly specialized, therefore it would be best to have the former Coordinate Control Officer complete this work, or to train a Geodesy Engineer to complete it, so that SNSMR can publish the NAD83 (CSRS) coordinates on the old network of points. These options are currently being considered.

The Department has completed a Geographic Products and Data Distribution Strategy. Components of this strategy are related to coordinate referencing and these were made available which influenced the direction of the NSCRS Strategy somewhat. In addition, the NSCRS Strategy will be used to inform the larger Nova Scotia Geomatics Strategy which is currently being planned for 2011-12 and 2012-13.

Taking all of the above factors into consideration, it is an appropriate time to re-evaluate the needs of the user community and the administrative authority's current and future program requirements.

## **2.0 Project Life-Cycle**

To begin the project a Statement of Work (SOW) was created by the Client. This SOW listed the major milestones / steps to be completed during the life-cycle of the project. The major steps are listed below in Table 1, along with their completion Status.

**Table 1- Project Milestones / Steps**

<b>Project Milestones</b>	<b>Task Descriptions</b>	<b>Status</b>
Step 1	Project Initiation Meeting, August 9, 2011	Complete
Step 2	Determine in conjunction with co-sponsors the various contacts both within Nova Scotia as well as other jurisdictions	Complete
Step 3	Review various provincial documents including the 1995 Coordinate Referencing Policy, 2003 Jacques Whitford Study, 2006 Draft Spatial Referencing Policy, Canadian Height Modernization Study, Geographic Data and Product Distribution Strategy etc.	Complete
Step 4	On-site visits, telephone and e-mail contact to solicit information needs from ANSLs, DNR, TIR, SNSMR, Environment, Elections, HRM, Genivar , etc. as per list section 7.0	Complete
Step 5	Contact via telephone and e-mail to solicit policy and program information from other jurisdictions including Federal Government, Provinces of NB, Manitoba, and NL.	Complete
Step 6	Review on-site hard copy information stored at the Amherst Operations Office and give recommendations for its life cycle (storage requirements).	Complete
Step 7	Develop Draft Final Report for Direction Strategies and Recommendations to move forward with over the next 3 to 5 years.	Complete
Step 8	Discuss Draft Report with the Project Co-Sponsors and make changes where necessary.	Complete
Step 9	Develop Final Report and provide to Client.	Complete
Step 10	Develop and present Power Point Presentation to Project Co-Sponsors.	

### **3.0 1995 Coordinate Referencing Policy for the Province of Nova Scotia**

Previous to 1994 the Coordinate Referencing responsibility resided within the LRIS program under the Council of Maritime Premiers (CMP). As a result of a decision taken by the CMP the LRIS program ceased to exist after March 31, 1994. It was then on April 1, 1994 that the Nova Scotia Coordinate Control System (NSCCS) became the responsibility of the Province of Nova Scotia.

With this event in addition to other changes taking place in coordinate referencing including the emergence of GPS technology it was determined an overall review should take place. This review was carried by a Control Surveys Task Group (13 in total) under the Land Information Systems Advisory Committee.

Their work was completed and a Policy Document was produced dated November 23, 1995. The purpose of the Policy Document was to establish the Nova Scotia Referencing System (NSCRS) as the reference for all land survey measurement and as the foundation for all positional geographic information uses.

This document was communicated broadly to the user community, and adopted internally to government as a policy.

#### **The following Policy Recommendations were made:**

1. To adopt the Nova Scotia High Precision Network (NSHPN) as the new Coordinate Referencing Network for use by geographic information users in the Province.
2. To maintain the existing network as a reference network during the transition to the NSHPN.
3. To adopt a horizontal datum for the NSCRS.
4. To adopt a vertical datum for the NSCRS.
5. To adopt a projection system for the Province.
6. To establish standards and specifications for the NSCRS.
7. To employ appropriate technology to maintain the integrity of the NSCRS.
8. To facilitate and encourage the use of the NSCRS.
9. To adopt legislation governing use of the NSCRS.

### **4.0 2003 Study on the Official Adoption of the Nova Scotia Coordinate Referencing System.**

Service Nova Scotia and Municipal Relations contracted to Jacques Whitford Environment Limited for research, user feedback and a forward action plan for the **official adoption** of the NSCRS. For this reason, as stated previously, it appears the 1995 Coordinate Referencing Policy Document may not have been fully recognized as an officially sanctioned Document and as

many changes in technology had taken place since the 1995 review it was thought a new review was warranted.

Jacques Whitford carried out a comprehensive study. For example information was received from 82 questionnaires in addition to in-person interviews with 35 individuals. Also a workshop was held at Acadia University which was attended by 38 people.

The following are 14 recommendations that were made:

1. SNSMR should implement a formal process for adopting the NSCRS.
2. Minimize the amount of formal bureaucratic regulatory paperwork required to both implement and update the NSCRS.
3. SNSMR adopt a formal, detailed process to engage stakeholders involved in the use, maintenance and updating of the NSCRS.
4. SNSMR share the results of the review of NS laws and regulations conducted under this project with the other government departments affected.
5. SNSMR include in the recommended information seminars, information about the potential impacts of the changes in the datum / map projection.
6. SNSMR include NAD83 (CSRS) as the geodetic reference standard in its adoption of the Nova Scotia Coordinate Referencing System. NAD83 should be implemented with the appropriate CBN-version.
7. SNSMR adopt a formal, detailed process for monitoring changes that might impact any adopted Nova Scotia Coordinate Referencing System and setup criteria to define what changes are significant and how any changes should be appropriately addressed.
8. SNSMR should provide assistance to positioning practitioners to ease the conversion burden. This assistance should include training workshops, software tools and advisory services and should involve hardcopy, softcopy and web enabled distribution.
9. SNSMR should provide assistance to the primary geospatial database owners to ease the conversion burden. This assistance should include training workshops, software tools and advisory services.
10. SNSMR should provide NAD83 (CSRS) coordinates for the Nova Scotia Coordinate Control System (NSCCS) network of control points, on a 'one-time' basis.
11. SNSMR should provide NAD83 (CSRS) coordinates for the NSCCS network to a level of accuracy consistent with the existing ATS77 coordinates for these points. These coordinate values must be available to the public before there is any formal requirement to use the new NSCRS.
12. SNSMR adopt the Universal Transverse Map Projection (UTM), based on NAD83 (CSRS), as the standard map projection to be used in the Province of Nova Scotia for all 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.)
13. SNSMR adopt the 3 degree Modified Transverse Map Projection (MTM), based on NAD83 (CSRS), as the standard map projection to be used in the Province of Nova

Scotia for all 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; 1:500; etc.)

14. It is recommended that SNSMR develop the capability to provide digital datasets to the public in either UTM or MTM, based on NAD83 (CSRS).

**The following are additional issues the Consultant thought should be considered:**

- a. One alternative to delivering the NSCRS is to implement an RTK network of Active Control stations around the Province.
- b. SNSMR may consider adopting, as the native coordinate type for all of its databases, 3D Cartesian coordinates (X, Y, Z) or geodetic curvilinear coordinates latitude, longitude and geodetic height (above ref. ellipsoid). Map projection coordinates can be derived from either of these.
- c. SNSMR has already produced a set of transformation parameters in the form of a grid shift file, based on the 153 points of the NSHPN. After the adjustment which integrates the NSCCS network and produces a set of NAD83(CSRS) coordinates for those points, SNSMR will need to consider if another grid shift file is to be produced based on those coordinates.
- d. The recommendations for the NSCRS should have little or no effect on the electronic submission of survey plans concept.
- e. It is important that SNSMR monitor and take advantage of ongoing research and development conducted by Geodetic Survey Division of NRCan in regards to the vertical reference system.

## **5.0 2006 Spatial Referencing Policy for the Province of Nova Scotia**

The 2003 Jacques Whitford report had been completed for some time and it was recognized a new Coordinate Referencing Policy Document was required. In 2005 a committee of three was struck to provide a new Coordinate Referencing Policy Document based on the 2003 Study results as well as the 1995 Policy Document. The committee was comprised of Ed Light, Manager of GeoNOVA, Allen Flemming, Coordinate Control Officer, and Bert Seely, Manager of the Nova Scotia Geomatics Centre.

The committee completed what was considered its final copy in January of 2006. The document was later presented to the GeoNOVA Steering Committee by the GeoNOVA Secretariat. The GeoNOVA Steering Committee generally agreed with the document however, they did not approve the document as they considered it outside of their mandate to do so. This policy remained as a published GeoNOVA standard, but because of a lack of a provincial geomatics policy and standards authority, to endorse formal policies such as this, it has not existed as an enforceable standard.

The following 16 recommendations are contained in the policy document:



## ***Operational Policies:***

### **Policy 1.0 Administration**

The NSCRS will continue to be administered by Service Nova Scotia and Municipal Relations, specifically the Geographic Information Services Section, of Information Management Services.

### **Policy 2.0 Operational Approach**

SNSMR, through the Geographic Information Services 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.

## ***Technical Policies***

### **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
- un-resolved 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. SNSMR 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.

### **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)

### **6.0 Where do we stand today in regards to the three previous major initiatives?**

The 2006 Policy document was developed taking into consideration the 1995 Policy document as well as the 2003 Jacques Whitford Study. In addition the 2006 Policy document also took into consideration advancements in technology as well as keeping abreast the direction the Federal Government and Provinces were taking in regards to Coordinate Referencing. It was therefore determined to rely on the 2006 Policy document as the most current to report on. The 16 Policy recommendations from Section 5 are categorized below.

#### **6.1 Recommendations/Initiatives from 2006 considered completed and/or ongoing:**

1. The NSCRS will continue to be administered by SNSMR. It is in the process of filling the existing vacant Coordinate Control Officer position.
2. The Nova Scotia High Precision Network (NSHPN) is the set of points at the provincial level defining the NAD83 (CSRS) reference frame for the NSCRS. SNSMR is responsible for this network of points and continues to monitor and maintain them.
3. SNSMR has developed a web enabled coordinate transformation service so as to ease the conversion burden experienced when transforming data from one projection and reference frame to another.
4. The Province has been operating within the context of the Canadian Spatial Reference System (CSRS), and has adopted and will continue to adopt national standards and specifications for the NSCRS.
5. The Province has been monitoring changes to the reference frame that could impact the NSCRS.
6. The Canadian Geodetic Vertical Datum of 1928 (CGVD28) continues to be the vertical reference system standard for the Province.
7. The Province has developed and made available a grid shift file for transformations between ATS77 and NAD83 (CSRS).

#### **6.2 Recommendations/Initiatives from 2006 partially completed:**

1. The Province has implemented NAD83 (CSRS) as the spatial reference frame standard within the NSCRS; however, this may not have been formally adopted and as such communicated to the user community.
2. The Province has been working towards providing NAD83 (CSRS) horizontal coordinates for the Nova Scotia Coordinate Control System (NSCCS) approximately 24,000 points. There is still approximately 60 days of work left to complete this task.

3. The Province has for all intensive purposes adopted the UTM projection and NAD83 (CSRS) as the standard map projection and reference frame for all Primary Database Mapping at scales of 1:10,000 and smaller. Left to be done however is for SNSMR to officially communicate this to the user community.
4. The Province has for all intensive purposes adopted the 3 degree MTM projection and NAD83 (CSRS) as the standard map projection and reference frame for all Primary Database Mapping at scales larger than 1:10,000. Left to be done however is for SNSMR to officially communicate this to the user community.
5. The Province has published metadata for the Nova Scotia Coordinate Referencing System monuments in the Data Locator application. This has not yet been made available within the GeoNOVA Geographic Catalogue.

### **6.3 Recommendations/Initiatives from 2006 yet to be initiated:**

1. The Province has yet to develop and deliver an Operational Strategy related to the NSCRS. The subject matter within the strategy should include but not be limited to communications, training, specifications and services; this will be a priority for the NSCR Officer in 2012-13.
2. The Province needs to establish a consultation process to engage stakeholders involved in the use of spatial referencing.
3. The Province needs to develop a communications plan for two way dialogue between the Province (SNSMR) and the user community. This will include informing the user community of changes that could affect the NSCRS including versioning.
4. The Province has not communicated the existence of the web enabled coordinate transformation service as well as it could to the user community. In addition, other methods of dissemination have not been provided nor has any training workshops been organized as was recommended.
5. It needs to be determined if a new grid shift file should be developed based on a more dense network of points once the re-adjustment of the NSCCS occurs with new NAD83(CSRS) values.
6. SNSMR needs to communicate to thematic data custodians when to apply the small and large scale map projection requirements when they are carrying out their mapping projects. Ex. UTM map projection to be used for scales 1:10,000 and smaller, and 3 degree MTM map projection to be used for scales larger than 1:10,000.

## **7.0 Present Study Contact List**

The final list of contacts to retrieve information from, in order to understand their business practices concerning coordinate referencing, was much larger than the original intended list. The following chart lists the organizations and contacts that were approached.

### NSCRS Policy / Strategy Review Contact List

Organization	Name	Telephone	E-Mail
ANSLS	Fred Hutchison	902-434-4659	<a href="mailto:fch@accesswave.ca">fch@accesswave.ca</a>
DNR	Bruce MacQuarrie	902-424-3145	<a href="mailto:macquaba@gov.ns.ca">macquaba@gov.ns.ca</a>
DNR	Bob Bowlby	902-424-3156	<a href="mailto:rhbowlby@gov.ns.ca">rhbowlby@gov.ns.ca</a>
DNR	Francis MacKinnon	902-679-6145	<a href="mailto:mackinfm@gov.ns.ca">mackinfm@gov.ns.ca</a>
TIR	Barb Baillie	902-563-2256	<a href="mailto:bailliba@gov.ns.ca">bailliba@gov.ns.ca</a>
SNSMR	Chris Mason /Kevin Blades	Nancy to contact	
Environment	Chuck Sangster	902-424-5348	<a href="mailto:sangstcw@gov.ns.ca">sangstcw@gov.ns.ca</a>
Elections NS	Pierre Gareau	902-424-8584	<a href="mailto:gareaupl@gov.ns.ca">gareaupl@gov.ns.ca</a>
AGRG	Tim Webster	902-825-5475	<a href="mailto:timothy.webster@nscc.ca">timothy.webster@nscc.ca</a>
HRM	Rob Wentzell	902-490-1793	<a href="mailto:wentzer@halifax.ca">wentzer@halifax.ca</a>
CBRM (no response)	John MacKinnon	902-563-0839	<a href="mailto:jfmackinnon@cbrm.ns.ca">jfmackinnon@cbrm.ns.ca</a>
Amherst (no response)	Ron Curtis	694-3959	<a href="mailto:rcurtis@town.amherst.ns.ca">rcurtis@town.amherst.ns.ca</a>
Mun. District of Chester	Geoff MacDonald	902-275-2599	<a href="mailto:geoff.macdonald@district.chester.ns.ca">geoff.macdonald@district.chester.ns.ca</a>
Genivar	Kevin Brown	902-835-9955	<a href="mailto:Kevin.brown@genivar.com">Kevin.brown@genivar.com</a>
Coordinate Control Officer (retired)	Allen Flemming	506-536-3357	
Gov. of Ontario	Brian Maloney	705-755-2204	<a href="mailto:Brian.j.maloney@ontario.ca">Brian.j.maloney@ontario.ca</a>
Service NB	Leo-Guy-LeBlanc	506-444-3023	<a href="mailto:Leo-guy.leblanc@snb.ca">Leo-guy.leblanc@snb.ca</a>
Dep. Gov. Services	Bob Budgell	709-729-3253	<a href="mailto:bbudgell@gov.nl.ca">bbudgell@gov.nl.ca</a>

and Lands, NL			
Manitoba Conservation	David Richards	204-945-8658	<a href="mailto:David.richards@gov.mb.ca">David.richards@gov.mb.ca</a>
NRCan (GSD)	Pierre Sauvé CGRSC 2011	613- 995-8313	<a href="mailto:plsauve@nrcan.gc.ca">plsauve@nrcan.gc.ca</a>

## 8.0 Results from Study Contacts within Nova Scotia Identified Above

The following information was obtained from the contacts identified above and is listed below in no order of priority. It is felt the final list of contacts represents a good cross section of the Coordinate Referencing profession and as such their responses and input will provide valuable information with which to consider in moving forward with what should then be an industry supported Coordinate Referencing Program.

1. The largest group by far represented through feedback was the Association of Nova Scotia Land Surveyors (ANSLS). It is also important to note that many others that were interviewed were also members of the ANSLS.

The vast majority of Surveyors in the Province, including DNR, HRM, and Private Survey Companies, are still using the NSCCS monuments and ATS 77 datum and 3 degree MTM projection. In other words very few and only occasionally are using NAD83 (CSRS) datum and 6 degree UTM projection.

The Land Registry Offices see all their plans in ATS 77 datum and 3 degree MTM projection from which they convert to NAD83 (CSRS) datum and 6 degree UTM projection.

Those consulted that seem to be using NAD83 (CSRS) and 6 degree UTM projection for the most part are Department of Environment, TIR, Applied Geomatics Research Group (AGRG), Elections Nova Scotia, Chester Municipality, and DNR Wildlife Section in Kentville. It is important to note however the majority of these groups were responding from a GIS perspective and not a Coordinate Referencing framework.

2. For those that are not using NAD83 (CSRS) as their standard, there were a number of reasons for this. The reasons included: surveyors used to working in ATS77, NSHPN stations too far apart, no NAD83 (CSRS) values on the NSCCS monuments, didn't realize HPN network existed, NSCCS more convenient, NSHPN not well communicated, and present framework of information is in ATS77.
3. For those that are not using the NAD83 (CSRS) as a standard, the possibility of moving to it was mixed. The majority of those respondents said they had no plans to adopt

NAD83 (CSRS) as their standard. One of the main reasons for this is that the NSCCS has not had NAD83 (CSRS) values applied to it.

4. It was clear that most, if not all, surveyors are working in the 3 degree MTM projection and have no plans to change. With today's technology that does not seem to be a problem.
5. Generally vertical accuracies of the coordinate referencing system are not a problem. One reason is that the vertical accuracies many require are quite lenient and another reason is that vertical is not required.
6. The surveyors do have to be careful with their horizontal accuracy as many indicated that the error discrepancies between monuments can be a problem. If they start their survey from one monument they should close back on that same monument to avoid varying monumentation errors.
7. Those that require coordinate referencing information have or acquire it in many ways. They include microfiche, property on line, CD, on-line, call the NSGC, Lotus files, and paper listings.
8. Most all of the contacts import data from various sources and export their data to others. This did not seem to pose any major issues with them. This is due in large part to the technologies they are working with.
9. Almost all of the contacts indicated the internet based Coordinate Transformation Service was important to them and they relied on it for their day to day operations.
10. In asking what other provincially sponsored supports would assist them there were only a few that came to light. By far the most important to them was the requirement to complete the adjustment on the old network in order to apply NAD83 (CSRS) coordinates to those 24000 stations; better communications with stakeholders was important; one respondent would like the ability to transform AutoCad drawings from one system to another; one respondent would like to see Lidar for coastal areas.
11. Many of the contacts said they used one service or another for their Real-Time positioning information. The services mentioned were:
  - Can-Net by Cansel
  - SmartNet by Leica Geosystems
  - Canadian Active Control System (CACS) by NRCan Geodetic Survey Div.
12. The Federal government and the Provinces are moving ahead with Height Modernization. When asked how this might affect them, most said it would not affect them or they would deal with it when need be. They understood it would have more of an impact in coastal areas or general hydrographic work. Some were not aware of the program. Generally they would like to be kept informed of developments in moving to a new height realization.



13. Most of the contacts said they were being adequately served by the Nova Scotia Coordinate Referencing System with the exception of a delay in getting NAD83 (CSRS) values on the 24000 monuments. One said they would like to see some of the missing or destroyed monuments replaced.
14. In terms of their future business requirements the following are things they would like to see happen with the NSCRS:
- The old network is important and requires the adjustment to be completed
  - More base stations established for the High Precision Network (NSHPN). The 155 stations there now are spaced too far apart.
  - Continue maintenance on the NSHPN sites to ensure they are still there and are not obstructed with tree growth
  - Consider establishing some Nova Scotia Active Control Stations (NSACS)
  - Communication with the user community was important. One suggested a quarterly newsletter or monthly bulletin with information on new developments
  - One respondent would like an “official” set of Administrative Boundaries and Coastline for the Province.

## **9.0 Results from Study Contacts of other Jurisdictions Identified Above**

### **Service New Brunswick:**

New Brunswick has what they consider to be a working coordinate referencing approach. They have the conventional network of monuments similar to Nova Scotia as well as the HPN network of control monuments similar to the 155 stations in Nova Scotia. In addition NB has 8 Active Control Stations (ACS) across the Province. Six of these sites were established by the Province and are operated and maintained by private industry. Two sites are Federal. The Province has an agreement with contractors to operate and maintain the 6 sites for an annual fee totalling \$32000. This contract was just renewed for another 5 years. The contractors in addition get to sell the real-time information streaming from the satellites. The static data which is continually being stored for post processing applications is supplied free of charge by SNB.

NB did a fixed adjustment of their old network and as a result threw out the points that did not meet their accuracy standards. Some points were as much as 19 metres off. In Nova Scotia the adjustment was based on a floating model which accepted all points. The error statistics would provide the users with an accuracy with which they could then decide if it was acceptable or not.

In terms of Height Modernization, NB understands there will be a need for training workshops at some point in time to introduce the new system. Leo-Guy said he believes the East Coast will be affected by as much as 30 to 45 cm. He says that flood plains, as-builds and in New Brunswick’s case dams will be an issue.



Leo-Guy LeBlanc is retiring in June 2012 and is not sure about a replacement at this time. New Brunswick's Coordinate Referencing System is legislated under the Surveys Act.

**Newfoundland and Labrador:**

The Province is still using NAD83 (Original) and plans to move to NAD83 (CSRS) this fall. They have approximately 440 HPN stations and are doing an adjustment of their old network of approximately 2000 stations. When this is completed they will need to create a grid shift file the same as Nova Scotia has done. They have no plans to install any new monuments or active control stations in the next 3 to 5 years. They have consulted surveyors and other stakeholders and concluded there are a sufficient number of control monuments in place. Their usual form of control data distribution is through search applications which have a fee attached.

The usual form of communication with the user community is through e-mail and telephone.

The Province will adopt the new Height Modernization when it gets finalized however there was scepticism about when that might happen.

**Manitoba:**

The Government of Manitoba did a major restructuring this year of its Corporate Geographic Information System. The new entity created is known as GeoManitoba. GeoManitoba is comprised of the following three main business areas: Geospatial Data Acquisition and Product Development, Geospatial Information Distribution and Support, and Geospatial Technology Management. The Director of Surveys and Survey Services resides under the Geospatial Information Distribution and Support Section.

The survey services provided to clients are under full cost-recovery and comprise the majority of their work. The Spatial Reference System Program is responsible for the creation and maintenance of the Manitoba Spatial Reference Network (MSRN) and this portion of the program is excluded from cost-recovery.

The MSRN is a passive network of 250 stations which also includes the 13 Canadian Base Network monuments. Site specific maintenance is done as the need arises and they have done two re-observation campaigns on the southern portion of the network since its creation in 1998. A third re-observation was started this season, but due to limited staffing issues the project is now on the back burner.

The provincial defacto datum is NAD83 with the MSRN referenced to NAD83 (CSRS) Epoch 1997. Their legacy control or conventional network was readjusted to the second iteration of NAD83, NAD83 (NMIP).

Manitoba has no plans to establish Active Control Points. There are currently three private real-time networks (Cansel (Trimble), Brandt (Topcon) and Lewis (Leica)) in the southern portion of the province. With the possible inclusion of these networks into the CSRS by the federal government these services will be an acceptable access to the CSRS.

Manitoba is in full support of the height modernization initiative in development by NRCan. Two presentations on Height Modernization (HM) were delivered to the Association of Manitoba Land Surveyors and the Manitoba GIS Users Group.

Currently the Spatial Referencing group has no formal structure for communicating with their users.

Currently there are no requirements for spatial referencing of surveys within the province other than surveys done on crown land under instructions by the Director of Surveys. A committee on spatial referencing standards is discussing the options for enforcement of a requirement/standard on all or certain types of surveys within the province.

**NRCan (Geodetic Survey Division):**

NRCan's Geodetic Survey Division is responsible for providing the standardized framework of coordinate reference information Canada wide which the Provinces are then able to build upon and densify for their own networks. The Canadian Spatial Reference System (CSRS) is the common reference system which all of the Provinces and Territories in Canada have adopted and is known as NAD83 (CSRS).

Unfortunately there are other reference systems in existence that users are taking advantage of and in particular Active Control Stations (ACS) for Real-Time positioning using GPS equipment. This Real-Time positioning is also known as a Real Time Kinematic (RTK) service. These other sources of coordinate information may be fine for some short term purposes however may lack the merits of data inoperability. This inoperability could indeed exist not only between various Government Departments but also within the same Department.

One of the issues is that some of the RTK services may be integrated into Provincial or Federal networks, however which are and which aren't?

The Geodetic Survey Division (GSD) has been tasked by the Canadian Council on Geomatics (CCOG) to develop a plan to describe, validate and provide certification of commercial private RTK providers to ensure their compatibility within the CSRS.

GSD also have a series of Canadian Active Control Stations (CACS) across Canada that provides users with CSRS data. They are however sparse with only one station located in Nova Scotia at BIO in Dartmouth #961000. One of the issues is that the farther from the station the project area is, the longer the observations need to be in order to achieve very accurate measurements. In this instance time is money. This is a primary reason that surveyors use various sources for their RTK requirements which may or may not be tied into the CSRS.

Another high profile initiative that GSD is working on is called Height Modernization. This is a project to replace the Canadian Vertical Datum of 1928 (CGVD28). The CGVD28 is the recognized standard which elevations are referenced in Canada. According to GSD there

about 80,000 CGVD28 Benchmarks (BM) in Canada and they are traditionally found along major roads, railways, and bridges. These BM points have not been maintained for some time and traditional levelling is no longer done over long distances due to inaccuracies and costs.

The Height modernization will realize a new vertical datum based on a geoid model computed from gravity measurements. It is expected that new heights for the 80,000 BM points will be completed sometime in 2013. GSD anticipates that both height systems will co-exist for a number of years.

GSD maintains a number of free on-line services to support the Canadian Spatial Reference System. They are the following:

NTv2	This service transforms between NAD27 and NAD 83 (original) geographic or UTM coordinates.
TRNOBS	Transforms Latitude/Longitude/Ellipsoidal Heights between NAD83 (CSRS) and ITRF reference systems.
GSRUG	Converts between Geographic and UTM coordinates
INDIR	Perform either a geodetic direct or inverse computation
GPS.H	Transforms Canadian NAD83 (CSRS) / ITRF ellipsoidal heights to orthometric heights compatible to CGVD28 using HT2_0 model
CSRS-PPP	This is an on-line Global GPS Processing Service. It processes RINEX observations from single or dual-frequency receivers operating in static or kinematic mode.
GPS Calendar	These calendars will help convert a typical calendar day to either the Day of the Year or GPS Week Number.

In addition to the many programs and services that GSD offers and supports there is the Help Desk support they provide to the Provinces. The Coordinate Control Officer is able to contact GSD on various Coordinate Referencing matters to obtain information or assistance of various forms.

### **Summary of Findings from other Jurisdictions**

1. One of the positive and encouraging findings from the jurisdictions contacted as well as the review of the CGRSC minutes from 2010 and 2011 is that the Provinces all seem to be working together in one form or another when it comes to Coordinate Referencing. All of the Provinces and Territories now have a high precision network based on NAD 83 as the Reference Frame even though many Provinces could be on different epochs or versions.
2. NB and Manitoba have adjusted their old network and made available NAD83 (CSRS) values and NL is in the process of doing so.

3. NB has established Province wide Active Control Stations (ACS) which are very popular. This has allowed for an easier transition to NAD83 (CSRS) for the user community. NL and Manitoba do not plan to install any ACS's in the next 3 to 5 years. Manitoba however is partially serviced by three private real-time networks however presently these networks are not tied into the Canadian Active Control Network. Manitoba anticipates they will be tied in at some future time. Other Provinces such as BC do have ACS's.
4. It appears the other jurisdictions are on board with the Federal Government on the Height Modernization initiative. There has been much discussion at the CGRSC meetings on this.
5. Communication with the major stakeholders and the various users is recognized as being important however this is seen as a weakness that needs to be continually worked on. At best it appears to be an ad-hoc process
6. NB and Manitoba have conducted training or information workshops. This also appears to be mostly ad-hoc with no formal recognized process in place. Manitoba though has just gone through a major re-structuring and so it is expected they will concentrate on more formal processes.
7. Many surveyors in the Provinces are working in Real-time. Where available like NB and some other Provinces they will use the Provincial system which is tied into NAD83 (CSRS). For others the surveyors are using private Real-time sources. This is an issue from a standards perspective in that non-government sources are likely not tied into the Canadian Active Control Network. NRCan and the Provinces are concerned with this and that is why NRCan is looking at a process to bring these private suppliers into the national standard of NAD83.
8. NRCan through the CGRSC structure and the Coordinate Referencing contacts in the Provinces appear to have a good working relationship with valuable information being discussed and exchanged. This is an important entity to continue to foster.
9. NRCan provides a wealth of support to the Provinces through direct personal contact and help desk functions. They also provide a number of free on-line services to support the Canadian Spatial Reference System.
10. Retirements are an issue across Canada. The CGRSC is worried about this. That is why it is important to get as many initiatives as possible tidied up so as to lighten the load for new people coming into the system as well as to have a solid baseline from where to take over.

## **10.0 Recommended Steps to Move Forward**

Overall and on the surface it appears from the consultation process that the Provincial users of the NSCRS are generally happy with what has been done to date and what is available to them. That is not to say however there are not issues to address and program improvements to consider. It is perceived there could be issues that have not yet risen and that at some point in time these factors will become a problem for everyone.

### **Recommendations for a Coordinate Referencing Strategy to March 31, 2013**

1. The hiring of the Coordinate Control Officer is underway. It is important that this person's focus be the overseeing the completing the adjustment of the NSCCS and publishing NAD83 (CSRS) values for the 24000 stations and then ensuring the

completion of the longer term items outlined in the NSCRS Strategy, over the next few years. The CGRSC has recognized the fact that expertise is being lost in provincial geodetic offices. For instance, in addition to Nova Scotia's highly specialized Coordinate Control Officer currently being vacant, the New Brunswick Coordinate Control Officer is planning to retire in June 2012.

2. Another initiative that needs to be addressed without delay is completing the adjustment of the NSCCS and publishing NAD83 (CSRS) values for the 24000 stations. This was the single most important request from the user community. SNSMR is currently considering options / approaches to complete the coordinate transformation calculations work.
3. Once the adjustment on the NSCCS network has been accomplished and published NAD83 (CSRS) values are available it should be determined if a new Grid Shift File is warranted.
4. It is recommended the new Coordinate Control Officer meet key people from the user community within a reasonable time frame to introduce him or her self and to gain valuable feedback in preparation for the Spring CGRSC annual meeting as well as in preparation for completing a Provincial Coordinate Referencing Policy Document. The first contact the Coordinate Control Officer should make is with the Executive Director of the Association of Nova Scotia Land Surveyors (ANSLS).
5. It is recommended that the Provincial Coordinate Referencing Policy be completed and signed off by the Deputy Minister of SNSMR as being officially adopted and that the NAD 83 (CSRS) be submitted to the CIO, to be adopted as an official standard
6. It is recommended that once the Policy has been adopted by SNSMR that the Policy should be communicated to the user community and training/ support be provided where required through provincial workshops. These workshops should be spread out across the Province so as to allow for as much participation as possible. It is recommended these workshops be held in such locations as Port Hawkesbury, Truro, Halifax, Bridgewater, Yarmouth, Digby, and Kentville.
7. Presently under the GeoNOVA Home web site, Coordinate Referencing Information can be found under various headings. These site headings are DataLocator, Property on-line and Coordinate Transformations. Other Coordinate Referencing information such as Policies and Standards are under the heading "about GeoNOVA". SNSMR, GIS section is currently in the process of re-vamping the GeoNOVA web site and is streamlining access to all information.

It is recommended that the GeoNOVA web site be looked at with a view to placing all pertinent information concerning Coordinate Referencing including Policies and Standards, Communications, News, Work Shops etc. on the Home Page or at least having some way of providing a direct link to this information.

8. It is recommended that an appropriate coordinate Referencing budget be secured for fiscal 2012/2013 in order to move ahead with needed initiatives. The longer these initiatives are put off the harder it will be to correct issues and implement standards and guidelines.

**The foregoing is all that is anticipated that could be accomplished by March 31, 2013. It is recognized that along with the above recommendations the new Coordinate Control Office will have a steep learning curve to become familiar with their position.**

**Recommendations continued from April 1, 2012 to March 31, 2016**

9. A comprehensive operational approach is recognized as of paramount importance in moving forward in order to set direction and to get wide spread buy-in to provincial standards and guidelines. It is also important to be able to identify what strategies are working and which are not, what programs and initiatives are required now and into the future, what training programs or information sessions may be required by the user community, and any other information which is deemed necessary to ensure wide spread knowledge, acceptance, and issue tracking is accomplished.

It is recommended then that the subject matter included in the operational strategy will include the following as a minimum; planned communications strategy and put into practice, planned training workshops and being carried out, standards and guidelines developed and made widely available to the user community, and possible new or improved services.

10. It is important to continually be engaged with the user community and particularly with the major stakeholders.

It is recommended that in addition to a communications strategy or in conjunction with this strategy a consultation process be developed especially when information needs to be exchanged with the user community. Examples of this could be as a result of new information coming from the CGRSC committee meetings or new policy or service additions.

11. The Height Modernization initiative is not seen as an immediate concern however it will have implication when implemented for coastal areas and provincial DEM's, etc.

It is recommended that as part of the communications information exchange that any information concerning Height Modernization be communicated to the user community.

12. Active Control Stations (ACS) would help support a quicker transition to the NAD83 (CSRS) Network. This would in turn also help to have more survey work established with provincial and national standards and thus alleviate the position which now exists which are islands of non standard information. That is surveyors are acquiring coordinate information from various sources of which little may actually be know. One option may be to do a pilot and establish one or two ACS's from which to gauge their value to the Province and the user community. It appears some Provinces in Canada are establishing ACS's while others have no plans to do so.

It is recommended that further study should be carried out to determine the feasibility of moving ahead with the establishment of Active Control Stations in Nova Scotia.

13. There was once a Maritime Coordinate Referencing System Committee that met each year or more often if necessary to discuss common goals and issues surrounding Coordinate Referencing and Geomatics in general. It was originally comprised of the Manager and the Coordinate Control Officer from the NSGC, the Director of Surveys and



Coordinate Control Officer from New Brunswick, and Provincial Tax Commissioner and Director of Surveys for the Province of PEI. The Tax Commissioner was also responsible for Topographic and Property Mapping for the Province. This committee ceased after a time as members retired or moved on.

It is recommended that the Maritime Coordinate Referencing System Committee be re-established to look at common Maritime Coordinate Referencing System issues. It is further recommended the Manager of the NSGC take the lead in trying to re-establish this entity. In the event this Committee is re-established minutes of these meetings should be forwarded to the GeoNOVA Manger and in turn presented as an agenda item to the GeoNOVA Steering Committee.

14. The foregoing recommendations will require much work to successfully accomplish as well in conjunction with many other day to day operational duties.

**It is recommended therefore that the foregoing recommendations and information is sufficient in the near term with which the new Coordinate Control Officer and SNSMR Management should deal with.**

Technology is rapidly changing and therefore projecting over any longer time frame would not be prudent. In addition the new Coordinate Control Office should project their own thoughts on the way forward with the benefit of the various information gathering process and technology advancements that are developed and available to them.

15. The GIS Section of SNSMR, Amherst Office, has extensive coordinate control information stored in cabinets and boxes. Approximately 500,000 documents have been scanned in order to provide a back up for this information and to provide access to relevant documents. The question remains, what should become of the original hard copy information. It would be very time consuming effort and would involve a steep learning curve for someone new to go through.

It is recommended that SNSMR implement a records management plan for these documents, after the adjustment of the NSCCS has been accomplished, NAD83 (CSRS) values published, and a decision made on whether a new Grid Shift File should be re-calculated.

The decision will take into account, records management policy and requirements, required access to the original documents in future by the NSCRS program and provision of access by users.

## Summary - Recommendations Task List

Recommended Work Plan to March 31, 2013	Recommended Work Plan April 1, 2013 to March 31, 2016
1. Complete the hiring of a Coordinate Control Officer ( well underway).	9. Develop and initiate an Operational Strategy to include: communications, training workshops, standards and guidelines and possible new or improved services
2. Complete adjustment of NSCCS and publish NAD83 (CSRS) values for the 24000 stations	10. Develop a Consultation process for two way communication with the user community
3. Determine if new Grid Shift File needs to be calculated after adjustment of NSCCS completed	11. Provide information to the user community on the Height Modernization initiative and as new information becomes known
4. Coordinate Control Officer should meet key stakeholders including E.D. of ANSLs	12. Further study should be carried out to determine the feasibility of establishing an Active Control Network for Nova Scotia
5. Complete new Coordinate Referencing Policy, have sign off by Minister of SNSMR, and submit to CIO for official adoption	13. The Maritime Coordinate Referencing System Committee should be re-established to look at common Maritime Coordinate Referencing System issues.
6. After Policy adoption the new Policy should be communicated to broad user community, training and support be provided where required through provincial workshops. Suggested locations include Port Hawkesbury, Truro, Halifax, Bridgewater, Yarmouth, Digby, and Kentville	14. The foregoing recommendations and information is sufficient in the near term with which the new Coordinate Control Officer and SNSMR Management should deal with.
7. GeoNOVA web site be revamped to accommodate more inclusive access to all Coordinate Referencing information	15. A decision on the fate of the various pieces of historical coordinate referencing information should be put on hold until after NAD83 (CSRS) values have been placed on the NSCCS stations as well as a decision on whether a new Grid Shift File needs to be recalculated
8. Secure an appropriate Coordinate Referencing budget for 2012/2013 in order to move forward with initiatives	



# Appendix “A”

**Geodetic Survey Division**

**Geomatics Canada**

**Canadian Geodetic Reference System Committee**

**(CGRSC)**

**Minutes of Spring 2011 Annual Meeting (DRAFT)**



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Robert Duval

Chair, CGRSC

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Pierre Sauvé

Secretary, CGRSC

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Natural Resources Canada

# CANADIAN GEODETIC REFERENCE SYSTEM COMMITTEE

Notes of the CGRSC meeting held in Ottawa, Ontario, May 2-4, 2011

## **CGRSC members present in Ottawa:**

Bob Budgell	Newfoundland Geodetic Surveys
David Morris	Dept. of Transport and Public Works P-E-I
Léo-Guy LeBlanc	Service New Brunswick
Luc Lapointe	Direction de la référence géodésique Québec
Yves Thériault	Direction de la référence géodésique Québec
Ron Berg	Ministry of Transportation Ontario
Trevor Holliday	Ministry of Transportation Ontario
Dave Richards	Manitoba Conservation, Survey Services Branch
Geoff Banham	Alberta Sustainable Resource Devel., Public Land Division

## **Participating via WEBEX :**

Allen Flemming	Nova Scotia Geomatics Centre
Morgan Goadsby	Ontario Ministry of Natural Resources
John Potter	Information Services Corporation of Saskatchewan
Vern Vogt	GeoBC, Victoria BC
Joe Evjen	US National Geodetic Survey

## **Geodetic Survey Division:**

Robert Duval (Chair)  
Pierre Sauvé (Secretary)  
Denis Hains  
Pierre Héroux  
Kim Lochhead  
Marc Véronneau  
Calvin Klatt  
Pierre Tétreault  
Mario Bérubé  
Mark Caissy  
Mike Craymer  
Paul Godin  
Ken MacLeod  
Earl Lapelle

## **Federal**

Rodger Reid	Surveyor General Branch, NRCan
John Ells	Canadian Hydrographic Survey, DFO

## **RTK Providers (May 3 only)**

Henri Ayers and Michel Bourdon	Leica Geosystems
Pat Hills and Pete Afshar	Sokkia/Topcon Canada
David Janssen	Cansel Surveys

Cory Biever and Kevin Staciuk Brandt Tractor (Regina)

Johnathan Chihonik (via WEBEX) Lewis Instruments Ltd (Winnipeg)

Gerry Bélanger (via WEBEX) Gemini Positioning (Ottawa)

Richard Andrews (via WEBEX) Spatial Technologies (Calgary)

Yufeng Zhang (via WEBEX) Nexteq Technologies (Calgary)

## Monday May 2, 2011 (Day 1)

### 1. Opening Remarks

Robert Duval welcomed members and guests in Ottawa as well as everyone participating via WEBEX.

### 2. CGRSC Notes, Agenda, Action Items

Members were asked for comments/feedback on the 2010 meeting notes. There were none so the minutes were adopted.

The status of the 2010 Action Items List was presented:

**10-01:** GSD is to work with US-NGS to ensure a consistent/seamless height system for North-America. GSD is to provide assistance to NGS in their GRAV-D project with gravity surveys where possible. (on-going)

**STATUS: No action, US not working close to the border.**

**10-02:** To provide consistency with coordinates adopted by the provinces, GSD will enable the retrieval of NAD83(CSRS) coordinates at the various realization epochs for CBN and CACS stations (similar to what has been done for PPP).

**STATUS: The “long report” has been modified and all realizations\*\* will be provided as well as ITRF2008 coordinates. This should be online by the end-of-the-week. The ACS datasheet has not been updated yet.**

**\*\* CBN long report only in 2002.0, NAD83 and NAD27**

**10-03:** As a follow up of the Paper on the “Evolution of NAD83 in Canada” (Geomatica Vol.60, No. 2, 2006), Mike Craymer is to write a new paper explaining the various versions of NAD83, coordinate velocities and criticality of their “epoch”. GSD and provincial websites should summarize the NAD83(CSRS) versions and link to Mike’s paper.

**STATUS: Publication of Geomatica was postponed; this paper will be submitted in June 2011 for later publication in Geomatica. A half-page description will be posted online.**

**10-04:** GSD to look at EPSG geodetic codes and parameters posted for reference systems used in Canada and evaluate who is in the best position (GSD vs. Provincial Agencies) to confirm or request corrections. GSD to continue involvement and contribution to the establishment of an ISO Control Body to validate Geodetic Codes and Parameters under ISO- TC211.

**STATUS: The EPSG codes will be discussed in the afternoon by Mike Craymer. At the request of the IAG Mike has been involved with the ISO Control Body that will validate geodetic codes such as those distributed by EPSG. Mike chaired a meeting in Ottawa 2 weeks ago, Roger Lott of EPSG was in attendance. Efforts are underway for Standards Norway to host an ISO compliant registry of Geodetic Codes and Parametres to be in place by year-end.**

**10-05:** Provincial agencies to consider simultaneous GPS occupation of provincial HPN during CBN East re-observation Campaign (link to on-line CBN re-observation schedule provided) and to coordinate with GSD Technical Services.

**STATUS: Done. Jason Silliker contacted the provinces.**

**10-06:** GSD to continue discussion with Surveyor General Branch (SGB) (and potentially territorial authorities) for the adoption of a reference epoch for the territories and offshore surveys.

**STATUS: Pierre Héroux discussed this with Jean Gagnon. SGB prefer not freezing to a specific epoch but instead to attach the actual epoch of survey to the data.**

**10-07:** As GSD is updating and modernizing its online and downloadable geodetic tools, Information Management and Clients Services (IMCS) will consult the provincial agencies to incorporate their feedback and accommodate if possible their specific functionalities.

**STATUS: Tools to be presented tomorrow by Mario Bérubé.**

**10-08:** Based on the extensive discussion during this meeting, GSD to draft a white paper and a set of recommendations responding to CCOG resolution F09-02 related to the certification of commercial private RTK GPS Providers (for review and approval by the provincial agencies). Target for presentation CCOG Fall meeting 2010

**STATUS: GSD prepared a RTK Integration Options document reviewed by members. The minimum requirement to integrate RTK references to monumented active or passive control was confirmed. CGRSC position and recommended next steps to be presented at next CCOG meeting. The last CCOG meeting was only a conference call (i.e. not appropriate to present it then). It will be presented at the next CCOG, after further discussion.**

**10-09** Related to above action item, GSD to inform RTK Service providers of recommendations and collect their feedback prior to communicating to CCOG.

**STATUS: "Level 1" (integration to a monumented network) was the highest priority. General specifications would be useful and would have to include service providers. Capacity to perform/validate integrated network solutions varies among provinces. No feedback yet from service providers on their ability to perform network solutions.**

**10-10:** To respond to the urgency expressed in the 2006 stakeholder consultation, GSD to proceed as early as possible with the implementation (adoption) of the Height Reference System upon agreement with the US on its defining parameters.

**STATUS: Marc Véronneau will report on Day 3.**

### **3. Members' Reports:**

Most members provided a report highlighting their agency's recent activities. Copies of reports are available on the CGRSC web site: [http://www.geod.nrcan.gc.ca/partners\\_e.php](http://www.geod.nrcan.gc.ca/partners_e.php)

Username: CGRSC, password: Private (case sensitive)

**Manitoba** – Dave Richards indicated that they have no intention of establishing active control points. There already exists a major private network following the rivers and CANSEL has a few northern stations. LEICA and TOPCON also have networks. The status of private RTK network integration to monumented geodetic control is unknown.

Survey Services now fall under the “Geospatial Data Acquisition and Product Development” section of the newly created GeoManitoba. Dave feels this will be a positive change. GeoManitoba does not yet have an executive director.

Since all land surveys in Manitoba will need to be integrated to CSRS 1997 there will be pressure for RTK service providers to integrate. Machine control is the biggest user of Network RTK (as opposed to surveys).

Dave pointed out they did not have a lot of work last year. They did control surveys along the East side of Lake Winnipeg. They plan to do some re-observation of the southern portion of the Manitoba Spatial Reference Network in summer 2011.

They did 2 presentations on Height Modernization and assigned horizontal coordinates for all their benchmarks.

**Alberta** – Geoff Banham indicated that Alberta had a new service provider (Prairie Precision). They are tied to the Alberta CBN's.

Key activity was working towards Height Modernization. They validated spirit levelling data for urban cadastral areas (Edmonton, Calgary plus 70 other municipalities) and are still evaluating the data for rural cadastral (PARCEL mapping areas).

A new ski resort is to be developed in Kananaskis area; the Fortress Mountain CBN pillar was saved as a 50m x 50m “no development” box was created around the pillar.

EDM calibration baseline is still being used as they had to evaluate 54 EDM calibration surveys that were submitted.

**B.C.** – Vern Vogt joined us via WEBEX. Vern pointed out that Kutalmis Saylam was transferred to another section in the branch. They are now 2 geodetic engineers and one technician. GeoBC is moving towards an open data policy.

GPS receivers are being updated to GLONASS. An agreement with Washington State Reference Network is in place to share real-time data. Real-time services now include

- Coast Guard
- CRD (one new station)
- Metro Vancouver
- Prince George
- CANNET.

The issue of providing real-time data feeds from public tracking stations to distributors in the private sector still needs to be addressed.

CDGPS was terminated April 1 at 0900 hrs and a notice was sent to manufacturers. Most questions regarding CDGPS decommissioning came from California and Alaska.

A suite of standards, specs and guidelines documents is now available online as well as their Resources GPS courses. They still have one trainer but the GPS courses are not being maintained due to staff limitations.

They allowed their ISO 9001-2000 registration to lapse also due to staff limitations.

**Ontario MNR** (no report submitted) – Morgan Goadsby, via WEBEX, noted that COSINE is still the primary source for geodetic information. 200 new users were added last year for a total of 1500. There are 115 contributing agencies. COSINE 2010 had major improvements:

- automatic account creation
- improved map background (LANDSAT, ortho-photos, parcel fabric)
- WMS Internet Mapping Framework toolset (but it's slow, they are looking into using Adobe and ArcGIS server)

Susan MacGregor was appointed as Ontario's Surveyor General succeeding Brian Maloney. Brian continues as director of MNR's Land Information Ontario.

MTO projects are NAD83 Original but they will be integrating municipalities to CSRS. They created a new classification (CLASS E) for 3000 stations in Toronto with published NAD27 coordinates. With the help of Mike Craymer the LEICA network was integrated into COSINE by weighted station adjustment which included US CORS stations.

Quickbird imagery was ortho-rectified (using 70 CSRS control points) to meet 1:10K scale mapping needs. They have a new precise DEM for the province (SRTM data) which will be useful for water resources.

Two staff participated in work on the ISO geomatics standard for Ontario. MNR and MTO are working on provincial specifications for digital levelling.

With the Peterborough airport expansion threatening a CBN pillar there was an attempt to keep machinery 15-30 metres away but to no avail; they lost the pillar!

With integrated surveys there has been a renewed interest in the EDM calibration baselines; even though they are no longer maintained.

**Ontario MTO** – Ron Berg and Trevor Holliday reported that since 2007 they had completed 12 new GNSS networks. In preparation for integration they compared “weighted” versus “fixed” adjustments and found small differences of generally a few cm.

With integrated surveys becoming in 2010 a legislated requirement in Ontario interest in PPP has increased. Ron and Trevor wrote the report “PPP Accuracy Analysis for Integrated Surveys” which was published in the Spring 2011 issue of AOLS magazine. They also wrote the “User Guide to the Precise Point Positioning Service” available publicly at the MTO Research Library Online Catalogue.

MTO revamped and consolidated their levelling specs. They added video logging equipment to their ASRAN (Automatic Road Analyzer) vehicle traditionally used for pavement analysis.

MTO is funding a research project to study the capabilities and accuracies of mobile mapping. Another contract was awarded to study the accuracy and compatibility of solutions from different RTK service providers (CANSEL, LEICA, TOPCON) in Ontario with testing being done at CBN’s.

Morgan Goadsby commented that defining the “threshold for change” for RTK reference monitoring will be critical. Robert Duval agreed that with crustal motion and the CSRS epochs issue this will be important.

**Quebec (MRNF)** – Luc Lapointe noted that they had a “small year” and a “small budget”. If the trend continues future activities may be restrained to strictly the HPN (High Precision Network).

They installed 30 new points and inspected 608. In preparation for Height Modernization they completed the validation of levelling data in their GEODEC database and are ready to compute elevations in the new height system.

Yves Thériault’s “Guide sur les référentiels géodésiques” was published in Fall 2010. GSD reviewed the guide, had it translated to English and provided copies to provincial members to read. A CGRSC teleconference will be held to decide if/how the guide can be adapted to meet the needs of all provinces.

**Nova Scotia** – Allen Flemming (via WEBEX) reported that they were undergoing an organizational review. Work is continuing on adjusting 24,000 points to NAD83(CSRS) using their HPN points as weighted stations.

*(NOTE: Allen retired on May 31 2011)*

**New Brunswick** (no report submitted) – Léo-Guy LeBlanc reported that he has had very little time to devote to geodetic as 99% of his time is spent on other duties. Léo-Guy will be retiring in June 2012 with no replacement in view. He feels this is an issue all provinces will have to face and that “geodesy” will eventually be handled by private networks/firms.

Contract for NB ACS has been renewed with 1 private station (part of LEICA network) and 2 “municipal” stations.

Their software GEOCALC will not run on 64-bit machines. New Brunswick is still using stereographic coordinates. UNB was hired to create the grid shift file from ATS76.



**P.E.I** (no report submitted) – David Morris indicated that an RFP that was ready to go (for establishing province-wide RTK network) was shelved due to budget cuts. They are currently rewriting legislation to abandon passive control networks. PEI is looking to assigning epochs to stations (not fixing to a specific epoch). LEICA and CANSEL now have RTK networks in PEI.

Coastal erosion is the biggest issue in PEI. 10-cm accuracy LIDAR was completed for the province to create the DEM for orthophotos. Léo-Guy pointed out that LIDAR contractors deliver MSL heights and may not archive ellipsoidal heights. He reminded all members of the importance of archiving ellipsoidal heights to be in a position to recompute MSL elevations following height modernization. Robert Duval indicated that there was an important communication issue.

**Saskatchewan** (no report submitted) – John Potter (via WEBEX) noted that he did not have much to report as they had insufficient resources for projects. He is intending to consult the survey community to determine their needs in terms of geodetic control (passive and/or active). Saskatchewan users all have a full listing of coordinates and sketches.

There has been an orthophoto program ongoing for the last 3 years. 85% of the province has been flown. The DTM (Digital Terrain Model) also produced seems to be better than CDED and SRTM.

**Newfoundland & Labrador** (no report submitted) – Bob Budgell reported that most of their work has been photo control, there were no new surveys. NL has decided to go CSRS. Their HPN was adjusted (440 stations?) and adjusting the conventional (2000 points?) is 90% complete. They will need to create a grid shift file and may have to contract it out to UNB. For mapping and orthophoto work there is a need for a new DEM. Plans are to acquire 30 cm resolution digital imagery (that product is in high demand).

**US NGS** – Joe Evjen (via WEBEX) indicated that US NGS is now doing airborne gravity in Alaska as part of their GRAV-D initiative. They are adopting IGS08 and in July their new CORS coordinates will be produced in NAD83 and ITRF. They will also adopt the 2010 epoch.

US NGS employs a staff of 200 as well as 50 contractors. They will be doing “absolute” antenna calibrations (like in Germany) using an automated robot to rotate the antenna around the vertical/horizontal axis. They plan to abandon NAD83 to go geocentric in 2022. Their OPUS-RS (rapid static) online processing service will do an adjustment online with as little as 15 minutes of data.

They produced a KML of their control and they use Google Maps Enterprise License.

## **Day 1 Lunch Break**

### **4. Strategic Intent 2015** (see PPT deck)

Doug Bancroft, Director General of CCRS (GSD is a division of CCRS) addressed the group highlighting some of the priorities of NRCan/CCRS (Emergency mapping, importance of remote sensing in the oil sands project, RADARSAT 2). He noted a big human resources issue that is being addressed: the “experience gap” caused by the “grey beards” being replaced by the “young fa\*\*s”.

## **5. International Reference Frames** (see PPT deck)

Mike Craymer indicated that ITRF 2008 was released May 28, 2010 (online for now, not “in print” yet). It included 579 sites and 920 solutions. There is an issue with the fact that only ¼ of the stations are in the Southern hemisphere and that there are now very few SLR and VLBI sites.

WGS84 coordinates for reference stations are now being updated once a month; in the future this may be done weekly or daily. IGS08 and ITRF2008 are considered as the same datum. Mike’s presentation showed IGS08 network maps.

NAREF, which combines various regional solutions into one continental solution, includes only continuous stations (incl. provincial ACP’s). The NAD83 velocity grid and epoch transformation are based on combined NAREF and CBN velocities.

## **6. GNSS Networks and products** (see PPT deck)

Mark Caissy highlighted that the national network of active control sites operated by NRCAN consists of about 50 stations, including 19 core sites fully supported by GSD and over 30 regional sites operated in cooperation with other federal agencies. The ACP map shows no change since last year

Reliable real-time access to a global network of IGS tracking is now a reality with over 100 stations streaming data. Mark noted that real-time services are part of the IGS strategic plan and an important component of the GGOS “Natural Hazards” theme which addresses landslides and tsunamis. Mark also presented RTCM State Space Representation (RTCM-SSR), the format to be used in GPS-C (next generation).

Robert Duval asked Vern Vogt (BC) if any RTK service providers had complained about (BC’s and NRCAN’s) free RTCM feeds. Vern did hear from CANSEL who had invested quite a bit in their infrastructure however municipalities did purchase CANSEL equipment. Vern indicated there will be a need for a formal policy. Robert noted that private service providers are taking responsibility away from federal and provincial organizations and that RTCM feeds are “public good” in these days of “open data”. Léo-Guy added that he felt providers made their money selling equipment, not the service, and wondered if they will still be there when the market is saturated.

## **7. Update on CDGPS**

Denis Hains noted that after 9 successful years we had reason to be proud. He acknowledged the work of GSD staff that maintained the correction feed and supported CDGPS distribution, BC who played the leadership role and CDGPS Board. Denis reminded us that the service had been extended to April 1 2011 as there was money left to maintain the service and CCOG had approved.

The GPS-C corrections continue to be generated as GSD searches for new commercial distributor(s). In December 2009, GSD issued an “announcement of opportunity” for distribution of the correction feed. We received half a dozen inquiries (and 2 proposals). In March 2010, the Calgary firm NEXTEC asked for a temporary license to investigate. Their evaluation was successful and a 5-year non-exclusive agreement was signed. Because of the upcoming elections the deal could not be announced (until sometime later in June). NEXTEC plans to re-distribute GPS-C over internet and integrate the corrections into a real-time internet-PPP solution embedded in their equipment.

Vern indicated the CDGPS Board would have a final “closure” meeting in June.

## **8. GSD Field Activities** (see PPT deck)

Kim Lochhead presented the field work proposed for the 2011 season which included CBN re-observation in the West (75 stations) in June-July 2011, absolute gravity work (in Waterloo and on the “Laurentian Line”) and targeted GPS network surveys in support of regional geodynamic investigations for the Public Safety Geoscience Program.

## **9. ISO Geodetic Registry** (see PPT deck)

Mike Craymer noted that the geodetic codes in the current EPSG archive do not meet all ISO standards. He talked about the work of the **ISO/TC211 Committee on Geographic information and geomatics** whose objective is to develop a structured set of standards. Their scope is however limited to international reference systems.

Mike is Chair of the **Control Body**, made up of technical experts, tasked with approving contents of ISO registers. They held a meeting on Ottawa in March 2011, prepared a draft on requirements which was submitted to the TC211 committee. Mike also presented the registry database management software **RegManTool** (developed by Dr. Theile) for which they are seeking approval to use.

## **10. Member Issues/Wrap-up**

Pierre Héroux mentioned that geodetic expertise within some provincial jurisdictions may not be available much longer in light of upcoming retirements (e.g. Léo-Guy in NB and Allen in NS). Robert noted that private firms could become the de-facto providers of geodesy and that new means of maintaining the consistency and compatibility of the geodetic reference may need to be established. Denis felt there would be a need to re-balance the federal/provincial roles.

Yves Thériault suggested that Height Modernization would have a big impact on the DEM. He felt that the older members of CCOG were aware of Height Modernization; however, we have not been present at CCOG for the past 4 years. Robert added that when we present at next CCOG our recommendations in regards to network RTK services it would be an opportunity to raise the issue of consistency/compatibility (e.g. with the US who are on a different timeline than us with Height Modernization and who plan to go to an ITRF-based geocentric reference frame).

## Tuesday May 3rd (Day 2)

Private RTK providers were invited to attend Day 2 of the meeting. The day began with a quick roundtable for everyone to introduce themselves. Participating RTK providers were:

### In Ottawa

Henri Ayers and Michel Bourdon Leica Geosystems

Pat Hills and Peter Afshar Sokkia/Topcon Canada

David Janssen Cansel Surveys

Cory Biever and Kevin Staciuk Brandt Tractor (Regina)

### Via WEBEX

Johnathan Chihonik Lewis Instruments Ltd (Winnipeg)

Gerry Bélanger Gemini Positioning (Ottawa)

Richard Andrews Spatial Technologies (Calgary)

Yufeng Zhang Nexteq Technologies (Calgary)

Robert Duval introduced the subject of Network RTK by stating that GSD and service providers all have the same goal: accuracy, consistency, proper integration. Denis Hains then explained the role of the CGRSC and how it was tasked by CCOG to recommend an approach for RTK service certification.

## **11. NAD83 Epochs and Realizations** (see PPT deck)

Mike Craymer began by summarizing the different versions of NAD83(CSRS) highlighting that:

- V5 (2006.0) was being used by CHS
- V6 (2010.0), already used by PPP, would be released in Summer 2011. It is based on ITRF2008/IGS08 at epoch 2010.0. Mike noted that improvements to international reference frames may not be possible much longer as a number of sites with VLBI and SLR capability are no longer being maintained.

Mike presented several maps showing the differences between various realizations/epochs. He showed how old realizations were less accurate and would remain that way in the future. He suggested we take advantage of the stronger/more recent realizations and use the velocities to propagate coordinates back to epochs of older realizations to maintain compatibility. He proposed epochs be used to reference NAD83 coordinates as opposed to a realization/version number.

Léo-Guy mentioned that bridging Network RTK across two provinces will remain an issue as long as provinces do not adopt a common NAD83 epoch. Mike pointed out that, unlike other provinces, PEI who is putting in place a province-wide RTK network may be adopting a dynamic NAD83 whereby an epoch would be provided with the coordinate without necessarily specifying a reference epoch.

Peter Afshar (Sokkia/Topcon) asked about the difference between 2002 and 1997 epochs. He also wondered if “RTK providers” base stations could be useful for GSD? Mike replied that we could certainly use sites in specific areas. Even though he questioned the stability of some of the monumentation he felt that some rooftop installations may be acceptable. He noted that some Quebec stations are being used for monitoring. Our CBN’s are re-observed every 4-5 years providing episodic monitoring, but CBN monuments are quite sparse.

Peter also questioned the NUVEL model asking if we should not create, with the US, a new representation of plate motion? Mike replied that for the time being, errors in NUVEL (2mm/year) were accounted for in the velocity model.

In closing Mike re-iterated that using a common “epoch” was critical, not so much the same realization (sub-cm differences between realizations at same epoch).

## **12. CSRS-PPP Update** (see PPT deck)

Pierre Tétrault presented the changes to PPP that will be introduced in the next update (June 1<sup>st</sup>) which includes:

- Improved error reporting
- Improved kinematic processing
- UTM projection scale factor and “combined” scale factor

Pierre noted that:

- GSD has a command-line script to automate PPP; it’s available upon request
- the (publicized) 100 MB file size limit is actually 300 MB
- we have had some requests for stop-and-go
- high-frequency data collection rate can help in kinematic
- 32% of datasets are submitted quickly (using the “90-minute” ultra-rapid solution)
- 13% of data submitted contained GLONASS and GPS

The next version of PPP will process GLONASS observations however GLONASS orbits are only available with a 24-hr delay. We expect longitude to improve slightly using GLONASS but the greatest improvement will be with kinematic PPP where satellite geometry at each epoch is important. There will be no real control to use/not use GLONASS; it will always be used as it will always improve the solution. It will not be possible to process old GLONASS datasets as old precise GLONASS orbits are not available.

Ron Berg reminded us that we must deal with the “federal MTM zone definition” issue in PPP.

Peter Afshar asked about the difference in accuracy of the “90 minute”, “next-day” and “17-day” solutions. Answer: The difference is very small (mm-level), negligible for most geomatics applications.

### **13. Information Management and Client Support**

Mario Bérubé presented statistics on clients, their segmentation and the types of requests. He showed a graph of the constant increase in usage of PPP (including an unusual peak in 2009 due to testing). He also showed maps of PPP usage around the world.

The number of stations GSD will make publicly available will decrease as classical networks will be archived. The emphasis will be on ACS, CBN, GNSS data and products.

Mario identified future improvements to web applications (GSRUG/TRNOBS/NET, NTV2, GPS-H, INDIR) and a new graphical interface for data retrieval. He also presented the new suite of desktop applications:

- GPS-H v3.1 (available by end of June)
- TRX (which combines GSRUG/TRNOBS/NET, version 1.0 to be available by the end of September)
- INDIR (future development)

Léo-Guy reminded us that NB uses the Stereographic projection and he could provide us the coding for the transformation to/from geographic. Mario will evaluate if it can be incorporated in the desktop apps.

### **Day 2 Lunch Break (Geodesy Room)**

Discussions were ongoing during this working lunch.

### **14. Integration of RTK services**

Pierre Héroux gave a background on how different realizations of CSRS had been adopted across Canada, how real-time access to active control is now available in both the public and private sectors and how coordination is required to ensure consistency and accuracy. He noted that private services give users the responsibility of choosing their reference frame by encouraging calibration on monumented control. Pierre showed maps of the public Active Control and some of the growing private networks. He noted that differences between NAD83 reference epochs from one province to another can make a 1-5cm coordinate differences along provincial borders.

He presented the CCOG resolution asking the CGRSC to examine integration issues and make recommendations. Through the 2010 CGRSC meeting and teleconferencing a 3-level model was proposed: Level I (Integrate), Level II (Monitor), Level III (Validate).

- All provinces thought **Level I** was required for sure but many did not have the capacity to perform/validate network adjustments.
- Service providers already do **Level II** (monitoring) on an ongoing basis (ensure monument stability). It's their responsibility towards their clients.

- All felt that **Level III** (validation) should be the responsibility of the end-user who must ensure they use proper methodology and create sufficient redundancy to validate their results.

Pierre indicated that the next step (of greatest concern right now) is to develop the broadband specifications for Level I Integration, meet with providers to discuss everyone's roles and responsibilities, and explore the possibilities of sharing data streams.

Pierre Héroux made a second presentation titled "**Level I Integration, some practical considerations**" which covered some of the integration/adjustment options, parameters, logistics and constraints.

### **Roundtable**

The roundtable discussion began with the question "**Are we ready for Level I Integration?**"

Mike Craymer asked if adjustment/integration would be a one-time event? CGRSC felt that it could be done one-time then monitoring afterwards would suffice. Pat Hills stated that they (Sokkia/Topcon) were open to recommendations or a suggested work-flow, just "let us know what you want or need".

The provinces were asked to speak up about their situation and issues:

**Manitoba** – Dave Richards indicated that they were re-observing their HPN network and that they would use CBN and base station data in their adjustment.

**New Brunswick** – Léo-Guy noted that NB contract out ACP's to private firms (4 Leica, 1 CANSEL, Moncton private). It is legislated in NB that new sites must be fully integrated to the NB network. But Service NB has no resources, no tools to do the adjustment, they'd be willing to verify and add new stations to their database.

**Ontario (MTO)** – Ron Berg indicated that with proper integration and review the stations could become published control monuments (if they meet legislation requirements). Adding new stations by infill would take some work but would not be an issue. Customers will want repeatability (onus will be on the service providers).

**Ontario (MNR)** – Morgan re-iterated that MTO and MNR had been talking to RTK service providers. There is a general will to support Level I integration. They could add the new theme "RTK" in COSINE for provincially-endorsed reference stations.

Léo-Guy stressed the fact that Mario's new tool (TRX) will be important to allow "going back" to old epochs. Robert Duval wondered if a NAD83 legislated "version", like the one adopted in NB, could be considered an "epoch". Ontario noted that their legislation states the NAD83 datum (without specifying Original, CSRS or an epoch).

Dave Richards indicated he'd like to see service providers report how they did their integration. Trevor Holliday (MTO) noted that Ontario had the publicly available document "Provincial Control Specifications" that could be a good starting point although it addresses the principles only.



Pierre Héroux then asked who presently had the capability of doing a network adjustment. (CANSEL, Leica, Ontario, Quebec and BC). Robert Duval offered GSD support for **Level I Integration** as long as provinces deemed acceptable.

Mike Craymer asked about possible site problems (antennas moving). Pat Hills replied that they have “alarms” to indicate movement. Robert added that to certify a station may require specific monument types (not a free-for-all). Pat Hills added that the 2-4 cm solution that their clients ask does not require geodetic stability and building bigger/better monuments costs \$\$\$. Dave Richards added that if we were to set a minimum acceptable standard we might see that the providers are already meeting it.

Vern Vogt noted that BC requires the covariance matrix. Robert hinted that we could possibly incorporate providers’ stations in our NAREF solution and produce, like an ACP, coordinates and covariance matrix.

Following the afternoon break Robert Duval clarified that his suggestion to have GSD do the integration had not yet been discussed by GSD management. Pierre Héroux wondered if network adjustments would not be “overkill”. Mike Craymer felt adjustments would be useful in some areas of Canada.

With regards to a potential PPP-only solution, Pierre H. reminded all that a PPP solution does not create direct ties between surrounding points (echoed/agreed by Léo-Guy). Robert then asked if PPP was an acceptable option or if we should do NAREF-type processing (on a daily basis?). While PPP seemed acceptable to many, a differential network solution was preferred.

Either way, Morgan stressed that integration is required soon given new legislation for integrated surveys in Ontario. Timing is a concern as is the issue of epoch/version/realization. Mike Craymer added GSD could publish in any epoch (use the latest “realization” but propagate back using velocities). Morgan added they wished for an adjustment to realization v3.0 (same as their HPN) and wondered if GSD could monitor such that RTK stations meet the Ontario “realization”. Mike answered we could initially compare to published values then compare week-to-week for stability.

Allen Fleming is OK with bringing back to an earlier epoch but was concerned about consistency and how much drift between realizations would be tolerable; would they have to re-observe their HPN?

Luc Lapointe added that in Québec clients are not asking for integration. They’re on NAD83(Original) which meets cadastral reform accuracy requirements. They’d like to see a concrete proposal to evaluate. In fact all provinces agreed in principle, but would like to see more details.

Providers were asked if they would agree to:

- Provide 3 weeks of data to GSD for Level I - Integration?
- Report monument stability for Level II - Monitoring?
- Make their data available for GSD to improve the crustal velocity model?

Providers were OK with this. CANSEL stated they had 250 stations they could push from their RINEX servers to the GSD server; would this overload us? Other questions:

- Would a new station require 3 weeks of data before getting official values?
- Often a new station is needed now! Could the PPP value be used in the meantime?



- What about the relative accuracy between points?

Robert noted that these are all technicalities that require consideration to come up with a realistic proposal and a better definition of roles and responsibilities.

Providers were then asked how they integrate their RTK references at present:

**Pete Afshar (Sokkia-Topcon)** - They started with 5 stations (run in PPP), then tied to CBN, find discrepancies and apply a simple shift. When they add stations they have at first PPP coordinates then 3 days later have final coordinates (adjustment using CACS data baseline ties).

**Corey Biever (Brandt)** - They have a network of 20 towers for which they obtained coordinates by averaging 3 or 4 days of PPP solutions.

**Henri Ayers (Leica)** - They did a full network adjustment (by pieces) connecting to ACP's, occupying CBN stations and using new data from GSD CBN campaigns.

**David Janssen (CANSEL)** - They first do PPP. Mike Wolfe did their network adjustments (initially with minimal constraints, then fully constrained)

**Richard Andrews (Spatial Technologies)** – They had help from Geoff Banham (who validated their adjustment). Some of their stations are in the ACSM database. They have detected some rooftop stations moving, they have in-filled new stations. Issues: finding suitable locations, resources to survey remote locations.

## **15. Access to Real-time CACS data stream**

Ken MacLeod gave the presentation “**Availability and Distribution of NRCAN Real-Time Data**”, showed maps of the 23 CORE stations currently providing real-time streams and another 20 Regional sites that could possibly be made available (if there was sufficient interest). There has been interest for regional stations around the Great Lakes.

Ken identified the current CACS real-time data users, explained the data formats and access methods (NTRIP caster). NTRIP can also be used to distribute high-precision wide-area corrections for real-time PPP (RT-PPP).

Robert Duval added that we will soon have a license for access to real-time RTCM feed. GSD will provide the data on a best-effort, no guarantee.

Ken pointed out that high-precision GPS-Corrections are now available for redistribution. IGS will also have a “combined solution” with IOC (Initial Operational Capability) by September. Our solution uses data from 120 low-latency GPS tracking stations distributed globally. Mark Caissy has been chair/coordinator of the International Working group RT-IGS (real-time) since 2002. The 1-sec-rate correction message can be re-broadcast. RT-PPP will not be as accurate as short baseline RTK. This Service will be most useful in remote areas, long-range airborne and natural hazards warning and monitoring applications.

## Wednesday May 4th (Day 3)

Private RTK providers were not present for this last half-day of the meeting.

### **16. GSD Strategic Implementation Plan**

Calvin Klatt highlighted sections of GSD's September 2009 Strategic Plan document. The GSD Strategic Implementation Plan (a more detailed document) is in final stages of revision and is slated for release in 2011 or 2012.

Calvin re-iterated how the spatial reference frame helps support public policy issues such as water resources management and natural hazards. He introduced a new network of stakeholders called the CGRSN (Canadian Geodesy-Related Science Network) which involves mainly academia and experts in geosciences.

Calvin pointed out the creation of a GNSS Coordination Office to manage ongoing issues. It will be led by Industry Canada, will have joint funding from several federal departments and will likely be headed by Norm Beck. Hickling Arthurs Low (HAL) Corporation has been awarded a DND contract to conduct a study to identify the GNSS vulnerabilities in Canada, GSD will be contributing input.

GSD expects to soon join the GGOS Inter-Agency Committee (GIAC) regrouping a number of national geodetic agencies in support of GGOS, the flagship project of the IAG. Canada will likely participate along with other North-American countries with which we are aligning our efforts.

Calvin also touched on HR renewal actions underway at GSD.

### **17. Guide to Geodetic Datum's**

Pierre Héroux presented Yves Thériault's excellent document "**Guide to Geodetic and Vertical Datum's in Quebec**". He felt it was a modern document that connected well vertical and geometric datum's. GSD had it translated and reviewed (by GSD staff). Robert and Denis acknowledged all the work done by Yves and thanked MNRF for granting us the permission to have it translated.

Pierre Sauvé had placed the document on GSD's FTP site for download. Pierre Héroux asked provincial members to read it and comment on its value in their province as well as if (and how) it could be given a "national" flavour.

- **Ron Berg** noted that they (MTO) have a similar document that addresses Ontario issues; he suggested that Yves's guide could have an appendix for each province.
- **Léo-Guy** commented that although it was not "light" reading (as it showed all the complexities involved) the (limited) audience for it will greatly appreciate! He felt it was good "as is" as a national document and that only the examples were from Québec.
- **Yves** suggested that maybe the few paragraphs that are specific to Quebec could be removed.
- **Ron** felt that maybe that didn't really matter and that those examples could be useful to anyone.

- **Robert Duval** reiterated that there were 2 options
  - Strip some specifics to make it more generic to fit Canada
  - Add content to make it applicable/specific to everyone ( a bigger effort)
- **Bob Budgell** felt that making that decision could wait as he (and others) had not read the document yet!
- **Pierre Héroux** offered to be the lead on this; he would be looking for feedback and setting the timeline on the project.

Yves indicated that the original French version had been posted on MNRF website since October 2010 and was available for free. Marc Véronneau felt the English version could be made public as well. Robert suggested the current documents could be published as a 1st edition, and the “Canada” version later as the 2nd edition.

## **18. Height Modernization**

Marc Véronneau gave an update on “Height Reference System Modernization”. He showed the differences between the various realizations of the “geoid” (“zero” equipotential reference surfaces) and noted that these surfaces are all compatible and that GPS-H could apply the vertical shifts between them. Marc noted that the gravimetric geoid model CGG2010 is available in both the ITRF and NAD83CSRS datum’s.

The latest geoid **CGG2010** has been available since it was officially announced at the CGU meeting (16-18 May 2011). CGG2010 was converted to the same equipotential surface as EGM08 and USGG09 (a shift of 12 cm from CGG2005). It comes with error estimates (ranging from 2 cm in general to 10 cm in the mountains). Although GOCE data was used, its contribution was minimum in terms of model improvement but significant for model validation. In validating CGG2010 against “GPS on BMs”, results are better overall than CGG2005, EGM08 and USGG09. “GPS on BMs” was done on 2700 points but unfortunately nothing in the North. We plan to acquire airborne deflection data for geoid validation in the Arctic.

Marc spoke of possible future improvements to GPS-H (conversion between Ortho/Dynamic/Normal heights, transformation between (W) reference surfaces and tide systems).

**Height Modernization Communication Plan:** An implementation date has not yet been set. We need to set a date and give it an official name (e.g. CVRS2014?). Some of the challenges will be to

- select the equipotential surface that will be the “zero” level
- come up with a procedure for maintenance

All members were reminded of the importance to store and safeguard ellipsoidal heights with proper referencing and time tagging. Robert Duval stressed the fact that this new height system will not make a huge difference!

Robert added that we cannot simply declare that we adopt unilaterally a new height reference system. CGVD28 is in legislation and GeoBase (a CCOG product) is on CGVD28. We will have to show the pro's and con's of adopting the new height system, get NRCan's SGB (Surveyor General Branch) on board and have MIB (Mapping Information Branch) publishing in it. Its adoption will have to be published in the Canada Gazette.

Denis Hains added that there should be a special (CCOG-GeoBase) conference/workshop. He will be at CCOG in October 2011 presenting the communication plan. One of the drivers is NRCan moving to a new DEM that will include data from various sources (1:250K, 1:50K, LIDAR). Some provincial datasets will be the first to benefit.

Robert noted that the main hold-up to implementation is the adoption of "W<sub>0</sub>". It is a "convention" that we could choose for ourselves; however we would prefer to adopt an international standard "W<sub>0</sub>" (not yet adopted by IUGG). Denis felt we should maybe adopt it in 2013 anyhow and that this should be discussed further in a CGRSC conference call in September. Leo-Guy stressed the fact that municipalities are now getting heights from GPS and that there will be a requirement for much education.

## **19. Outstanding Issues**

Pierre Héroux was wondering if, in addition to integrating provincial active stations with NRCan/ACP stations (as proposed by Robert), second-epoch observations at provincial HPN passive stations could also be used to contribute to the CSRS velocity field.

Allen Fleming was concerned as to how the reference frame will evolve over time.

Léo-Guy noted that, since there are now ACP's and Network RTK, their HPN (140 points) are hardly used any more and there is no money to maintain them in the future. All legal data comes in using active control. Allen Fleming and Geoff Banham both echoed that they are getting away from using HPN control markers as well. There are 210 points in Calgary and in 5 years they will no longer be maintained. Expertise is being lost in the provincial geodetic offices. With the growing number of service providers willing to collaborate there will be a need for sanctioning.

In closing Robert Duval stressed the need to improve the velocity model so that new work can be tied to provincial standards. He wondered if provincial HPN should be re-observed? Mike Craymer felt it would take a lot of work plus much of the initial work (lower quality, inadequate monumentation) could not be used. Léo-Guy felt the biggest issue is cost.

Ron Berg added that some Network RTK providers are "done" with passive control as they are already serving 95% of users with active sites and have limited interest occupying control monuments in remote locations.

## **22. Action Items**

**11-01:** Provincial agencies to consider simultaneous GPS occupation of provincial HPN during CBN West Re-observation Campaign and to coordinate with GSD Technical Services. Members have already been provided with Observations schedule and contact information.

**11-02:** New version of PPP to be released to the public by end of June 2011. New features will include the use of GLONASS data, improved error reporting, scale factor information and improved kinematic processing. Action: Pierre Tétreault

**11-03:** GPS\_H v3.1 to be released to the public by end of June 2011. This new version will permit the use of geographic (D, DM or DMS) coordinates, Cartesian coordinates or UTM/MTM/custom TM coordinates. It will read and write files in GHOST, Geolab, UNICSV and custom formats. Action: Mario Bérubé and Pierre Sauvé

**11-04:** New TRX software to be released to the public (without batch capabilities) by end of September 2011. TRX will permit coordinate transformation between ITRF (various realizations) and NAD83(CSRS) at a specific epoch and CSRS epoch shifting using the NETv1.0 Velocity grid. It will accept geographic (D, DM or DMS) coordinates, Cartesian coordinates or UTM/MTM/custom TM coordinates. Action: Mario Bérubé and Pierre Sauvé

**11-05:** Léo-Guy Leblanc to provide GSD with New Brunswick Stereographic Projection parameters for inclusion in CSRS-TRX.

*Update: Léo-Guy has delivered the source code.*

**11-06:** GSD will evaluate 1) the possibility of carrying out the Integration of RTK service provider from a NAREF-type network solution and 2) the possibility of incorporating the RTK network on a continuous basis to improve the velocity model while monitoring the stability of the RTK networks; and will formulate a proposal to member by Fall of 2011.

**11-07:** GSD is to consider hosting combined CGRSN (Canadian Geodesy and Related Science Network) and CGRSC meetings when agenda are of shared interest to ensure complementarities.

**11-08:** Quebec MNRF and GSD to see how best post the translated-to-English version of Yves Thériault's document "Guide to Geodetic and Vertical Datum's in Quebec" and inform CGRSC members when available on-line.

**11-09:** CGRSC members to review the “Guide to Geodetic and Vertical Datum’s in Quebec” document and provide their feedback by end-of-June as to how it could be made more national (By making it generic? By adding an appendix for each province?). This will be discussed at a teleconference.

**11-10:** New Geoid model CGG2010 including most recent GRACE and GOCE Satellite mission gravity data and error estimates to be released to the public by May 20<sup>th</sup> 2011 (after the CGU meeting).

**11-11:** GSD is to confirm by end-of-September 2011 a release date for the New Vertical Datum based on the development related to the international adoption of a World Height System at the IUGG and in consultation with USNGS .

**11-12:** GSD is to prepare a communication plan for Height Modernization to be reviewed/discuss at a fall teleconference.

## **Update**

Since this CGRSC meeting there have been on-going discussions between GSD, service providers and the provinces. A teleconference was held September 14<sup>th</sup> 2011.

## **Next Meeting**

A date for the next CGRSC meeting was not confirmed but will likely be next spring (April or May 2012).

Pierre Sauvé

Secretary, CGRSC

Sept 28th, 2011

# Appendix “B”



Interpretation Resources (IR Mapping)  
[www.irmapping.com](http://www.irmapping.com)

Bus: 902-661-0830  
Fax: 902-661-2241

31 Church St  
PO Box 783  
Amherst, NS  
B4H 3A7

## NSCRS Policy / Strategy Review Questionnaire

**Organization:**

**Contact(S):**

### **Background**

The Department of Service Nova Scotia and Municipal Relations (SNSMR) has contracted to Interpretation Resources to conduct a Policy and Strategy review with respect to the Nova Scotia Coordinate Referencing System (NSCRS).

The NSCRS database (NAD83 (CSRS) is designed to be the primary source for all land related measurements and the location of geographic information in the province, providing the framework for all provincial topographic, property, and thematic mapping programs in Nova Scotia.

Presently the NSCRS is comprised of approximately 23,000 2<sup>nd</sup> order control monuments and 155 High Precision Points (NSHPN) around the province.

In 2007, SNSMR received a request from the spatial referencing user community to produce NAD83 (CSRS) values on the 2<sup>nd</sup> Order Network of points and SNSMR has been working towards that endeavor over the last three years.

The Province is planning to initiate a Geomatics Strategy this fall and therefore it is felt that it is the appropriate time to re-evaluate the needs of the user community with respect to coordinate referencing.

SNSMR is interested in obtaining feedback from specific users as to their present and future needs.



## Questions

1. What reference system is currently being used by your organization?

NAD83 (CSRS)  Other Comment:

2. If NAD83 (CSRS) is not the standard in use, are there plans to adopt it?

Yes  No

If yes, when?

3. If NAD83 (CSRS) is not the standard you use what are your challenges/reasons for not adopting or using it?

4. How do you access the coordinate information you require?

5. What is the range of positional accuracies you work in?

6. What is the range of vertical accuracies you work in?

7. If and when the Province moves ahead with the new Height Modernization Strategy how do you see this affecting your operations?

8. Do you import or use data from other sources which is not compatible with your data and needs additional processing?

Yes  No

If yes please explain if it is due to such things as accuracy, datum, data issues, etc.

9. If the answer to question #8 is (Yes), please indicate where your additional data is coming from?

10. Do you export or make available your data to others?

Yes  No

11. If yes, can the receiving party accept your data seamlessly into their system?

Yes  No  Don't Know

12.If the answer to #11 is (No), please explain if this is due to such things as accuracy, datum, data issues, etc.

13. The Province provides an internet based Coordinate Transformation Service. Is this service important to you?

Yes       No

If (No) please explain:

14. What if any other provincially sponsored supports would assist you?

15. Natural Resources Canada through the Geodetic Survey Division (GSD) presently operates a network of GPS satellite tracking stations, called the Canadian Active Control System (CACs). Do you use this service for improved GPS positioning?

Yes       No

16. Do you use any other Active Control System to assist with increased positional accuracies?

Yes       No

If (Yes), please indicate the source of this information:

17. If you answered (Yes) to question #16 do you know if this service is tied into the CACS?

Yes       No       Don't Know

18. Based on your business requirements are you presently being served adequately by the NSCRS?

Yes       No

If (No) please explain:

19. Based on your future business requirements what changes, if any, would you like to see happen with the NSCRS?