

White-Tailed Deer Monitoring Protocol for the Heartland I&M Network and Prairie Cluster Prototype Monitoring Program Parks

Standard Operating Procedure (SOP) # 3

Using GPS

Version 1.0 (October 2004)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

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

Key Concepts: **PDOP** (proportional dilution of precision), a measure of GPS accuracy. Check the **Quickplan** charts for the park and days in which fieldwork will be conducted to identify times of high **PDOP**, thus times to avoid collecting GPS data. You should try to GPS when the **PDOP** is low, below 6. High **PDOP** typically reflects a combination of poor satellite geometry and atmospheric conditions.

Using the Trimble Pro XR GPS Units

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

TDC1 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. 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 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 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

A) Plan drive

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 Arcview as a table.

B) To prepare/access Data Dictionaries

See Appendix with definitions for 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 Arcview. 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.

C) Field Materials and Equipment

1. notebook and pencil
2. GPS field guide (this document)
3. watch
4. water

5. compass
6. radio or cellphone
7. bug repellent
8. field guides as needed
9. GPS unit

III. SYSTEM ASSEMBLY

A) Trimble Unit Assembly

1. Each gps unit is stored in its own case in the field equipment closet. Even though parts are interchangeable the units should be stored as complete sets.
2. At least two 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 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

B) 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			
Point feature	5 seconds	1 second	5-5
Line/area	5 seconds	1 second	
Not in feature	none	none	
Velocity	none	none	
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	5-19
PDOP switch	6.0	6.0	

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 Measure Type Confirm	meters vertical EC Per feature	meters vertical EC Per feature	5-36

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.

I. FILE TRANSFER from PC to DATA LOGGER

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:

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.
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.

II. 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**.

4. The *Antenna Options* screen will appear next -> press **enter** (settings are default and should be left as you find them).
5. The Start feature screen will appear next. Scroll down to the feature type you wish to collect and press **enter**.
6. 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)
7. 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.
8. Close feature when finished by pressing **enter**.
9. 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.
10. 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 !!**
11. Turn off Data Logger by pressing the Green-On/Off button.

VI. FIELD OPTIONS

A) 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.

B) 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.

C) 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.

D) 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.

E) 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:
 - c) Use the GPS unit when you want to save a location identified in the field.
 - d) Plot waypoint from a map.
 - e) 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 sofkey *Mode* (F1). By pressing the sofkey *Options* (F2) you can choose the contents of the Info panels. Normally these are set to Turn, Bearing, Velocity, and Time.
 - c) By pressing sofkey *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).

VII. FILE TRANSFER from DATA LOGGER to PC

Connecting the 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.
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 setup. If this occurs, check the cabling and your sequence of events. Also check that the cable is attached to the proper COM port.
6. Ensure that the Send Tab has been selected.
7. 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*.
8. After the transfer is complete close *Data Transfer* window and close Pathfinder Office.

APPENDIX A

Elevation Mask: Sets cut-off elevation for satellites (the unit will not gather positions from satellites lower than the degree set). Should be a minimum of 1 degree above the Base Station Mask with 15 degrees recommended. . This is most important during the planning stages. If you are working in locations with obstructions you can set the mask higher so that only those satellites higher in the sky will be used for data collection. You can also allow for these situations by checking the azimuthal position of satellites in Quick Plan

SNR Mask: Signal strength or Signal to Noise Ratio. If it's too high you won't get good data. The range is 0-99. If you raise the SNR mask you can receive more satellites but the data isn't as good. The default is 6.

PDOP Mask: Position Dilution of Precision. It is an indication of the accuracy of the calculated position based on the location of the satellites in the constellation. If satellite positions do not allow the use of coordinate geometry, then accurate ground locations can not be triangulated from them.

Less than 4 = very good; 5 to 8 = adequate; more than 8 stay home.

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.

Feature - the thing about which you wish to collect data. Examples include buildings, woodlots, roads, trails, etc.

Attributes - descriptive characteristics of features

Points, Lines, and Polygons – geographic terms related to scale that describe how features are drawn. Points are single dimensional, lines have length, and polygons have area.