



Canadian Geodetic Reference System Committee Report:

Height Modernization Consultation Results (preliminary)



Background

- **2002 – CCOG recognizes the need for Modernization of the Canadian Geodetic Vertical Datum, a key component of the CSRS**
- **2003 - CCOG recognizes that the information required to build a comprehensive implementation strategy can best be gathered through an extensive Canada-wide stakeholder consultation**
 - **Consultation Objective**
 - **Confirm stakeholder's/ user's requirements**
 - **Basis for an effective implementation plan to minimize impacts and maximize benefits for User Community and Stakeholders**
 - **Raise Awareness that Modernization is on the Horizon**
 - **Agreement to confirm participation and funding initiated in May 2004 / signed in February 2005**
 - **\$86,100 + \$50,000 (ESS) = \$136,100 (target funding \$150k)**
 - **Contract awarded to Hickling, Arthurs & Low (HAL) – Oct 2005**
 - **Managed by GSD + Steering Committee (Qc, Alta, Man, N.S.)**
 - **Draft Final report delivered July 2006**
 - **Final review and development of next steps on agenda of CGRSC Sept 18-20**



Recap: Height Modernization Rational

- **The current Canadian Geodetic Vertical Datum of 1928 (CGVD28), officially adopted in 1935 suffers from significant limitations:**
 - **The datum is only defined at benchmarks (located along main road and railways), leaving much of the country without access to the height standard.**
 - **The physical network is very expensive to maintain because of the large number and extent of benchmarks upon which it depends. As a result, neither the federal nor provincial governments have been maintaining benchmarks, and do not plan to in the future.**
 - **The reference system has significant inherent distortions that are further exacerbated by geodynamic movement.**
 - **The system is not directly compatible with GPS-based measurements and therefore will not be in accord with future international standards.**

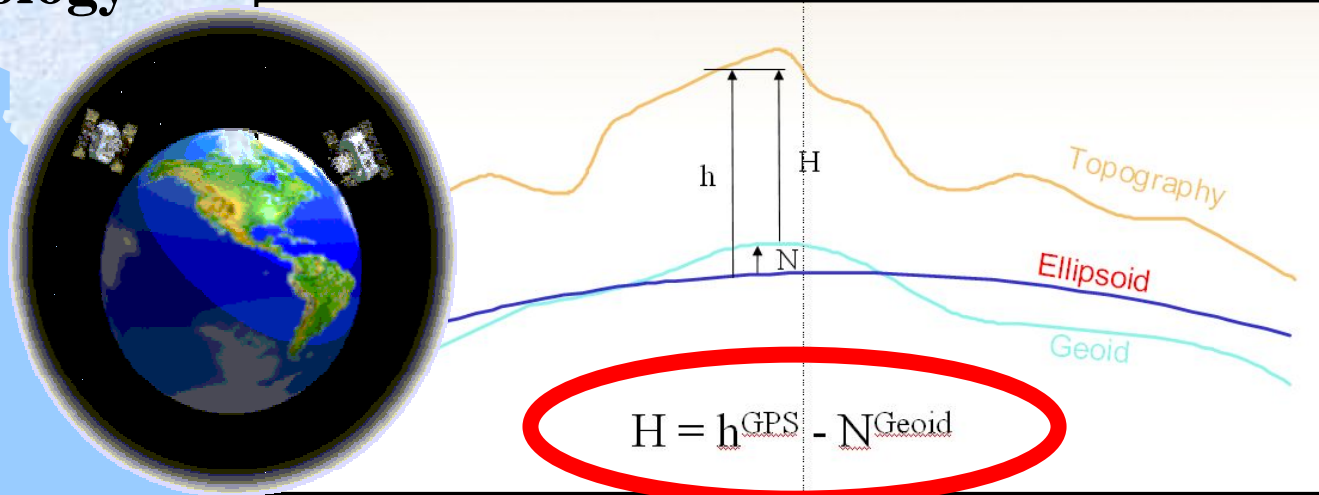


Recap: Height Modernization?

Move from Classical Networks:
+250,000 km of levelling lines
+100,000 monuments (BM)

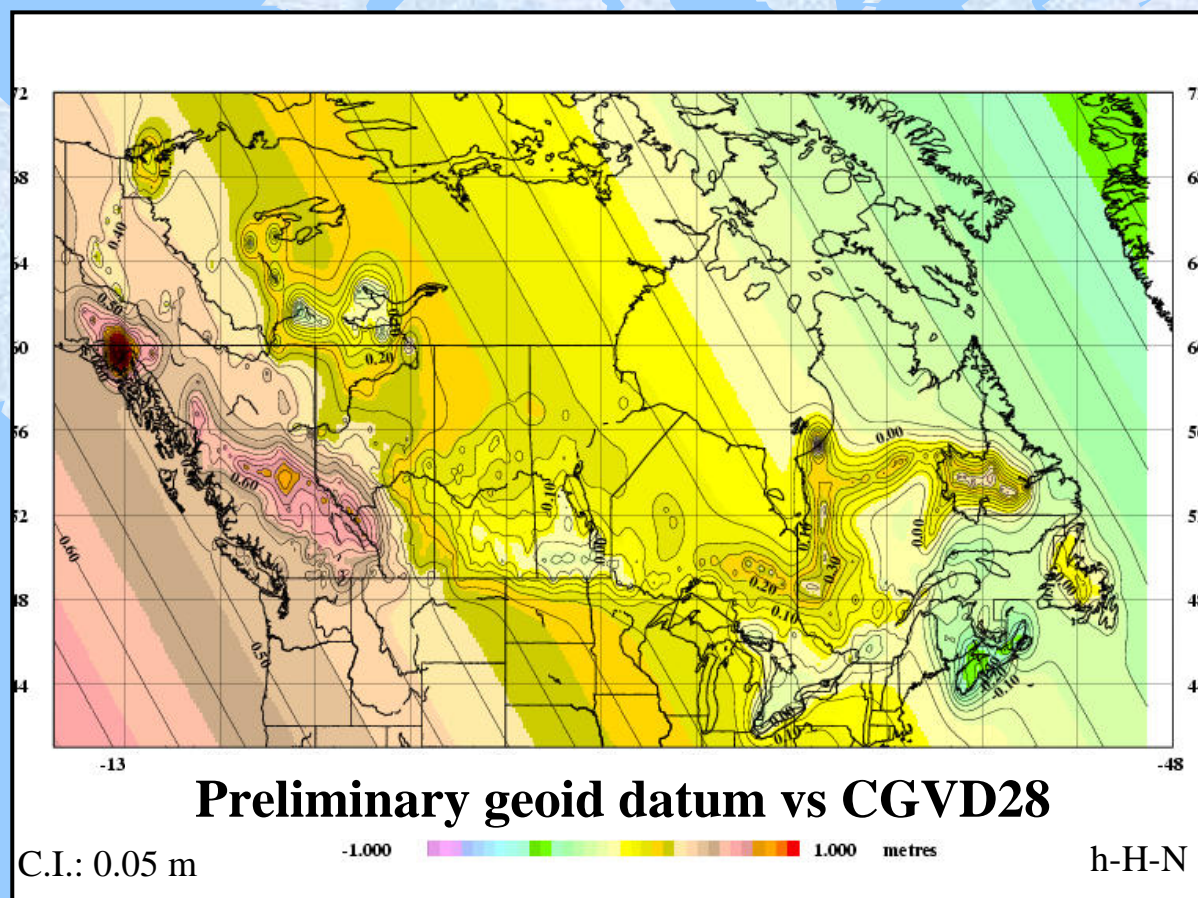


**To Geoid based system enabling
efficient use of Space-based
Technology**



Recap: Changes in Heights with New Datum

- assuming Rimouski used as fundamental reference (same as US)



St-John's:	-10 cm
Halifax:	-35 cm
Montreal:	-10 cm
Toronto:	-5 cm
Winnipeg:	-5 cm
Regina:	0 cm
Edmonton:	25 cm
Banff:	75 cm
Vancouver:	50 cm
Whitehorse:	60 cm



Consultation Report: Findings

- **The majority of stakeholders feels that the benefits of the modernization outweigh the disadvantages. There is a realization that the current system is outdated, inaccurate, and at odds with modern approaches.**
 - ➔ **This view is shared by many other jurisdictions, and countries around the world are moving towards a geoid model approach. New Zealand has already implemented a geoid-based height reference system and the United States is considering such a change, but over a longer timeframe.**
- **A change in the height datum should not have legal ramifications as long as there exists an official transformation from the old to the new system. It may be prudent for stakeholders to review and amend the wording in legal documents, but as long as it is clear which datum was used at the time of the drafting of an agreement, the appropriate conversions can be made.**
- **Most users are concerned with relative accuracy with respect to local control networks. Only those establishing precise control networks over large areas (such as some watersheds) may be concerned with absolute accuracy**
- **Absolute accuracy does become important, however, when combining information from different data sets – a practice that is becoming more common as information in various GIS systems is shared and integrated among users.**



Consultation Report: Findings

➤ Accuracy requirements

Applications	Cited Relative Accuracies	Operating Ranges
Bridges and Dams	Millimetres	100s of metres
Research	Millimetres	10s to 100s of Kilometres
Construction	Centimetres	100s of metres to Kilometres
Legal Surveys	Centimetres	100s of metres
Municipal	Centimetres	10s of Kilometres
Water Management	Centimetres	10s to 100s of Kilometres
Oil and Gas	Decimetres	10s of Kilometres
Ports	Decimetres	Kilometres
Mapping	Metres	10s to 100s of Kilometres



Consultation Report: Height Modernization Advantages

- **Significantly lower cost for maintenance of the height reference system.**
- **Lower costs for determining heights, especially in remote or rugged terrain.**
- **Accessibility to the datum at any point on land or sea, without the need for access to benchmarks.**
- **Compatibility with modern spaced-based approaches to height measurement using, for example, GPS.**
- **Better compatibility across disparate datasets, making it easier to share and integrate data.**
- **Improvement in accuracy.**
- **Future compatibility with international standards for height measurement.**



Consultation Report: Height Modernization Disadvantages

- **Cost of training and equipment acquisition necessary to implement a geoid-based approach to height measurement.**
- **Cost of the creation and maintenance of an accurate geoid, and the cost of communicating the changes to stakeholders.**
- **Possible need to convert legacy databases to the new datum.**
- **Possible confusion between the old and new datums, resulting in confusion and errors.**
- **Possible need to update legal documents and legislation.**



Consultation Report: Impediments, Risks, and Mitigating Actions

- **Dependence on Satellite Technology:** Problems with the GPS system could result in the unavailability of position data.
 - ➔ **Maintain at least some major existing benchmarks and ensure compatibility with other Global Navigation Satellite Systems (GNSS) in addition to GPS.**
- **Misunderstandings and Errors :** The small changes between the old and new datums could result in errors and confusion.
 - ➔ **Create a designation for the new datum system that will differentiate it from the previous datum.**
 - ➔ **Ensure that data users are fully informed of the changes and their implications.**
 - ➔ **Provide a national network of benchmarks where all three heights (ellipsoid, geoid, and orthometric) are available.**
- **Maintenance of the New Datum:** Stakeholders are concerned that the datum will change too often.
 - ➔ **'Get it right the first time' and minimize changes necessary to the geoid in the future.**
 - ➔ **Develop geophysical models of the various processes that impact elevation in all regions of North America.**



Consultation Report: Impediments, Risks, and Mitigating Actions

- **Resistance to change:** Stakeholders may be wary of uncertainty and reluctant to change.
 - Provide communications and educational material that reduces uncertainty and demonstrates the advantages of the new approach.
- **Transformation of Legacy Data:** Some stakeholders are concerned about the cost and difficulties of transforming legacy data to the new datum.
 - Provide methodologies and tools for data translation.
 - Publishing old and new height values for federal and provincial benchmarks.
- **Cost of Implementation:** The transition period will require information, tools, and data dissemination.
 - Provide the provinces and territories with help to facilitate the transition in their jurisdictions.
- **Implementation Management:** Stakeholders may not support the datum change unless they feel that they have had the opportunity to guide its implementation.
 - Implementation should be steered by a joint council of federal and provincial agencies (such as CCOG) and other stakeholders, such as municipalities, surveyors, and water resource professionals, should be involved.



Consultation Report: Federal Government Responsibilities

- **Continue scientific research to define the best gravity-based surface (geoid) to adopt as datum and conduct additional fieldwork to verify and maintain this model.**
- **Provide and maintain the Canadian Base Network and the Active Control Points.**
- **Carry out the required transformation of the existing primary levelling network in order to compute and propagate new heights.**
- **Provide conversion tools and guidelines required to ensure that information gathered with respect to the CGVD28 datum can be integrated with data in the newly defined datum.**
- **Establish the datum formally when appropriate.**
- **Help the provinces to facilitate transition and adoption of the new standard among their user communities by providing information and tools for communications.**
- **Work with the GPS receiver and GIS software industries to ensure that the standards, procedures and documentation are in place to assist users in using the new height reference system.**



Consultation Report: Provincial and Territorial Geomatics Departments Responsibilities

- **Provide and maintain the High Precision Networks.**
- **Lead client liaison activities in their region, including communications, consultations, and guidance.**
- **Carry out the required transformation of the existing provincial leveling network in order to compute and propagate new heights.**
- **Provide continuous feedback to federal government regarding user needs, user adaptation and potential improvements.**
- **Consider establishing the datum formally in their constituencies over time.**
- **Disseminate information, tools and data enabling height determination with respect to the new datum, to clients and stakeholders.**
- **Help the municipalities and other provincial stakeholders to facilitate transition and adoption of the new standard.**



Consultation Report: Providers and Users of Height Information responsibilities

- **Become informed of the proposed changes and consider the implications for their operations.**
- **Invest in the education and technology required to implement the new approach within their operations.**
- **Educational institutions will provide educational material that incorporates the geoid-based approach to height determination.**



Consultation Report: Implementation Plan Key Elements

- **Governance :**
 - **A Working Committee consisting of representatives from the federal government and the provinces and representatives of other stakeholder communities reporting to CCOG**
- **Geoid Development and Maintenance**
 - **An accurate geoid model for Canada will be developed and maintained. It is based on CHAMP, GRACE and GOCE satellite gravity missions**
- **Stakeholder Interaction**
 - **Communications, Consultation and Guidance**
- **Tools Development**
 - **Clear guidelines, transformation parameters, and tools will be provided for the conversion of legacy data to the new datum.**
- **Education**
- **Formal Adoption**
- **Monitoring**



Timeline

	06/07	07/08	08/09	09/10	2010 +
Height Modernization consultation	Yellow				
Confirm implementation plan and Communication Strategy	Yellow				
Data collections & analysis (GPS/levelling/gravity & DEM)	Yellow	*	Yellow		
Stakeholder communications / Education / Support		Yellow	Yellow	Yellow	Yellow
Development of tools using preliminary geoid models		Yellow	Yellow	Yellow	
Computation of <u>new geoid model</u> including GOCE data			Yellow		
Adoption and publication of a new geoid model				Yellow	
Publication of new heights for classical levelling network				Yellow	
Transition period (CGVD28 / New datum)					Yellow
Infrastructure maintenance (ACS, CBN, and HPN)					Yellow
Geoid model maintenance					Yellow

* Launched of the GOCE satellite gravity mission (1-2 cm accuracy at a spatial resolution better than 100 km)