GRCA Geospatial Data Standards

Considerations for the delivery of 2D and 3D spatial data

Version: 1.09
Last Update: July 23, 2024

Geomatics, Information Systems and Technology
Grand River Conservation Authority (GRCA)

Introduction

Purpose

This document is intended to provide GRCA project managers, GRCA technical staff, and partner organizations with a summary of best practices and **GRCA standards related to geospatial data** (e.g. GIS, GNSS, LiDAR). It is a resource to assist GRCA staff when defining project requirements and deliverables to ensure appropriate terms are included in contracts, agreements, and other collaborative arrangements involving geospatial data.

The quality, reliability and usability of data outcomes are directly impacted by parameters contained herein and warrant consideration in early stages of project planning. Acronyms used in this document are described in the Glossary.

Speak with GRCA Geomatics staff in advance of a project for support defining project requirements.

Summary of Minimum Requirements for Projects Involving Geospatial Data

- Geospatial data format complies with standards outlined in Table 1
- Horizontal and Vertical referencing complies with Table 2 and Table 3
- Metadata must accompany any data product provided by or to GRCA
- Intellectual property rights must be clearly communicated and/or or data license included
- Provide data capture specifications to consultants in advance (precision, attributes, etc.)

Geospatial Data – The Basics

All data need a geographic coordinate reference system[1]. Building on that, there are two common approaches to storing horizontal position information: projected (e.g. UTM with northing, easting coordinates) or unprojected (aka. geographic, with latitude/longitude coordinates). A horizontal datum is the foundation for both. When elevation data is captured, a vertical reference system is also required.

GRCA has a need for both survey grade data (high accuracy) and general mapping level of detail or non-survey grade data. Reference system standards can vary between survey grade and non-survey grade data.

[1] Common reference systems used for Ontario data include NAD83, WGS84, and NAD83 CSRS.

Note: Geospatial data delivered to GRCA as part of a project need to meet the spatial reference system standards outlined in Table 1 through Table 3.

Standards

Formats

GRCA uses Esri software including ArcGIS, ArcGIS Pro and SDE. Acceptable data formats for geospatial data are listed in Table 1.

Table 1: File Format and Unit of Measurement Standards

Format	Preferred Option	Alternate Option
Vector	Esri file geodatabase Feature Class	Esri shapefile Feature Class
Raster	Esri file geodatabase Raster or geoTIFF	Refer to project Specifications
Tabular	Esri file geodatabase table or .CSV	Refer to project Specifications
Unit of measure	Metric	Refer to project Specifications

Horizontal Reference System

The following table specifies the preferred horizontal coordinate system for **survey grade** data and **non-survey grade** data. Speak with GRCA Geomatics staff for clarification if needed.

IMPORTANT: Also review the *Geographic Transformations* section for critical information.

Table 2: Horizontal Reference System Accepted by GRCA[2]

EPSG ID	Horizontal Reference System	Survey Use	Non-Survey Use
22617 22717	NAD83 CSRS v6 UTM Zone 17 NAD83 CSRS v7 UTM Zone 17	**Preferred**	Alternate
26917	NAD83 UTM Zone 17	No	**Preferred**
8252	NAD83 CSRS v6	Alternate	Alternate
8240	NAD83 CSRS v3	Alternate	Alternate
22317	NAD83 CSRS v3 UTM Zone 17	Alternate	Alternate
4326	WGS84	Contact	Contact

For clarity in project specifications and deliverables, use the EPSG Registry ID with the referencing system. Alternately, specify WKIDs used by Esri which are largely based on EPSG numbers.

Vertical Reference System

The official geodetic vertical datum for GRCA is the Canadian Geodetic Vertical Datum of 2013 (CGVD2013). GRCA adopted CGVD2013 to further support the national "Height Modernization" initiative being undertaken by CGS-NRCan and other provincial geodetic agencies across Canada. CGVD2013 is defined by an equipotential surface which represents by convention the coastal mean sea level for North America.

Table 3: Vertical Reference System Accepted by GRCA[3]

EPSG ID	Vertical Reference System	Usage
9245	CGVD2013 based on Geoid CGG2013a	**Preferred**
5713	CGVD28 based on Geoid CGG2000 Htv2	Alternate

[2] ArcGIS uses versioning to distinguish between different realizations (epochs) of NAD83 CSRS where "v3" refers to NAD83 CSRS epoch 1997 GCS and "v6" refers to NAD83 CSRS epoch 2010 GCS

[3] Heights in terms of CGVD2013 are orthometric. Heights in terms of CGVD28 are normal-orthometric. See Figure 1 in Height Reference System Modernization published by Natural Resources Canada

Geographic Transformations

Geographic transformations are used to transform from one geographic coordinate reference system to a different geographic coordinate reference system. The accuracy of a transformation can range from a few centimetres to metres. Use CAUTION.

Transformation Notes:

- Transformation between WSGS 1984 and NAD83[4] is common for North America. With ArcGIS this requires the transformation "WGS_1984_(ITRF)_To_NAD_1983".
  N.B. This is not NAD83 CSRS.
- Use of NTv2 tool is a common file-based transformation method
- Transformation between NAD83 and NAD83 CSRS not available with all GIS software; GRCA uses custom geographic transformation files

Special Note for Survey Grade Data: If the data is not collected natively in accordance with the Preferred standards listed above **DO NOT apply a transformation**. Contact GRCA Geomatics staff for support.

Data Capture Methods

Geospatial data can be collected and created in a variety of ways. Knowledge and experience an external service provider has regarding generating geospatial data that complies with GRCA standards is an important consideration when selecting such a provider to work on a project.

Digitizing

Digitizing from mylar maps or heads-up from digital imagery on-screen are common data capture methods. Ensure the following details are documented:

- Source
- Description
- Date on source
- Scale or resolution of source
- Horizontal Reference System
- Media type
- Conversion method

[4] WGS84 was originally compatible with the NAD83 reference system but WGS84 has been redefined and is now compatible with ITRF2008 reference system.

Note: Respect copyright when digitizing from existing map or data products. See Intellectual Property below for more information.

GNSS

GNSS/GPS receivers need to be configured in advance of data collection to ensure the best possible way to achieve the desired accuracy. There are various factors to consider when determining which receiver settings are most appropriate. The GNSS operator will also need to ensure data collected using the GNSS receiver will comply with GRCA standards.

If your project includes data collection using LiDAR, UAV or Total Station, that equipment will, with very few exceptions, inherently use GNSS.

Unless post-processing is employed, RTK GNSS is a common “survey grade” solution. Access to a Network RTK subscription service[5] provides high quality real-time GNSS corrections while out in the field. The survey grade GNSS receiver that GRCA owns uses this method.

When project requirements do not necessitate highly accurate survey grade data then GNSS receivers suitable for general mapping or even recreational purposes may be suitable for data collection.

> Using GNSS for data capture? Refer to Table 2: Horizontal Reference System Accepted by GRCA and Table 3: Vertical Reference System Accepted by GRCA.

Additional Specifications

Project Deliverables

Before data collection commences clearly specify project deliverables to include:

- Metadata
- Geospatial data that meets GRCA standards outlined in Table 1 through Table 3
- Where GNSS is used also request the tabular data from the receiver, i.e. original source data
- Data license to accompany data and/or intellectual property rights outlined in project contract. The latter is strongly advised particularly when GRCA is hiring external professional services.
- Comply with MFIPPA

[5] Trimble’s RTK network is called Can-Net. Topcon’s network is TopNET*live*. Both of these private RTK networks are compliant with and broadcast the NAD83(CSRS) national standard.

- See also to Summary of Minimum Requirements for Projects Involving Geospatial Data

GNSS Precision / Accuracy

In the early stages of project planning, identify the required level of relative positioning precision. Communicate this requirement clearly to the Contractor; data collection settings on the GNSS receiver must be set accordingly. Note that the term “accuracy” is frequently used interchangeably for “precision”.

“Survey grade” is generally considered decimetre precision but should be able to achieve relative positioning with *centimetre* precision depending on how long observations are recorded at a given location. For general mapping purposes (i.e. non-survey grade) precision is typically in the 2-5m range. Note that it is more difficult to achieve vertical precision than horizontal.

With survey grade GNSS data, it is useful to request that horizontal precision, vertical precision, PDOP, and number of satellites be recorded and uploaded from the receiver as feature level metadata in the resultant GNSS data table. Refer to *Table 1: File Format and Unit of Measurement Standards*.

Geospatial Data Accuracy

Often reported as + /– X metres or an RMSE value should be provided. Intended use of data plays a big part in deciding on accuracy requirements for the project.

Accuracy statements for DEMs should include both horizontal and vertical accuracy statements that comply with ASPRS [6] or Natural Resource Canada standards.

> e.g. This data set was tested to meet ASPRS accuracy standards (Edition 2) for a ___ cm Vertical Accuracy Class. Actual non-vegetated vertical accuracy was found to be RMSEz = ___ cm. Actual vegetated vertical accuracy was found to be +/- ___ cm

Metadata

GRCA metadata template should be used. Minimum required information includes:

- Abstract
- Description of attributes and list possible values
- Horizontal coordinate system including datum; incl. WKID or ESPG ID
- Horizontal projection as applicable; incl. WKID or ESPG ID
- Vertical coordinate system, as applicable; incl. WKID or ESPG ID

[6] American Society for Photogrammetry and Remote Sensing (ASPRS) Positional Accuracy Standards for Digital Geospatial Data.

- Terms of use
- Spatial precision / accuracy
- Data capture (or creation) date
- See also *Data Capture Methods*

Intellectual Property

For GRCA projects, the main contract with the service provider should address intellectual property (IP) rights. For incoming and outgoing IP, e.g. data, a data license needs to exist or accompany the data.

For most GRCA projects, the requirement will be that GRCA holds full IP rights to project deliverables. There can be exceptions to this, especially where third party rights come into play.

Be cognisant of pre-existing data, i.e. IP that existed pre-project and will be used for the project. Use of, or incorporating, such data into a deliverable warrants close consideration of third-party rights. It may not be possible for the service provider to assign full IP rights to GRCA.

If GRCA cannot hold full IP rights to deliverables of a GRCA project, ensure full licensed rights and granted. Speak with GRCA's Geomatics team for more details.

Remarks

At time of publication:

- National standard for horizontal is NAD83CSRS v7 epoch 2010;
- CGVD2013 is the height reference standard across Canada;
- GRCA GIS data warehouse is currently referenced to NAD83;
- GRCA Survey data is currently referenced to NAD83 CSRS v7;
- GRCA uses a custom transformation file with ArcGIS to transform between NAD83 and NAD83 CSRS epoch 1997 v3;
- Using ArcGIS it is not yet possible to transform between NAD83 CSRS 1997 v3 and NAD83 CSRS epoch 2010 v6/v7; and
- As of January 2024, GRCA is using ArcGIS version 10.8.1, ArcGIS Pro 3.2 and ArcSDE 10.8.

Glossary

Acronym	Full Description
CGG	Canadian Gravimetric Geoid, e.g., CGG2013
CGVD	Canadian Geodetic Vertical Datum, including CGVD1928 (tidal), CGVD2013 (gravimetric)
CSRS	Canadian Spatial Reference System, a 3D grid maintained by Natural Resources Canada
DEM	Digital elevation model
EPSG	European Petroleum Survey Group. The EPSG Geodetic Parameter Registry contains a dataset of Coordinate Reference Systems and Coordinate Transformations. The dataset is maintained by the Geodesy Subcommittee of IOGP's Geomatics Committee
GCS	Geographic Coordinate System, often used interchangeably with "datum"
GLONASS	Russian Global Navigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System, the American Global Navigation Satellite System
IOGP	International Association of Oil and Gas Producers
IPR	Intellectual property rights
MFIPPA	Ontario Municipal Freedom of Information and Protection of Privacy Act
NAD83	North American Datum 1983
PDOP	Position Dilution of Precision; recorded by GNSS receivers. The greater the value, the lower the accuracy of the GNSS data. Receiver settings typically set to a maximum acceptable PDOP value; data capture prevented in conditions where PDOP reading is above that limit
RMSE	Root Mean Square Error
RTK	Real Time Kinematic
UTM	Universal Transverse Mercator
WGS84	World Geodetic System 1984
WKID	Well-known ID