

**Bird Monitoring Protocol for Agate Fossil Beds National Monument,
Nebraska and Tallgrass Prairie National Preserve, Kansas**

Standard Operating Procedure (SOP) # 3

Using the Global Positioning System

Version 1.00 (July 18, 2003)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This Standard Operating Procedure explains the procedures that all observers should follow when collecting geo-spatial data or navigating to sampling plots using a Mapping Grade GPS Receiver unit. This SOP is intended to complement but not replace the operations manual accompanying your GPS unit. Therefore, each observer must be familiar with the use of their particular GPS unit before entering the field to collect data or navigate between points.

I. Required Equipment

- (1) GPS unit
- (2-4) batteries depending on GPS unit
- (1) notebook
- (3-4) pencil
- (1) watch
- (1) compass
- (1) radio or cellphone
- (1-3) bug repellent
- (1) operations manual

Minimum GPS Receiver Standards for Mapping and Navigating should be:

- Capable of producing and storing data in a format compatible with standard base station data used to perform differential corrections (rinex, ssf, etc.).
- Capable of storing attribute data about features collected.
- Capable of storing time and coordinates of features collected.
- Capable of exporting features collected to a format that can be used by a GIS

Minimum GPS Receiver Settings Standards

Name	Standard
Almanac	acquired within 10 days prior to data collection or navigating
Altitude reference	Height above Ellipsoid (HAE) or Mean Sea Level (MSL); if MSL is used, indicate Geoid Model
Antenna heights	1.0 – 2.0 meters
Datum	NAD 83
Elevation mask	15 degrees
Feature types	point, line, area (polygon)
Logging intervals	Point 1 second
Minimum number of positions for a point feature	50
Mode	3D
PDOP Mask	6.0 or less
Position mode	manual 3D
Satellite vehicles	4
SNR Mask	6.0 or greater
Unit of Measure	Meters

Systematic Errors (modified from Arkansas State Land Information Board, 2001)

Positions acquired using GPS receivers are determined based on a measurement of time and distance. Receivers calculate the time and distance from a minimum of three satellite vehicles to acquire a horizontal position and four satellite vehicles to acquire a 3D (horizontal and vertical) position. There are several known sources of error that should be taken into consideration when collecting GPS positions.

Atmospheric delay: occurs when GPS signals are interrupted by the earth's ionosphere and troposphere. As the signal is disrupted, the time it takes to reach the earth is altered, and can contribute approximately 1 meter of error. Since GPS positions are determined by time and distance, this alteration in time has an adverse effect on the accuracy of GPS fixed positions collected. The heat of the day is when atmospheric delay is greatest. Satellite vehicle signals low on the horizon also experience higher delays because the signal travels through more atmosphere.

Dilution of Precision (DOP): is the combination of error factors caused by poor satellite vehicle geometry that can alter position and time solutions. The receiver is using trilateration to determine its fixed position. If the satellite vehicles are not properly spaced the DOP values are higher and the horizontal position is degraded. Setting the receiver to accept positions when the PDOP is 6.0 or less (lower is better) will control this source of error by not allowing data with high DOPs to be saved by the receiver. Errors incurred by PDOP's higher than 6.0 can cause approximately 1 meter of inaccuracy.

Multipath error: occurs when a satellite vehicles signal is reflected off an object prior to reaching the receiver, thus causing a time delay. This can cause several meters of error. Buildings, trees, mountains, signs, etc, may cause multipath errors. Generally multipath errors are easily recognized when the GPS data collected is viewed in a geographic information system (GIS).

Obstruction errors: occur when the GPS receiver loses a lock from a satellite vehicle from which it is receiving code. Receivers and base stations both require a clear view of the sky. Weather generally does not affect the functionality of a receiver. Extreme conditions could impede a receiver's performance. A clear view of the sky is one that is not blocked by solid objects.

Satellite vehicle clock error and receiver rounding error: also contribute to GPS data inaccuracies.

Operator error: caused by using the wrong datum or coordinate system is the biggest source of error and may result in 100+ km of error.

Selective availability (SA): is an intentional degradation of the code sent from satellite vehicles. The Department of Defense degrades the code. On May 1, 2000 the Department of Defense turned off selective availability. Selective availability may be activated anytime and without notice. Errors caused by selective availability can be difficult to observe. Post-processing aids in removing time and location errors collected by the receiver. Most mapping grade receivers come with post-processing software. All fixed positions collected should be post-processed. This will increase and standardize horizontal and vertical accuracies. Raw data from the receiver and base station should be archived. Future software may allow for finer post-processing accuracies.

II. Using a GPS unit

Planning a field day

In order to facilitate data collection; ask your GIS Coordinator for the most current almanac available. The almanac is a set of data that is used to predict the timing and path of satellite orbits over approximately a month long period. For your GPS unit to function properly and collect accurate geo-spatial data there must be at least 4 satellites overhead and preferably more. In addition, PDOP must be less than 6. Schedule your field work, based on the almanac information, at a date and time when the PDOP is <6 and the number of available satellites is ≥ 4 .

Setting up Data Dictionary

When collecting geo-spatial data, name the file in your GPS unit that data will be stored in. This file will be exported into a shapefile. If you don't name it, your data will be named a 'default' point, line, or polygon which may become confused with other files on your GPS unit.

You will need to name the features within the database. Names should correspond with field names from each project database. You will also need to designate the features as a point, line, or polygon. You will also need to define attributes you wish to record for each field in a data file. Designate whether the field entry of an attribute is optional (normal), required or not permitted. Continue until all attributes in the data file have been entered.

Setting up filters for data collections

Most GPS systems come configured with default filter settings. However you may need to make changes to these settings before going out in the field. The logging intervals and minimum positions for point and line features may need to be configured for each session, see standards listed above. Additional changes may be necessary depending on where you are collecting data. It is essential that the coordinate settings be confirmed before collecting or uploading data.

Coordinate settings for Prairie Cluster Prototype Long-term Ecological Monitoring Program parks

Park	UTM Zone	Datum
AGFO	13 North	NAD 1983 (Conus)
EFMO	15 North	NAD 1983 (Conus)
HOME	14 North	NAD 1983 (Conus)
PIPE	14 North	NAD 1983 (Conus)
SCBL	13 North	NAD 1983 (Conus)
TAPR	14 North	NAD 1983 (Conus)
WICR	15 North	NAD 1983 (Conus)

Loading Waypoint

Waypoints are named 3 dimensional positions on the earth's surface. Waypoints are assigned to fixed locations in the field so they can be navigated to consistently and accurately through time. Waypoints are generated and stored in computer databases and must be loaded onto the data logger prior to navigating to these points.

Pre-trip planning

It is essential to plan your travel route in the field. When you are recording data, having knowledge of the area allows you to maximize your time in the field by allowing you to work on several features on the same trip. In addition, the topography of the area where you are collecting data may require changes in the Data Logger's configuration. Knowing where features are located will help you prepare the data dictionary in the Data Logger for recording information in the field.

Pre-trip planning will also allow you to load required waypoints for navigating in the field. A map of the park with waypoint locations on it should be printed out prior to entering the field. This map should be used to plan the order in which waypoints will be visited. The observer should carry a copy of the map in the field to aid in navigating between points and for choosing alternative waypoint locations if the need arises.

Navigating to waypoints

GPS units provide a fast and accurate way for navigating to and between known points in the field (waypoints). From the appropriate data file on the Data Logger choose the pre-loaded waypoint you want to navigate to. Using the arrow on the handheld receiver navigate in the direction of the waypoint until it is located. From this point the next waypoint can be chosen and the direction to it determined. Pre-planning your survey route allows the observer to navigate between waypoints in close proximity to each other, thus allowing for more points to be visited during a field day.

Collecting data

Data collection can be done with data stored in a newly created database on the data logger or in an existing database not older than seven days. In either case data is generally stored in the central memory of the Data Logger. If storage space becomes a concern many GPS units contain Flash Cards (data disk) onto which data can be stored. When recording data, make sure you are where you want to be when you restart (a few feet makes a difference). Be sure and name each feature in the data dictionary that data is collected on so it can be identified later in GIS.

Many GPS units allow you to collect nested features when collecting line or polygon data. This option allows you to collect data on features that are located in or around your travel route. However, you must first transfer the Data Dictionaries for features you are likely to encounter to the Data Logger before leaving the office. If you do not, your nested points will be downloaded as generic points without feature identification. If the nested feature is not on the line you are recording, first press the *Pause key* on your unit then travel to the feature. Record the nested feature to the data file, then return to the same place you left your line and resume collecting data.

Sometimes it is necessary to collect data from a position in order to identify a second location of interest that is not accessible. This is referred to as offset data collection. The offset configuration calculates a position taking into account the change of location.

Downloading data

At the end of each field day data should be downloaded to a PC computer for safe keeping and differentially corrected as soon as possible. If this is not possible, download data and differentially correct as soon as you return to the office.

III. References

Arkansas State Land Information Board. 2001. Standards for collecting mapping grade global positioning system positions.

<http://www.gis.state.ar.us/LIB/Projects/GPS.htm>

APPENDIX A Glossary of Terms Critical to Using a GPS Unit (modified from Arkansas State Land Information Board, 2001).

Accuracy - an indication of how closely a measurement is to the true value.

Almanac - location and time supplied by satellite vehicles orbiting the earth.
This information contains estimated position of satellite vehicles, precise time corrections, and potential atmospheric delay parameters.

Attributes - tabular information supplied about features. Tabular information should include latitude and longitude coordinates for the data GPS collected features. It may include other information such as feature type, quality, time, etc.

Autonomous - calculating a fixed position based solely on satellite vehicles information and a receiver. This is the least accurate means of GPS collection and typically produces accuracy errors ranging from 10-100 meters.

Base station (base receiver / base unit) - a GPS receiver that is placed in a precisely known location and serves as a means, by which the positions collected by all other receivers can be corrected. A base station is used to collect data from a number of satellite vehicles at a known position. This information may be used during real-time and differential correction processes.

C/A code- the standard (Coarse/Acquisition) GPS code; also known as the civilian code or S-code. A sequence of 1023 pseudo-random, binary, biphase modulations on the GPS carrier at a chip rate of 1.023 mhz.

Carrier phase - the difference between the carrier signals generated by the internal oscillator of a receiver and the carrier signal coming from the satellite vehicle.

Code - precise time and location information emitted by satellite vehicles.

Datum (geodetic datum) - a mathematical model that is designed to fit a point on the earth's surface to an ellipsoid. Commonly used datum's are North American Datum (NAD) 1927, and NAD 1983. GPS coordinates are based on the World Geodetic System 1984 (WGS84 datum).

Differential Correction - the process of improving fixed positions utilizing data from a base station.

Dilution of Precision (DOP) - refers to the geometry of satellite vehicles to the position of a GPS receiver. There are several types of DOP. The most common type of DOP is termed PDOP (position dilution of precision).

Elevation Mask - the minimum angle at which a GPS receiver will track satellite vehicles.

Feature - the physical location of spatial data. A GPS receiver typically collects points, lines, and areas (polygons).

Fixed position - the spatial location computed by averaging a predetermined number of positions. A fixed position is the single point or points (line and area) derived from a number of positions accepted by the GPS receiver.

Global Positioning System (GPS) - a constellation of a minimum of twenty-four satellite vehicles orbiting the earth approximately every twelve hours at an approximate pacing of sixty degrees.

Ionosphere - the part of the earth's atmosphere in which ionization of atmospheric gases affects the propagation of radio waves, which extends from about 30 miles (50 kilometers) to the exosphere, which is divided into regions of one or more layers whose altitudes and degrees of ionization vary with time of day, season, and solar cycle, and which is contiguous with the upper portion of the mesosphere and the thermosphere.

Julian Date - Day of the year between the range of 1 and 365. For example, the Julian Date for February 2 is #33. February 2 is the calendar date.

Lines – geographic term related to the scale that describe how a feature is drawn. Lines are linear measures of a feature.

Mapping grade - GPS receivers capable of attaining five meters of accuracy or better using differential correction.

Metadata - data about the content, quality, condition, and other characteristics of data.

Multipath - error which occurs when a GPS signal sent from a satellite vehicle is bounced or redirected by an object, prior to reaching a GPS receiver. Multipath will cause the time it takes a GPS signal sent by a satellite vehicle to reach a GPS receiver to be inflated. This will cause inaccuracies in positions collected.

PDOP mask - the maximum PDOP value that a receiver will accept positions.

Phase differential - utilizes radios to transmit signals between a mobile GPS receiver and a base station in order to differentially correct data as it is being collected.

Points – geographic term related to the scale that describe how a feature is drawn. Points are single dimensional features.

Polygons – geographic terms related to scale that describe how features are drawn. Polygons have area associated with the feature.

Position - spatial location acquired from positions averaged to determine a fixed position.

Post processing - utilizing base station data, GPS software, and data acquired by a GPS receiver in the field to gain an accurate fixed position.

Precision - the degree of refinement with which an operation is performed or a measurement stated.

Pseudo-random code - a signal with random-noise like properties. It is a very complicated but repeating pattern of 1's and 0's.

Receiver, rover, GPS unit / handheld - a mobile GPS receiver that consists of an antenna, and computer that will collect and store code sent from satellite vehicles.

Selective Availability (SA) - implemented by the United States Department of Defense, degrades the satellite vehicles signal sent to receivers. SA may be turned off or on at anytime. A GPS user should always assume SA is on and take the necessary steps to correct the GPS data collected.

Signals - see code

Signal-to-noise ratio (SNR) - a measure of the strength of a satellite signal. SNR ranges vary based on a number of factors. GPS data should only be collected when the SNR value is six or higher.

Spatial data - information that identifies the geographic location and characteristics of natural or constructed features and / or boundaries on the earth.

Trilateration - position of an unknown point is determined by measuring the lengths of the sides of a triangle between the unknown point and two or more known points (i.e. satellite vehicles).

Troposphere - the lowest densest part of the earth's atmosphere in which most weather changes occur and temperature generally decreases rapidly with altitude and which extends from the surface to the bottom of the stratosphere.

Waypoint – is a named 3 dimensional position on the earth's surface. That is, it has horizontal and vertical positions such as latitude and longitude. Waypoints are assigned to a fixed location in the field so it can be navigated to consistently and accurately through time.

APPENDIX B. Standard Operating Procedure (SOP) for Using a Trimble™ Pro XR GPS Unit.

This Standard Operating Procedure explains the procedures that all observers should follow to learn how to use the Trimble Pro XR GPS units to collect data and navigate to plots.

REQUIRED READING

Trimble General Reference Manual:

Section 1.3, pages 1-14 to 1-20; Introduction to GPS

Section 2.1 – 2.3, pages 2-1 to 2-6; Introduction to GIS: Data Capture, Data Types, and Data Structure

Section 3.1 – 3.2, pages 3-1 to 3-7; Collecting GPS Data for a GIS

Section 4.2 – 4.4, pages 4-10 to 4-31; GPS Accuracy: Planning Data Collection
Data Collection Parameters
Data Collection Procedures

Pro XR Receiver Manual: Section 4, pages 4-1 to 4-16

TSC1 Asset Surveyor Operation Manual: Section B, pages B-1 to B-8

I. SCHEDULING FIELD DAYS

For your GPS unit to function properly and collect accurate geographic locations there must be at least 4 satellites overhead and preferably more. In addition, PDOP (the measurement of relative accuracy) must be less than 6. Schedule your field work at a date and time when the PDOP is <6 and the number of available satellites is ≥ 4 . In order to facilitate your data collection; ask the GIS Coordinator if the most current almanac is available, if it is not have one downloaded at this time. The almanac is a set of data that is used to predict satellite orbits over approximately a month long period.

To access current almanac

1. Open **PATHFINDER OFFICE** by double clicking on the icon on the desktop – the *Select Project* window will appear. For a specific park select the corresponding project, otherwise close the window and continue.
2. Go into -> click on *Utilities* and choose *Quick Plan* from the drop down menu.
3. Select Date by choosing *Today*, *Tomorrow*, or *Day after Tomorrow*
 - a - Click on *Prev Month* or *Next Month* if the wrong month is displayed

- b - If necessary, enter the *Julian* date (see Appendix A for definition) in the lower left corner and the *calendar* date in the lower right corner.
- C -Press **ok** to close the dialog box.

4. *Edit Point* defines the latitude and longitude location where observations are taken. You can change the default location by clicking on *Cities* and selecting the appropriate city (e.g. Philadelphia) if it did not appear as the default location - click **ok** to accept changes. Close *Edit Point* by pressing **ok**.

5. *Status* window opens summarizing the information discussed in number's 2 and 3. Confirm the information and close the window.

6. You will now be in the *Plan: session #* window. Click on *Graphs* and choose *Number of SV's and PDOP* to get a graphical image of the number of visible satellites and the PDOP for the specified day and time. If your PDOP is above 6, that's too high and the GPS unit will reject readings. This also occurs when there are less than 4 satellites available. Therefore, you must schedule your field work for a date and time when PDOP is less than 6 and there are 4 or more satellites available.

II. PRE-TRIP PLANNING

Plan walk

It is essential to plan your route. When you are recording data, having knowledge of the area may allow you to maximize your time by allowing you to work on several features on the same trip. In addition, the topography of the area where you are collecting data may require changes in the Data Logger's configuration. The GIS coordinator will help you with any changes.

Knowing where features are located will help you prepare the Data Logger for recording information in the field. Pathfinder Office allows you to create a form for data collection in the Data Logger. This is accomplished by preparing Data Dictionaries in Pathfinder Office. They are then transferred to the Data Logger for your field work. When you return from the field, the information you recorded with the Data Logger is downloaded to the computer. The GIS Coordinator is then able to export the information directly into Arcinfo as a table.

To prepare/access Data Dictionaries

See Appendix A for definitions of terms with which you are unfamiliar.

1. Go into Pathfinder Office and click on *Utilities* to open the *Data Dictionary Editor*
2. Name the file – this will be the name that will be exported into Arcinfo. If you don't name it, your data will be named a 'default' point, line, or polygon.
3. Click on *New Feature* and enter a feature name. Feature names should correspond with fieldnames from each project database. Next designate the feature as a point, line, or polygon.

To change the name or designation of a feature, click on *Edit Feature*

4. To define attributes you wish to record in the field, click on *New Attribute* and pick *New Attribute Type* (listed below).

- a) Menu – letters, numbers, or other characters. Can select only one value (use for the comment field and possibly the name field if you know all the possible names)
- b) Numeric – numbers only, with decimal point (use for the i.d. #)
- c) Text - letters, numbers, or other characters. Can enter any value – use for the name field if you don't use a menu
- d) Date – collects a date value
- e) Time – collects a time value
- f) File Name – collects a file name
- g) Separator – are added to break up the list of attributes and increase readability, but are not attributes and do not contain attribute values.

5. Type in *Attribute Name* and click on *New*. Type in attribute value and click *Add*. These could be the names of attributes or measurements associated with attributes. Designate whether the field entry of an attribute is optional (normal), required, or not permitted. Continue until all attributes have been entered.

III. SYSTEM ASSEMBLY

Trimble Unit Assembly

1. Each gps unit is stored in it's own case in the field equipment closet. Even though parts are interchangeable the units should be stored as complete sets.
2. At least three hours before anticipated use check to ensure that batteries have been fully charged.
3. Install three VCR batteries in the carry-pack. Two of these will be connected to the clips that are in the carry-pack. The third battery is carried as a spare. These clips are to be handled carefully. When returning the GPS unit for storage be sure to disconnect the batteries.
4. After installing the three VCR batteries, zip the carry-pack closed.
5. Carefully attach the satellite receiver (the white disk) to the top of the antenna
6. Go outside now so that you won't crash into walls. Set up the antenna to carry with the backpack and connect the long cable to the satellite receiver. The extra cable can be inserted in either the pocket of the carry-pack or in storage places on the belt of the carry-pack.
7. Connect the 2nd, shorter cable to the Data Logger

Configuring the Data Logger

The system is already configured with default settings, but you may need to make changes before going out in the field. The logging intervals and minimum positions for point and line features may need to be configured for each session's use. Additional changes may be necessary depending on where you are collecting data.

CRITICAL SETTINGS:

SETTING	DEFAULT VALUE	SET TO AT WICR	USER GUIDE PAGE
Logging intervals	5 seconds	1 second	
Point feature	5 seconds	1 second	
Line/area	none	none	5-5
Not in feature	none	none	
Velocity			
Minimum positions (point feature)	3	50	5-8
Minimum Time (carrier phase)	10 minutes	N/A	5-10
Position Mode	Manual 3D	Manual 3D - possibly Auto 2D/3D in woods	5-14
Elevation Mask	15 degrees	15 degrees	5-17
SNR ratio	6.0	6.0 - may need to drop to 3 in woods	5-18
PDOP mask	6.0	6.0	
PDOP switch	6.0	6.0	5-19

NON-CRITICAL SETTINGS:

SETTING	DEFAULT VALUE	SET TO AT WICR	USER GUIDE PAGE
Audible Click	Yes	Yes	5-22
Log DOP Data	Yes	Yes	5-23
Dynamics Code	Land	Land	5-24
Antenna Options			
Height	meters	meters	
Measure	vertical	vertical	5-36
Type	EC	EC	
Confirm	Per feature	Per feature	

It is essential that the coordinate settings be confirmed before collecting or uploading data.

1. Turn on the Data Logger by pressing the Green-on/off button. The **Main Menu** screen will appear with the following options:

- Data collection
- File Manager
- Configuration
- Utilities

Navigation
Map
Receiver status
Satellite information

2. Using the arrow pad scroll down to **Configuration**. Press **enter**. The **Configuration** screen will appear with the following options:

GPS rover options
GPS base station options
Communication options
Coordinate System
Map display options
Navigation options
Units and Display
Time and Date
Quickmarks (after this, use the arrow pad to scroll down further)
Constant Offset
External Sensors
Hardware

Highlight **Coordinate System**, press **enter**. The **Coordinate System** screen has a listing of available projections. If UTM is not selected select it now and press **enter**. Datum should always be set to NAD 1983 (Conus). Zone should be selected based on the following table.

Park	UTM Zone	Datum
AGFO	13 North	NAD 1983 (Conus)
EFMO	15 North	NAD 1983 (Conus)
HOME	14 North	NAD 1983 (Conus)
PIPE	14 North	NAD 1983 (Conus)
SCBL	13 North	NAD 1983 (Conus)
TAPR	14 North	NAD 1983 (Conus)
WICR	15 North	NAD 1983 (Conus)

In order to change the Zone you must highlight this option and then press the **right arrow**. A menu listing all possible zones will appear. Use the arrow pad to scroll to the appropriate zone. Once you have selected the proper Zone press **enter**. Upon returning to the main projection menu ensure that the Datum is still set to NAD 1983 (Conus). If this is not the case scroll down to **Datum** and press the **right arrow**. Scroll through the list until you have selected to NAD 1983 (Conus). Press **enter**. Next scroll down to Altitude reference. This should be set to HAE. If it is not highlight this option and press **enter**. If all of the information is correct press **enter** a second time.

IV. FILE TRANSFER from PC to DATA LOGGER or Data Logger to PC

Check that you have all the necessary equipment and that it is operational. You can do this by setting up and connecting the Data Logger.

Connecting the Data Logger to and transferring data from PC to Data Logger

1. Connect cable from the PC to the Charging Unit (the cable extends from the back of the computer's hard drive tower and fits onto the end of the Charging Unit marked Computer).

2. Connect the cable from the Data Logger to the Charging Unit port labeled Data Logger.

Alternatively: The Data Logger may be connected directly to the PC if the battery in the Data Logger is sufficiently charged.

3. Turn the GPS unit on by pressing the **Green/On-Off** button. After a moment you will get a message on the screen saying that the GPS cabling has not established a connection and would you like to try again. Answer **no** using the softkey F1.

4. The Data Logger will show the *Main Menu* screen. Use the arrow pad to scroll down to File Manager, press **enter**. Use the arrow pad to scroll down to File Transfer, press **enter**.

5. In Pathfinder Office, click on *Utilities* and choose *Data Transfer*. A message will appear - *connecting to data logger*. This connection will either happen quickly or it will not work due to problems with the set up. If this occurs, check the cabling and your sequence of events. Also check that the cable is attached to the proper COM port.

6. Once the connection is made, check with the GIS coordinator that the Source Directory is correct.

7. Ensure that the Send Tab has been selected.

8. Choose *Data Type* (ex: Data Dictionary, Waypoints). Click your mouse to highlight the file(s) you wish to send to the Data Logger. To choose more than one file, hold the shift key while highlighting. Click on Add then click on *Transfer*.

9. After the transfer is complete close *Data Transfer* window and close Pathfinder Office.

Note: Reverse data transfer procedure when up loading data from the Data Logger to a PC.

V. DATA CAPTURE

1. From the **Main Menu** screen scroll to *Data Collection* and press **enter**. Select from one of the following.
 - Create new file
 - Open existing file
 - Create base file
2. Highlight **Create new file**, press **enter** to get the Create new file screen with the following information:
 - Filename:
 - Data dictionary:
 - Storage disk:
 - Free space:

For the Filename you will see a default file name based on the following format.

File Naming Convention: RMMDDHHx

File Prefix = R (for Rover)

Default Naming Formula: R

MM (month)

DD (day)

HH (hour)

"x" = "a" at the start hour, "b" at the second hour, etc.

Example: May 25 at 10:00 am = R052510a

If this works for your particular project scroll down to Data dictionary and press the right arrow. If the data being collected does not have a specific data dictionary select Generic and press **enter**.

Normally files will be stored in the central memory of the Data Logger. If storage space becomes a concern please use the GPS unit containing the 64mb Flash Card. In order to access this card select Storage Disk and press the right arrow. This will provide you with the options of TSC1 (the Data Logger) or PC card. After making your selection press **enter**.

3. The **Antenna Options** screen will appear next -> press **enter** (settings are default and should be left as you find them).
4. The Start feature screen will appear next. Scroll down to the feature type you wish to collect and press **enter**.
5. The next screen to appear will have the form with your Data Dictionary for you to fill out. For point features, enter the values while collecting satellite positions. For line or area features, first *pause* the unit by pressing the softkey **pause (F1)**. While

the unit is paused, enter the values and press the softkey **resume (F1)** to start collecting data. Make sure you are where you want to be when you restart (a few feet makes a difference)

6. Filling out the Data Dictionary:

- a. A mark means it is a menu choice and you can press **enter** to get the menu. Highlight your choice and press **enter**.
- b. If there is only a question mark, fill in the value or text that goes with the feature you are recording and press **enter** after each data entry.
- c. While on the main screen **DO NOT PRESS ENTER** until you are finished collecting satellite positions for that feature; if you do the unit will stop collecting data.

7. Close feature when finished by pressing **enter**.

8. The screen **Start feature** will reappear. To begin a new feature repeat steps 6 through 8 or exit data capture by pressing **ESC** key and repeat until you are back at the main menu.

9. Note End Time (and location if different from where you started) for every file. **Write down the file name and the date and time each file was collected in your field notebook !!**

10. Data Logger may be turned off by pressing the **Green-On/Off** button when the main menu screen is showing.

VI. FIELD OPTIONS

Nested Features

This option allows you to collect data on features that are located in or around your travel route. You must first transfer the Data Dictionaries for features to the Data Logger before leaving the office. If you do not, your nested points will be downloaded as 'generic'.

EXAMPLE: When you are recording a trail and want to identify things such as downed trees, trail signs, etc., you could use this option.

1. If the nested feature is not on the line you are recording, first press the softkey **Pause (F1)**, then travel to the feature.
2. When you are ready to record the nested feature, press the softkey **Nest (F3)** to pop up a menu of point features that can be nested with that feature. Scroll to and highlight the appropriate point feature by using the arrow key, press **enter**.

3. Press the softkey **resume (F1)**.
4. While collecting satellite positions fill out the Data Dictionary and press **enter**. Save the nested feature by pressing **enter**. This returns you to the **Data dictionary form** screen.
7. Return to the same place you left your line or area feature
8. Press the softkey **Resume (F1)** to continue collecting data.
9. When you want to record another nested feature, press the softkey **Nest (F3)** and repeat the process.
10. When you complete data capture for your line or area, press **enter** to save. This takes you back to the **Start Feature** screen.

Quickmarks

Use this option when you either can't or do not want to stop and record satellite positions for the feature. It will not be as accurate, but will estimate the feature position from the locations of features recorded before and after your quickmark.

It is essential that the Data Logger be configured with the correct time and date so the unit knows which positions to use. As with nesting features, in order to quickmark points in association with a line or area feature, Data Dictionaries for those features must be transferred to the Data Logger. If not, all your points will be downloaded as 'generic'. To record quickmarks do not *pause* from data collection

1. Press the softkey **Quick (F4)** to record a quickmark location. The selection of point features will appear on the Data Logger screen (generic and any Data Dictionaries you downloaded). Highlight your choice and press **enter**.
2. It does not matter if you have passed the quickmarked feature when you fill out the Data Dictionary.
3. The choice of whether to edit quickmarks in the field is made at the beginning of data collection by selecting **Configuration** from the **Main menu** screen -> scroll down to **Quickmark** and highlight -> press **enter**.
4. You will get two fields to define:
 - Attributes: *Default* (the values dictated by the Data Dictionary)
 - Confirm: choose *Yes* to review and/or edit the attributes. Choose *No* and the default attributes are saved.
5. Press **enter** to return to the Configuration screen. Press the **ESC** to return to the **Main menu** screen.

Offsets

This option is used when it is not possible to collect GPS positions at a feature due to interference and you must stand to the side. The offset configuration calculates a position taking into account the change of location.

EXAMPLE: If you want to record the corners of a building, the structure will interfere with data collection. Using the offset feature will allow you to move away from the building and still get the locations.

1. The choice of whether to offset features in the field is made under the **Configuration** screen -> scroll down to *Constant offset* and highlight -> press **enter**.
2. The default is no offset.
3. Highlight either point, quickmark, line, or area. Press **enter** and fill in values.
4. The assigned offset values will then automatically apply to each point, line, or area recorded
5. Pressing the softkey **Format (F2)** allows you to choose between 2 methods of describing the offset.
6. After all values have been updated press **enter** to accept the values and return to the previous screen.
7. An offset can be reset to zero by following the steps listed above and then pressing softkey **Reset (F1)**.

Point Feature Offsets:

- a) The easiest option to display a constant offset is as a bearing (the angle from true north), a horizontal distance (from the feature), and a vertical distance (above the horizontal distance).
- b) Your other option is to enter a bearing, the slope distance (a range), and the inclination (the angle above or below the horizon).

Quickmarks, Line or Area Feature Offsets:

- a) Your easiest option is to enter the option as a direction (left or right of the feature, a horizontal distance, and a vertical distance.
 - b) Your other option is to enter the direction, slope distance, and the inclination.
8. If you are using a constant offset and a feature doesn't need it press the softkey **Offset (F4)** then press softkey **Reset (F1)**. Press softkey **Yes (F1)** to confirm this change. Press **enter** to return to the data collection screen

9. All features (points, lines, areas, or quickmarks) can have only one offset associated with them.
10. If you need to change the offset when recording a line feature, it is necessary to segment the line so that each line segment has its own offset.
11. Be careful capturing area features with an offset, as the same offset value must apply to the entire area feature. If you need to vary the offset, you can do so by collecting the area as a series of line features or segmented lines.
12. **Applying Offsets to a specific feature:**
Offsets can be applied to a specific feature even when a Constant offset has not been established.
 - a) During the collection of a feature press the softkey **Offset (F4)**.
 - b) Press the softkey **Format (F2)** to switch between the two methods of display and input the appropriate values. Press **enter** to return to the data collection screen.

Segmenting a Line

1. Choose your Data Dictionary from the **Start Feature** screen and press **enter**.
2. You must finish entering the attributes of one line segment before you can start the next segment. When you press the softkey **Seg (F4)**, the Data Logger will confirm the previous segment's Data Dictionary values. You will have to wait at a halt to complete the first feature before starting the next segment.
3. Press the softkey **Seg (F4)**, enter values into the Data Dictionary and press **enter**. Press the softkey **Seg (F4)**. This will give you the Data Dictionary with the previous segment's values highlighted. Enter the new value for the new segment and press **enter**.
4. If there is satellite interference, the new segment will not begin at the same location as the previous segment ended.

Navigation

Navigation can be used for movement to known Waypoints and between known Waypoints. A waypoint is a named 3 dimensional position. That is, it has horizontal and vertical positions such as latitude and longitude. The 3rd position is elevation.

1. Waypoints can be recorded using 3 methods:
 - a) Use the GPS unit when you want to save a location identified in the field.
 - b) Plot waypoints from a map.
 - c) Generate waypoints in Pathfinder Office.

2. Waypoints can be assigned in Pathfinder Office in two ways:
 - a) Import a comma delimited file (csv) containing X, Y coordinates and a unique name for each waypoint (ex. 410021, 6454433, “waypoint1”).
 - Click on *File* -> choose *Waypoints* to get a choice of *New*, *Open*, and *ASCII Import*. Select *ASCII Import*.
 - Change *Files of type* to Comma-separated files (*.csv).
 - Browse to the location of your csv file. Select it and click *Open*.
 - b) Open a new waypoint file and in the Waypoint Properties window, fill in the Latitude, Longitude, and Altitude fields.
 - Click on *File* -> choose *Waypoints* to get a choice of *New*, *Open*, and *ASCII Import*. Select *New*.
 - Name the new waypoint file and browse to where you would like it to be stored.
 - Under the *Waypoint Properties* dialog box select create.
 - Name the new waypoint, add a north and south coordinate (Altitude is optional), and click *Save*.
 - When you are finished adding waypoints click *Close*.

For transfer of waypoints from computer to the Data Logger please refer to section IV.

3. Using the Data Logger to Navigate in the Field:
 - a) From the **Main Menu**, scroll down to *Navigation* and press **enter**.
 - b) The screen that appears will be either the Direction Dial Screen or the Road Screen. You may toggle between these two screens by pressing the softkey **Mode (F1)**. By pressing the softkey **Options (F2)** you can choose the contents of the Info panels. Normally these are set to Turn, Bearing, Velocity, and Time.
 - c) By pressing softkey **Target (F4)** the user is able to select from one of the listed waypoints. After a selection is made press **enter** to return to the navigation screen.
 - d) Returning to the Navigation screen the display will show the bearing needed to reach the waypoint and at the bottom of the screen will be the distance to the waypoint. From the **Main Menu** screen, highlight *Utilities* and press **enter**.
4. Navigating between Waypoints in the Field
 - a) From the *Main menu* screen, highlight *Utilities* and press **enter**.
 - b) Highlight *Waypoints* and press **enter**.
 - c) You will get a menu with the names of the programmed locations
 - d) Highlight your start point and press the softkey **measure (F3)**. By default, this will give you the 1st and 2nd waypoints you have programmed

- e) You can switch where you wish to navigate from and/or to by highlighting the waypoint, pressing **enter**, and making a new choice. This screen will also give you the distance (in meters) between waypoints and the compass bearing you must follow to reach your destination (**T** refers to true north, **M** to magnetic north).