



Primary Vertical Bench Marks, Canada, Level 1 Product Specifications

Edition 1.0

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FUTURE WORK

Key word	Description

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ACRONYMS AND ABBREVIATIONS

CACS	Canadian Active Control Systems
CGVD28	Canadian Geodetic Vertical Datum 1928
CSRS	Canadian Spatial Reference System
GSD	Geodetic Survey Division
GPS	Global Positioning System
ITRF	International Terrestrial Reference Frames
NAD27	North America Datum 1927
NAD83	North America Datum 1983
PVBMC1	Primary Vertical Bench Marks, Canada, Level 1
PVC	Primary Vertical Control
UTM	Universal Transverse Mercator

TERMS AND DEFINITIONS

CGVD28

Canadian Geodetic Vertical Datum 1928, mean sea level. (Adopted, public vertical reference system.). The average height of the surface of the sea for all stages of the tide. Usually determined by averaging height readings observed hourly over a minimum period of 19 years.

NAD27

North American Datum 1927. A non-geocentric horizontal control datum for the U.S., Canada and Mexico, defined by a location and azimuth on the Clarke spheroid of 1866, with origin at Meades Ranch.

NAD83

North American Datum 1983. (Public horizontal reference system). The horizontal control datum for the U.S., Canada, Mexico, and Central America, based on the Geodetic Reference System 1980 (GRS80) geocentric reference ellipsoid.

NAD83CSRS

North American Datum 1983 Canadian Spatial Reference System (3-D coordinate system). An adjustment of the Canadian Base Network and high-order GPS tied to the Canadian Active Control System (CACS). Reference ellipsoid is GRS80. These coordinates may not be compatible with NAD83 public values.

1 Overview

The Primary Vertical Bench Marks, Canada, Level 1 (PVBMC1) are (approximately 80000) monuments established about every 2 km along major highways and railways across Canada.

Elevations issued by the Geodetic Survey Division (GSD) are those based on the 1928 adjustment of the national levelling networks – Canadian Geodetic Vertical Datum 1928 (CGVD28).

The data format of the PVBMC1 information could be GML (ASCII) or SHAPE. PVBMC1 information includes geographic and UTM coordinates, orthometric elevation, marker information description, and inspection data.

2 Data Identification

2.1 Spatial resolution (“scale”)

The Primary Vertical Bench Marks, Canada, Level 1 (PVBMC1) are (approximately 80000) monuments established about every 2 km along major highways and railways across Canada.

2.2 Language

The main language used in the dataset (points) is English, although some French is also used.

2.3 Character set

The character coding standard used for the dataset is ISO-8859-1.

2.4 Topic category

The primary vertical bench marks are designed to serve as a fundamental vertical reference frame for spatial positioning in Canada (the geodetic Canadian Spatial Reference System - CSRS).

According to the GCMD¹ (Global Change Master Directory) thesauri, PVBMC1 can be classified into Science keywords structured using a 4 levels hierarchy: category > topic > term > variable. The following list indicates which have been retained for Primary Vertical Bench Marks, Level 1.

CATEGORY > TOPIC > TERM > VARIABLE

- EARTH SCIENCE > SOLID EARTH > GEODETIC > CONTROL SURVEYS
- EARTH SCIENCE > SOLID EARTH > GEODETIC > REFERENCE SYSTEMS
- EARTH SCIENCE > HUMAN DIMENSIONS > BOUNDARIES > SURVEYS

Other topics related to PVBMC1 are: Canadian Geodetic Vertical Datum 1928, CVGD28, Canadian Spatial Reference System, CSRS, Vertical, Elevation, Levelling, Primary Vertical Bench Marks, PVBMC.

¹ Information about the NASA Global Change Master Directory (GCMD) can be found at:
<http://gcmd.nasa.gov>.

2.5 Geographic box

The geographic box or minimum bounding rectangle (MBR) delineating the coverage of all existing PVBM1 geodetic points in Canada is:

- West Bounding Coordinate: 141° West (or -140°)
- East Bounding Coordinate: 52° West (or -52°)
- North Bounding Coordinate: 84° North (or 84°)
- South Bounding Coordinate: 41.5° North (or 41.5°)

2.6 Geographic description

The Primary Vertical Bench Marks, Canada, Level 1 (PVBM1) are established about every 2 km along major highways and railways across Canada.

2.7 Extent

The elevation extent (minimum value and maximum value) for the PVBM1 is categorized according to mean sea level height.

1) Mean sea level height

- Minimum elevation value is 0.
- Maximum elevation value is 2206.
- Unit of measure for elevation is the metre.
- Datum used to determine the elevation is Canadian Geodetic Vertical Datum of 1928 (CGVD28).

3 Geospatial Characteristics

3.1 Spatial representation type

The method used to spatially represent PVBMC1 is vector data.

3.2 Spatial representation (VD) (GD)

The PVBMC1 are 3-D spatial points. The set of PVBMC1 points forms a geodetic network.

3.3 Coverage and continuity

The PVBMC1 is located every 2 km along major highways and railways across Canada.

3.4 Data segmentation (VD)

NOT APPLICABLE

4 Data Model (VD)

4.1 Data modelling schema used (VD)

The data-modelling schema used is UML.

4.2 Application schema (Conceptual model) (VD)

Primary Vertical Bench Marks, Canada, Level 1 (PVBMC1) data are represented in GeoBase as a point feature. Each PVBMC1 feature is unique and independent. There is no relationship or association between PVBMC1 features or with other external feature.

PVBMC1 FEATURE
UNIQUE NUMBER
MARKER GROUP
NAME
PROVINCE
LATITUDE
LONGITUDE
NTS MAP NO
UTM ZONE
UTM NORTHING
UTM EASTING
ELEVATION
MARKER TYPE
INSPECTION DATE
MARKER CONDITION

5 Data Dictionary / Feature Catalogue (VD)

The PVBMC1 feature attributes listed below are a subset of the *Canadian Spatial Reference System Database (CSRS DB)*. The *CSRS DB Data Model and Data Dictionary* document² presents the data-modelling schema in the form of an Entity-Relationship diagram adjusted for GeoBase.

² This document can be found at <http://www.geobase.ca/> - Data Description section.

ATTRIBUTE NAME	CORRESPONDING CSRS DB TABLE – COLUMN - DATA TYPE	DATA TYPE (OUTPUT FORMAT)	DESCRIPTION
UNIQUE NUMBER	STATION_MARKS - STATION_NO - VARCHAR2(8)	STRING	The unique station identifier of a survey monument, which may comprise of between 5 to 8 alpha/numeric characters. For more information on “Unique Numbers” and its coding see Appendix A of <i>CSRS DB Data Model and Data Dictionary</i>
MARKER GROUP	Returned on output according to its group	STRING	The name identifying a group of geodetic markers. Possible Marker Groups are listed below.
NAME	STATION_MARKS - STATION_NAME - VARCHAR2(16)	STRING	The station name. There could be several stations with the same name. The “Name” could be what is stamped on the monument or another agency’s identifier or a local name for the area.
PROVINCE	STATION_MARKS - PROVINCE - VARCHAR2(2)	STRING	The province in which the monument is located. Canada Post and ISO3166 codes are used. Possible Province Codes are listed below
LATITUDE	GEODETIC_COORDS - LATITUDE - NUMBER(12,6)	STRING (N99° 99' 99")	The angular distance north or south of the earth’s equator, measured in degrees, minutes and seconds along a meridian.
LONGITUDE	GEODETIC_COORDS - LONGITUDE - NUMBER(13,6)	STRING (W999° 99' 99")	The angular distance on the earth’s surface, measured east or west from the prime meridian at Greenwich, to the meridian passing through a position, measured in degrees, minutes, and seconds.
NTS MAP NO	Computed on output using the Latitude and Longitude	STRING (999A99)	The National Topographic System (NTS) map sheets number in which the coordinates for the monument fall.
UTM ZONE	Computed on output using the Latitude and Longitude	NUMBER(2) (99)	UTM zone. A series of central meridians defined by 6 degrees of longitude zones starting at 180 degrees west.
UTM NORTHING	Computed on output using the Latitude and Longitude	NUMBER(7) (9999999)	UTM Northing. The distance from the equator in metres.
UTM EASTING	Computed on output using the Latitude and Longitude	NUMBER(6) (999999)	UTM Easting. Eastings are measured from a separate point for each zone, namely, an imaginary line lying 500 000 metres west of the zone’s central meridian.
ELEVATION	STATIONS - ELEVATION - NUMBER(14,9)	NUMBER(4) (9999)	The elevation in metres above a reference datum that is close to mean sea level.
MARKER TYPE	STATION_MARKS - MARKER_TYPE - VARCHAR2(2)	STRING	The type of marker left behind to identify the survey monument.
INSPECTION DATE	INSPECTIONS - REPORTED_ON - DATE	STRING (YYYY)	The date the survey monument was last inspected.
MARKER CONDITION	INSPECTIONS - MARKER_CONDITION - NUMBER(1)	STRING	The condition in which the survey monument was found on its last inspection. Possible Marker Conditions are listed below.

Marker Groups

- Canadian Base Network (NAD83CSRS)
- Horizontal Control Network 2-D (NAD83)
- Primary Vertical Control Network (CGVD28)
- Special Purpose 3-D Network (NAD83CSRS)

Province Codes

AB	Alberta	NU	Nunavut
BC	British Columbia	ON	Ontario
MB	Manitoba	PE	Prince Edward Island
NB	New Brunswick	PQ	Quebec
NF	Newfoundland	SK	Saskatchewan
NS	Nova Scotia	YT	Yukon Territory
NT	Northwest Territories		

States and Countries

AK	Alaska	NY	New York
ID	Idaho	ND	North Dakota
ME	Maine	OH	Ohio
MI	Michigan	PA	Pennsylvania
MN	Minnesota	VT	Vermont
MT	Montana	WA	Washington
NH	New Hampshire	WI	Wisconsin
DK	Greenland		
FR	Saint-Pierre et Miquelon		
US	(State Unknown)		

Marker Conditions

- Damaged
- Destroyed
- Good
- Inaccessible
- Marker displaced
- Not Found
- Repaired
- Special equipment required
- Unreliable

6 Coordinate Reference System

Geodetic 3-dimensional coordinate reference system (Φ , λ , h); Geocentric 3-dimensional reference system (latitude, longitude, ellipsoid height).

6.1 Horizontal reference system

SCALED – From National Topographic System (NTS) series map sheets at 1:50 000. May sometimes come from truncated geodetic coordinates referenced to NAD83CSRS or NAD83.

6.1.1 Horizontal coordinate system

Data is stored in latitude (Φ) and longitude (λ) geographic coordinates.

6.1.2 Unit of measure (coordinate system axis units)

The unit of measure for storing horizontal spatial data is decimal degree, given to 9 significant digits after the decimal (1×10^{-9}).

6.2 Vertical reference system

CGVD28 Canadian Geodetic Vertical Datum 1928, mean sea level. (Adopted, public vertical reference system.). The average height of the surface of the sea for all stages of the tide. Usually determined by averaging height readings observed hourly over a minimum period of 19 years.

6.2.1 Unit of measure (coordinate system axis units)

The unit of measure for storing vertical spatial data is the metre (m), given no significant digit after the decimal (1×10^0).

7 Data Quality

7.1 Scope

NOT APPLICABLE

7.2 Lineage

Primary Reference Layer

7.3 Completeness

NOT APPLICABLE

7.4 Logical consistency

NOT APPLICABLE

7.5 Positional accuracy

Absolute accuracy is 100 m.

Relative accuracy is 100 m.

Gridded data position accuracy is 100 m.

7.6 Temporal accuracy

Because of the dynamic nature of the data, it is current at the time of retrieval.

7.7 Thematic (attributes) accuracy

NOT APPLICABLE

8 Metadata

There are usually 2 levels of metadata to describe a product, as shown in following figure: collection and product/dataset. The higher level of metadata covers the entire data collection: it applies to the series of available datasets (group of features), database, etc. The other level, called product level metadata, gives specific information about each dataset.

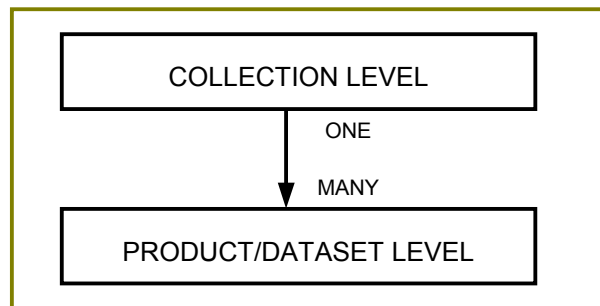


Figure 1: Metadata Levels

For the Primary Vertical Bench Marks, Canada, Level 1 metadata exist only for the entire collection. There is no product level metadata because all PVBMC1 features are part of a unique source database.

PVBMC1 metadata are available via GeoBase Portal (in the Data section at <http://www.geobase.ca>) and GeoConnections Discovery Portal (in the Data section at <http://geodiscover.cgdi.ca>).

9 Data Portrayal / Data Transfer Format / Physical Model

9.1 Conversion process

The PVBMC1 data is stored in an Oracle database and is converted to GML or to SHAPE formats.

9.2 Files

NOT APPLICABLE

9.3 Directories

NOT APPLICABLE

9.4 Point entities (VD)

NOT APPLICABLE

9.5 Linear entities (VD)

NOT APPLICABLE

9.6 Surficial entities (VD)

NOT APPLICABLE

10 Data Delivery

10.1 Format information

The available output file format for the product are: GML (Geography Markup Language) in ASCII and SHAPE (ESRI™). Appendix A presents the name and the data type of each attribute in both formats. An example of a dataset in GML (ASCII) format is presented in Appendix B.

10.2 Medium information

The datasets are available on-line via an FTP site. The customer is informed by e-mail when the process is complete and the file is available for transfer.

10.3 Constraints information

The constraints information for data access and data use are defined in the GeoBase Unrestricted Use Licence Agreement (<http://www.geobase.ca/> - in the Data section).

11 Data Capture and Maintenance

Data are maintained as needed.

Update scope – ALL.

APPENDIX A: Attributes in GML and in SHAPE Formats

PVBMC1 ATTRIBUTE NAME	GML³ ATTRIBUTE NAME	SHAPE ATTRIBUTE NAME	SHAPE DATA TYPE
UNIQUE NUMBER	uniqueNumber	UNIQUENO	char(8)
MARKER GROUP	markerGroup	GROUP	char(41)
NAME	name	NAME	char(16)
PROVINCE	province	PROVINCE	char(2)
LATITUDE	latitude	LATITUDE	char(17)
LONGITUDE	longitude	LONGITUDE	char(18)
NTS MAP NO	ntsMapNo	NTSMAPNO	char(6)
UTM ZONE	utmZone	UTMZONE	number(2)
UTM NORTHING	utmNorthing	UTMNORTH	number(9,2)
UTM EASTING	utmEasting	UTMEAST	number(8,2)
ELEVATION	elevation	ELEVATION	number(7,3)
MARKER TYPE	markerType	MARKERTYPE	char(60)
INSPECTION DATE	inspectionDate	INSPECDATE	char(4)
MARKER CONDITION	markerCondition	STATUS	char(25)

³ For GML format data type is always TEXT (STRING).

APPENDIX B: Example of PVBMC1 Dataset in GML Format

Extract from a GML file – PVBMC1 Geodetic Marker 08U1211

```
<?xml version="1.0" encoding="iso-8859-1"?>
<gsd:GSDCollection xmlns:gsd="http://www.geobase.ca/gsd"
xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.geobase.ca/gsd GeodeticMarker.xsd">
<gml:description>Natural Resources Canada - Geodetic Survey Division -
Geodetic markers description </gml:description>
<gml:name>44.0 44.6 78.0 78.5</gml:name>
<gml:boundedBy>
<gml:Box srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
<gml:coordinates/>
</gml:Box>
</gml:boundedBy>
<gml:featureMember>
<gsd:GeodeticMarker>
<gsd:uniqueNumber>08U1211</gsd:uniqueNumber>
<gsd:markerGroup>Primary Vertical Control Network (CGVD28)</gsd:markerGroup>
<gsd:name>MCCXI</gsd:name>
<gsd:province>ON</gsd:province>
<gsd:latitude>N44 17' 28"</gsd:latitude>
<gsd:longitude>W78 18' 29"</gsd:longitude>
<gsd:ntsMapNo>031D08</gsd:ntsMapNo>
<gsd:utmZone>17</gsd:utmZone>
<gsd:utmNorthing units="meters">4907719</gsd:utmNorthing>
<gsd:utmEasting units="meters">714773</gsd:utmEasting>
<gsd:elevation units="meters">193.536</gsd:elevation>
<gsd:markerType>Permanent Agency Marker</gsd:markerType>
<gsd:inspectionDate>1908</gsd:inspectionDate>
<gsd:markerCondition>Good</gsd:markerCondition>
<gml:location>
<gml:Point>
<gml:coordinates>-78.308,44.291</gml:coordinates>
</gml:Point>
</gml:location>
</gsd:GeodeticMarker>
</gml:featureMember>
</gsd:GSDCollection>
```