Province of British Columbia

GPS Data Collection Procedures for Georeferencing Vegetation Resources Inventory and National Forest Inventory Field Sample Plots

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Notes

This document is a “how-to-do” procedure manual designed specifically for GPS data collection by contractor crews for the vegetation resources inventory (VRI) and National Forest Inventory (NFI) field sampling.

For the purpose of this document, the following terms are often used:

1. Data collector: The person responsible for GPS data collection. It will be the VRI/NFI field sampling crews.
2. Data processor: The person responsible for processing the GPS data. It will be either proponent staff, another contractor independent from the field crews, or staff from the sampling crews company..

Because VRI plots may be re-visited, andNFI sample plots are permanent and will be regularly re-visited in the future, a target accuracy standard (i.e. maximum positioning error) is set at 10 meters horizontal and 15 meters vertical at the 95 percent confidence level for georeferencing VRI/NFI sample plots using GPS. All the specifications and procedures in this document are made to achieve this target accuracy.

The following relevant materials are also given in the Appendix.

1 Trimble GeoExplorer Operation Procedures
2 GPS Data Processing and Presentation
3 The Check List for GPS Project Management

For any questions, suggestions, and comments concerning the GPS data collection, please contact the under-signed at the following address:

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GPS Field Data Collection Procedures

The following is an overview of the procedures to collect GPS data for the vegetation resources inventory field sampling.

GPS Hardware and Software

GPS hardware and software must meet the minimum requirements specified in the Procedures. In particular, for field data collection, the GPS hardware and software must be capable of achieving the target accuracy (i.e. 10 meters horizontal and 15 meters vertical, 95% of times) using standard single-frequency pseudo-range differential correction techniques. All the components of the GPS system, such as receiver, antenna, cables, battery, and connections, must be robust and reliable. Any GPS system to be used in the VRI/NFI field projects must be capable of collecting and post processing GPS data. Appendix 1 provides a quick step-by-step operation procedures of Trimble GeoExplorer , one of the commonly used GPS systems, for VRI/NFI field GPS data collection.

Point Feature

The tie point and plot center pin (integrate plot) are the point features that shall be measured for their locations using GPS. Access point (e.g. helicopter landing point) shall also be surveyed with GPS.

Observation

GPS observations shall be attempted immediately when arriving at the point features. If positioning is difficult, proceed other work and attempt again. Every effort must be made to collect the data. If data cannot be collected due to problems in receiving the signal or any other reasons, the data collector must document the reasons on the comment section of the compass and plot establishment cards.

The VRI/NFI project manager shall provide the data collector with a summary of optimum satellite coverage for the areas in which they are working. The summary describes the time of day when the optimum number of satellites will be overhead to allow for data collection. The data collector must attempt to record data at these optimum times as this method will ensure the best opportunity for collecting the data.

Offset

GPS data must be collected directly over the point feature to be surveyed wherever possible. If it is not possible, an offset position shall be surveyed with GPS. The offset distance and true azimuth **from the GPS antenna to the point feature to be surveyed must be measured** with a sighting compass and nylon tape. The maximum offset distance allowed is 50 m (horizontal). Any offset distance over 25 m must have the compass azimuth observed both forward and backward (with the averaged forward azimuth being recorded). The offset information (forward azimuth, slope distance and vertical angle) is to be recorded on the field cards comment section (Compass Card and Cluster Layout Card) in the following format:

GPS offset :Slope dist: 12.4m @ 030^{o}, vertical angle + 8^{o}

Bearings must be accurate to 2 degrees, and distances to 1 meter.

Vertical angle is measured from the observation point (e.g. GPS antenna) to the target point (e.g. plot center pin).

The vertical distance between ground level to the GPS antenna (called "Height of Instrument") must also recorded for every observation.

File Names

Field GPS data is logged to a file which must be uniquely named, not only within the GPS receiver itself, but it also must be unique among the many field GPS units that may be operating simultaneously on a large project. For the Trimble GeoExplorer the default naming convention shall be adopted:

File Name AMMDDHHa

A Crew identifier (A..Z and 0....9 allowing up to 36 unique crew identifiers)
MM 2 digit number corresponding to the current month (01-12)
DD 2 digit number corresponding to the current day (01-31)
HH 2 digit number corresponding to the current hour (00-23)
a file identifier (a= first file open in this hour, b= second file etc.)

After GPS data has been collected, the data collector must record the default file names on the field cards (along with the offset information). Note that in the field data collection, only GPS file names are required to recorded on the field cards and the positions of the point features are recorded by the data processor after differential corrections.

Measurement

Each point feature must be observed with the GPS receiver for no less than 300 seconds with at least 200 position fixes (at 1 second logging interval) during that period. If satellite tracking is difficult, it shall be a minimum 150 seconds with at least 50 position fixes.

GPS Equipment

The data collector must ensure that all the field GPS equipment is properly maintained and operational (e.g. batteries are charged; receiver space is cleared; configuration is correctly done; etc.). The data collector must ensure that GPS data is downloaded properly each day, and storage and back-up of the data are done before erasing it from the receivers. The data collector will require a portable laptop computer and an adequate power source.

GPS Data Collection Parameters

The following GPS data collection parameters must be configured.

Parameter	Value	Comment
GDOP	< 10.0	use only if HDOP or PDOP not available in rover unit
PDOP	< 8.0	use only if HDOP not available in rover unit

HDOP	< 5.0	use of HDOP preferred over PDOP
Elevation angle	> 15	satellite elevation tracking angle (degrees)
Positioning modes	3D	no 2D positioning acceptable
Logging interval	1 sec.	maximum allowable is 5 sec under certain conditions
Signal strength	default	minimum threshold to be set at manufacturer's default value (or higher)
Dynamics	lowest	set to lowest value available
Static averaging	200	minimum observation time is 300 seconds with at least 200 position fixes during that period, or 150 seconds with at least 50 position fixes under difficult satellite tracking conditions

GPS Data Presentation

The data collector must submit GPS data in the original receiver download format to the GPS data processor designated by the VRI/NFI project manager as soon as possible. The data submitted must be accompanied by the copies of field cards (i.e. the Header Card, Compass Card, and Cluster Layout Card) and any other field notes relating to GPS measurements. The presentation medium and means of delivery (e.g. through modem, ftp, Internet, Canada Post, or personal delivery) will be defined by the project manager before the start of each project.

It is especially important to provide the first several samples in each sampling project in order to ensure that data collection is being performed correctly. It is critical that the GPS data is processed and the results are communicated back to the field crews in a reasonable turn-around time so that if there are any problems or issues, they can be resolved while field crews are still in field.

GPS Data Archiving

The data collector must ensure that backups of the data are made on to 3.5 inch disks. Hard drive backup only is not acceptable. All the raw data collected must be archived for at least two years, unless otherwise instructed, after the completion of each field project.

Appendix 1 Trimble GeoExplorer Operation Procedures

This section is designed for the vegetation resources inventory for use of Trimble GeoExplorer GPS receivers as they are commonly used in the province.

Basic Operation

Trimble GeoExplorer The GeoExplorer is a 6-channel GPS receiver made by Trimble Navigation capable of both displaying an uncorrected coordinate position and storing multiple position fixes for post processing.

Rover Data File For each point feature to be survey, e.g. tie point and plot center, a file shall be created and data stored and a precise coordinate position of this point shall be determined after the differential correction. This data file is typically called rover file.

Major Keys The **ESC** key will allow you to back up to the previous screen or it will cancel entered data
The **DIAMOND** key at the center is used to SELECT a menu option and to ACCEPT entered data.
The **UP** and **DOWN** arrows are used to SCROLL up and down through the menu.
The LEFT and RIGHT arrows are used to move the cursor left and right throughout the menu.
The **ON/OFF** switch is the lower bottom button to turn receiver on and off.
The key is used for accepting an entry.

On/Off Press the **ON** switch to turn the receiver on, and press the **ON** and hold it for 5 seconds to turns it off.

Main Menu Turn the receiver on. Press the **ESC** key until the menu 'backs up' to the MAIN MENU. Scroll up and down the main menu using the **UP** and **DOWN** arrows.

Note: the receiver will power up to the same menu location that it was on when the power was turned off.

GPS Positioning Press ESC until you reach the MAIN MENU. Scroll using **UP** and **DOWN** arrows to the 2. POSITION under the MAIN MENU. Press DIAMOND key to select the 2. POSITION option. Keep the receiver steady for at least more than 3 minutes. If the screen displays a set of coordinates and message GPS POSITION, this indicates that the receiver is receiving data and is able to calculate a position. If the message OLD POSITION is displayed, it indicates that the receiver is not able to determine its current position. If this happens (i.e. the receiver is not determining its position, please refer to the SATELLITE TRACKING.

Note: the position displayed is not accurate (could be 100 meters off). It must be post corrected with the reference data to get a less than 10 meters accuracy.

Recording GPS Positions

Press ESC until you reach the MAIN MENU. Scroll using **UP** and **DOWN** arrows to the 1. DATA CAPTURE under the MAIN MENU. Press DIAMOND key to select the 1. DATA CAPTURE option. Scroll to 1. OPEN ROVER FILE using the **DIAMOND** key to select the option. The name of the rover file is automatically generated and is displayed in the upper left hand corner. This file name must be clearly recorded at this time on to the field card (along with feature type, offset if there is any, time, and any other notes). The number on the upper right corner will be showing up and accumulating. It is the number of acceptable points recorded.

Note: If the number is not changing, there may be problems with satellite tracking and you should refer to the SATELLITE TRACKING section. For configuration of the receiver, refer to the CONFIGURATION section.

File Closing

When a suitable number of positions have been collected (i.e. 200 position fixes), select **CLOSE FILE** using **DIAMOND** key to close the file for storage.

*Note: You must close the file. Otherwise next time you select **DATA CAPTURE** and data will add to the old file that you have not closed.*

Receiver Shut off

Press ON/OFF key and hold it for 5 seconds to turn it off.

Configuration

The configuration of the field GPS receivers must be done by a qualified technical person. Contractors and Regional staff should check with RIB remote sensing staff to ensure the receiver is configured correctly. However, the contractor must verify and check it during the field work.

View Configuration Options

Press the **ESC** until you are at the MAIN menu. Scroll to the 6.CONFIGURATION menu using the **UP** and **DOWN** keys and select this menu using the **DIAMOND** key. Scroll to 1. ROVER OPTIONS and select this option with the **DIAMOND** key. Scroll through the PARAMETERS and check each one.

Position mode	Manual 3D
Elevation mask	15
PDOP mask	8
PDOP switch	8
SNR mask	4
Feature log pts	1 sec
Feature log line/are	5 sec
Feature log min pos	200
Not in feature rate	All

Parameter Setup

Use the **LEFT**, **RIGHT**, **UP**, and **DOWN** keys to move the cursor and change value for each parameter and use the **DIAMOND** key to accept it.

Note: If the values do not match the above specifications, confirm the differences with RIB staff. Do not change them yourself, unless you have received approval.

Appendix 2 GPS Data Processing and Presentation

GPS data shall be processed and mapped by either another independent contractor or the MSRM staff.

GPS Reference Station

Only the GPS reference stations that are validated and approved by the MSRM are used for GPS differential corrections. The distance between the GPS reference stations and field receivers must be within 500 km. These reference stations must have a capability of archiving data for no less than 30 days and a data logging interval at no slower than 5 seconds. The data processor will ensure that reference stations are activated in the sample areas and for the times the field crews will be collecting the data. The project manager must ensure that the data processor is notified of when the data collector will be in the field collecting data.

GPS Data Processing

All GPS positions must be corrected by standard differential GPS methods. Both Pseudo-range and navigation corrections are acceptable. Any data editing processes, such as filtering, smoothing, interpretation, or generalization, must be noted in the project report. A quality assurance summary report must also be produced at the end of project.

Data Presentation

The data processor must submit to the project manager the following deliverables:

- All raw GPS data files (including both field and reference station data) and corrected GPS data files before any editing and manipulations for each point feature in the original manufacture's proprietary or RINEX format, associated with all field cards and notes regarding the GPS files;
- A Microsoft Excel table including (at a minimum): date of data capture in field, processing date, project ID, map #, polygon #, sample #, crew ID, file name, # of fixes, reference station ID, datum, offset, and final UTM Northing/Easting/Elevation;
- Digital plots (IGDS) and hardcopy maps showing the final positions of tie points and plot centers;
- A QA report per batch, as well a summary of QA results by the end of each project; and
- A summary report by the end of the project.

Note: It is a requirement that the data processor be stand-by in order to provide a quick turn-around of processed results back to field crews during the field data collection period. Plots that are questionable about their locations (e.g. outside the polygon to be sampled) are required to be submitted within no more than 2 days upon the receiving GPS field data. It is very crucial for field crews to get GPS data processing results back within a week so that any problems or issues can be resolved quickly while crews are still in field.

Data Archiving

The data processor must make a back-up and archive of all the raw data (directly downloaded from the receiver) in the manufacture's proprietary format and processed/interpreted data in the format specified by the project manager.

Appendix 3 The Check List for VRI/NFI GPS Project Management

The following check list is provided to ensure the successful capture of GPS data.

The project manager shall:

- check the contractors' (data collector and data processor) hardware and software, etc. and ensure that they are appropriate for the project work;
- provide training to the contractors on the use of GPS;
- provide GPS status information to the GPS field data collectors and the observation schedule according to current GPS almanac;
- identify methods and media for data archive and transfer;
- oversee the field data collection and data processing; and
- receive and conduct quality assurance on the project deliverables.

The data collector shall:

- provide (rent/purchase) an appropriate GPS data collection unit and provide adequate data backup (laptop PC);
- familiarize with its operation;
- ensure that all staff on the project attend the training session;
- collect GPS data; and
- provide digital GPS data to the data processor.

The data processor shall:

- check the availability of the GPS reference stations within the project area (e.g. if it is validated; if operating continuously during the scheduled time of the project; if its receiver/ parameters/data format, etc. are appropriate; and cover the costs);
- ensure that GPS reference stations are turned on and order the reference data;
- receive uncorrected digital GPS data from the data collector and perform differential correction;
- map the GPS coordinates; and
- provide feedback to the project manager that the data is collected correctly.