Geo-Referencing Requirements on Canada Lands
Past Geo-Referencing Requirements

- 1 km rule based on conventional connections
- Used pin-pricked photos or Topographic Maps
- CSA Connections
  - Accuracy of cadastral data in CSA < 10 cm
  - Further connections provide little benefit in many cases
- Northern Land Claim Surveys
  - Geo-referenced surveys has provided accurate cadastral data
  - Data in communities and developed corridors < 30 cm
  - Many areas do not need further geo-referencing
Background

- 1999 – Technical, Social and Legal Implications of Using Coordinates-only to Define Boundaries
- 2002 – Integrated Land Surveys
- 2005 – CCOG Resolution on Integrated Surveys
  - NAD83CSRS Connections: Urban 5 cm, Rural 20 cm, Remote 1 m

- GNSS positioning technologies

- New Spatial Applications: Google Earth, Navigation, Municipal Infrastructure GIS

- Users are demanding more accurate spatial data
Data Accuracy Demands, e.g. Google Earth
Benefits to CLS System

- Improves Accuracy of Cadastral Data
- Digital Submissions are in consistent reference System
- Efficient Cadastral Data Maintenance
- Transitional Bridge in Using Coordinates to Define Boundaries
Benefits to Surveyor

- Data is consistent with GNSS (GPS)
- Helps search for boundary evidence
- IDs blunders between new survey and cadastral data
- Data is Free to Use for all Geomatics Projects
New Geo-Referencing Standards

- Phased approach towards requiring geo-referencing of all surveys in 2 years
- First phase effective April 1, 2008, Chapter D1 of General Instructions
- Remote Surveys: 1 m at 95%
- GPS Controlled Surveys: 20 cm at 95%
New Geo-referencing standard

- Remote surveys: includes areas outside inhabited urban and rural areas, and small Reserves

- 20 cm requirement applies when survey grade receivers are being used to control or measure the boundaries, e.g. RTK, GPS baselines, bearing control

- Exempt if survey is connected to accurately geo-referenced cadastral fabric

- 20 cm and 1 m accuracies are required for the entire survey
Absolute Accuracy of Survey

Sample: Absolute Accuracy = \sqrt{(10^2 + 5^2)} = 12\ cm

Absolute Accuracy of the whole survey must not exceed 20\ cm.
Why NAD83(CSRS)

- National Reference System as is CLS system
- Distortion “Free”; removed errors in NAD83
- Directly linked to Global Reference Frame (ITRF); aligned with GNSS observations
- Uses Higher Precision Markers and GNSS
- Source Coordinates have known accuracies
- Access to ground control is NOT required
- NTv2 Models available to convert NAD83 databases
- Adopt now rather than playing catch-up later with distorted cadastral data
NAD83: One datum, two realizations

NAD83(Original) and NAD83(CSRS)

NAD83(Orig.) stations re-observed with high-order GPS
Difference between Original and CSRS

GSD has helped the provinces produce NAD83(Original) to NAD83(CSRS) grid shift files

Source: Geodetic Survey Division
Geo-Referencing Methods

- CSRS-PPP solutions
- Fed/Prov. High Precision Control Markers
- Legal Survey Control Markers with known accuracies
- Active Control Stations (CACS, BCACS)
- Metropolitan Reference Station RTK Suppliers (Cansel CAN-NET, Sokia PowerNET, GVRD)
- Other Reference Station Suppliers
NAD83(CSRS) Federal geodetic control

http://www.geod.nrcan.gc.ca

Provincial survey agencies also have High Precision Networks (extended CBN)

Observing at a CBN monument

Source: Geodetic Survey Division
Post-Processing CSRS-PPP

CSRS-PPP is an on-line application for GPS data post-processing that allows GPS users to submit observation data over the Internet and recover, using precise GPS Orbit and Clock information, enhanced positioning precisions in the Canadian Spatial Reference System (CSRS) and the International Terrestrial Reference Frame (ITRF).

Select one RINEX File: [Browse]
(Compression: none or zip (.zip), gzip (.gz) or UNIX Compress (.Z))
(Form: RINEX or Compact RINEX (Hatanaka))

Select Mode of Processing: ☐ Static ☐ Kinematic

Select Reference System: ☐ NAD83-CSRS ☐ ITRF

Enter/Change E-Mail to which results will be sent: plsauve@nrcan.gc.ca

File Upload/Processing: [START]
(Note: Processing will start once the upload is completed which may take a few minutes)

http://www.geod.nrcan.gc.ca

FREE for GPS users WORLDWIDE

Precise Point Positionning

RINEX
Submit
E-Mail

Source: Geodetic Survey Division
CSRS-PPP (Static)
Single-frequency mapping-grade receiver

20 cm accuracy in 2 hours

Shirley’s Bay Tests, open sky

Source: Geodetic Survey Division
CSRS-PPP (Static)
Dual-frequency geodetic receiver

4 cm accuracy in 2 hours

Source: Geodetic Survey Division
Geo-referencing Reporting

- List the Coordinates / Heights of the Source Control, Established Control and Key Monuments on the plan.
- Show the GPS Control Stations and Network Sketch on the plan.
- Accuracy Report; specify the absolute accuracy of the control stations and of the survey.

<table>
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<tr>
<th>STATION</th>
<th>NORTHING</th>
<th>EASTING</th>
<th>ORTHOMETRIC ELEVATION</th>
<th>COMBINED SCALE FACTOR</th>
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Coordinates are derived from a least squares adjustment of GPS observations and compass rule adjustments of conventional observations holding the CCCM supplied coordinate values for 43809 fixed in 3D and the CSRS published coordinate values of 437052 fixed in 2D.

Elevations are orthometric heights derived from the orthometric height of Geodetic Control Monument "43809".

* denotes values provided by CCCM
** denotes published values

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Cadastral Data Maintenance

- Input Control Stations as Reference Points in the Cadastral Data

- Reference Points are used to control the cadastral data and track the accuracy of data.
Cadastral Data Maintenance

Improving the cadastral data by:

- Requiring geo-referenced surveys
- Data updates attempt to preserve the relative accuracy of the new survey and existing data while improving the absolute accuracy of the data
- Developing new adjustment techniques and looking at measurement-based systems
- Doing re-builds when there are large updates
- Assess and document the accuracy of the data
- Requiring Digital Spatial Files of Surveys as per New Appendix E5 (Oct 1 effective date)
More Details and Questions?

- Procedural Guide being developed by CCCM; available May 31. Contact any CCCM Office for a Copy of the Guide; also will be on CCCM web site