

Resource GPS Data Collection Specifications



**Developed by
Resource Grade GPS Steering Committee**

April 7, 2011

Guidelines and Specifications for Resource Level GPS Collection

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1.0 Objective

Agency of Transportation has increasingly used Global Positioning System (GPS) to locate, inventory and record features for multiple applications across the Agency. GPS provides an accurate and efficient manner of collecting mapping data in the field. There has been an increase in access to this technology due to improving equipment and the decrease of equipment cost. As the technology becomes more accessible to users in the Agency, GPS data collection standards become critical to insure data integrity and consistency.

This document is designed to provide standards and guidance for both internal VTrans Employees and others performing work for the Agency through contracts with third parties. Certain projects may require specifics outside or beyond the scope of this document and may require their own standards.

1.1 Types of GPS Receivers

GPS receivers can be broken down into the following three main classes:

A) *Recreational Grade GPS / GNSS*

Recreational grade GPS receivers are the least expensive and the simplest to use of the three types. These units have less functionality and are intended for recreational navigation uses. These units can be expected to produce locations with accuracy of approximately 15-30 meters. This grade of GPS is not advisable for data collection within or for the Agency.

B) *Mapping/Resource Grade GPS / GNSS*

Mapping or Resource Grade GPS collect positions with accuracies between 0.5 and 5 meters with differential corrections. These units have expanded functionality as well and can also record features as points, lines and polygons. These units also allow for loadable feature libraries designed to efficiently collect attribute information describing the feature.

C) *Survey Grade GPS / GNSS*

Survey grade GPS tools are intended for tasks requiring a very high degree of accuracy. Positions determined by these receivers can be accurate to within less than a few centimeters. These systems produce data of the highest horizontal and vertical positional accuracy. They are relatively expensive and complex requiring specialized training and dedicated staff to oversee its use. Survey grade GPS is not covered in this document and is bound by separate specifications.

The remainder of this document will address **Mapping/Resource Grade GPS** only.

2.0 GPS Data Collection

GPS data collection should be completed by staff that has had training in GPS or GIS or under the direct supervision of trained staff. The Resource GPS Steering Committee is available for technical assistance in the purchase of GPS equipment and software. The following specs should be considered when purchasing or using GPS equipment:

2.1 GPS Receiver Requirements

Mapping grade GPS receivers used for data collection must:

1. Routinely achieve 2 meter or better horizontal accuracy, using either in real time or post processed differential corrections.
2. Allow for the storage of positions for features that are being mapped. The receiver must have enough data storage capacity for a typical day's worth of data collection either internally or through the use of removable memory.

2.2 Suggested GPS Receiver Capabilities

Though not required, it is suggested that GPS equipment have the following properties:

1. Should be able to utilize real time collection such as WAAS.
2. If it is desirable to utilize a higher accuracy, real-time differential corrections, the unit should be capable of using correction information from VT CORS stations.

2.3 GPS Parameter Settings

To ensure data consistency, the following parameter setting should be followed:

Standard GPS Collection Parameter Settings

Point

Logging interval	1 second
Minimum positions	30 positions
Position Mode	All position fixes must be determined in 3D mode. 3D positions generated from 2D fixes supplemented with user entered elevations are not acceptable.
Elevation Mask	15 degrees or greater
PDOP Mask	PDOP less than 6

Line or Area

Logging interval	Line or Area: distance since last location = 5 – 10m It is suggested that line features are improved using nested points
Minimum positions	Line or Area: dependent on line length or area perimeter
Position Mode	All position fixes must be determined in 3D mode. 3D positions generated from 2D fixes supplemented with user entered elevations are not acceptable.
Elevation Mask	15 degrees or greater
PDOP Mask	PDOP less than 6

Exceptions: The above parameter settings are designed for the collection of standardized, accurate GPS data. On occasion, in certain locations, field conditions make using these specifications impractical or even impossible. Canopy cover, poor view of the satellites, buildings or other obstructions can create a tough environment for data collection. In these situations the user can choose to sacrifice some accuracy in order to collect “some” data. When selecting productivity over precision the user is consciously lowering the standards and this should be noted in a comment or other field in the resulting feature layer. This notation should be referenced in the resulting metadata and associated metadata. GPS data should always be differentially corrected, especially in these exception cases.

3.0 GPS Processing Software

The Agency currently licenses Trimble Pathfinder Office (TPO) to be used for Trimble GPS post processing. The software can be requested through the standard IT software request process. Cost associated reflects the availability of network licenses. GPS equipment from different hardware providers may require other processing software specifically compatible with that equipment.

3.1 Software Requirements (Agency Use)

If there is a business need for a different resource grade GPS software product, that product must adhere to the following requirements:

1. Be capable of performing differential corrections.
2. Provide the following quality control information:
 - Standard deviations of point features
 - Files processed
 - Collection mode
 - Elevation mask
 - PDOP mask
 - RMS values
3. Be capable of exporting data to a GIS using
 - Geodatabase feature class or shapefile
 - Vermont State Plane Grid meters
 - NAD83
4. Be capable of exporting data to CADD
 - Microstation DGN
 - Vermont State Plane Grid US Survey feet
 - NAD83

3.2 Differential Corrections

All resource grade GPS data collected by or for VTrans must be differentially corrected. Differential Correction can be completed real-time in the field or after the data has been uploaded in the office. Base data for post processing may be available through post processing software but is also publically available using the websites given in Section 7; Resources.

3.3 Analysis and Edit

Once the GPS data has been uploaded, post processed and exported to GIS or CADD, the data should undergo some type of coarse quality control, visual or other. Using the exported precision information and existing GIS/CADD information to validate locations can identify erroneous locations. If point features are to be edited, the corresponding GPS information such as PDOP, correction type or position precisions should be removed and that record should be designated as “digitized in office” or DIO. If edits to line features are required the vertices may be deleted and repositioned to achieve a best fit linear feature. In any case where edits are made to the resulting shapefile or feature class, the original export files should be preserved and named with a “_ORG” suffix.

4.0 Guidelines for Data Export to GIS

This section addresses situations in which the final deliverable for the GPS field data is spatial data designed to be used in the GIS environment.

4.1 Attribute Information

In addition to feature geometry and the associated attribute data collected in the field, most GPS processing software packages are capable of automatically generating metadata information regarding these locations. This information provides users an indication of the GPS position quality. The following attributes should be exported with GPS data as a form of metadata for all exported features.

For point features

- PDOP
- Receiver type
- Correction Status
- Date of collection
- Time of collection
- Data file
- Total positions
- Filtered positions
- Vertical Precision*
- Horizontal Precision
- Standard Deviation
- Elevation*

For Line and Area

- PDOP
- Receiver type
- Correction Status
- Date of collection
- Time of collection
- Data file
- Ave Vertical Precision*
- Ave Horizontal Precision

**these fields should be included when collecting data with vertical values*

4.2 Default Settings for Data Export to GIS

System:	US State Plane 1983
Zone:	Vermont 4400
Datum:	NAD 1983 Conus (latest realization)
Vertical Datum:	NAVD 88
Geoid:	GEOID09 (or latest hybrid geoid)
Units:	meters

5.0 Guidelines for Data Export to CADD

This section addresses situations in which the final deliverable for the GPS field data is spatial data designed to be used in the CADD environment.

5.1 Attribute Information

In addition to the inclusion of the appropriate line work in DGN. A GIS export should be created including the attribute information described in Section 4.1 above. This data should accompany design files on submittal and during storage. The GIS export will allow the agency to catalog and store the GPS field data in such a manner that the data is available outside and site specific design plans.

5.2 Default Settings for Data Export to CADD

System:	US State Plane 1983
Zone:	Vermont 4400
Datum:	NAD 1983 Conus (latest realization)
Vertical Datum:	NAVD 88
Geoid:	GEOID09 (or latest hybrid geoid)
Units:	US Survey Feet

**Note: VTrans will not accept data in international feet*

6.0 Guidelines for Deliverables

Regardless of whether the work is being done by VTrans staff or a third party the data associated with each project should be collected and delivered as follows:

- All original field recorded data files
- Base information for post processed field data (if post processed)
- Differentially corrected files
- Original CADD file with projection files (if required)
- Original GIS file with projection files
- Final manipulated shapefile or CADD file with projection files

7.0 Resources

Additional Guidelines

VGIS Handbook – Vermont GPS Guidelines

http://www.vcgi.org/techres/standards/partiii_section_1.pdf

Base Data Providers

Vermont Capital CORS

<http://www.aot.state.vt.us/geodetic/cors/vtcors.htm>

National Geodetic Survey CORS

<http://www.ngs.noaa.gov/CORS/>