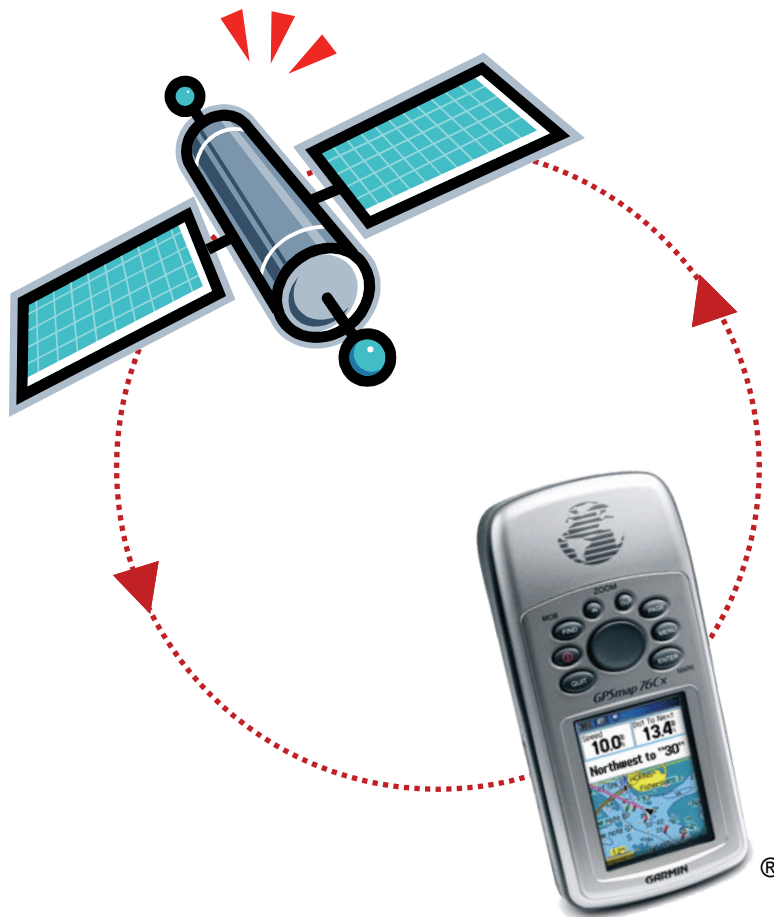




**Advanced**

# **GPS Training**

**for Natural Resource Professionals**



**Western Maryland Research and Education Center  
Keedysville, Maryland**

*Jonathan Kays, Natural Resources Extension Specialist*

*Elli Hammond, Forestry Extension Assistant*

[www.naturalresources.umd.edu](http://www.naturalresources.umd.edu)

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# Integrating Terrain Navigator & GPS Training Manual List of Contents

Materials available online at

[www.naturalresources.umd.edu/GPS.cfm](http://www.naturalresources.umd.edu/GPS.cfm)

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## **Integrating Terrain Navigator & GPS Training for Natural Resource Professionals**

**Instructors:** Jonathan Kays, Extension Specialist – Natural Resources

### **Agenda**

- 8:30 Registration (Each participant receives a GPS unit for workshop use and a training manual)
- 9:00 Introduction to GPS and Terrain Navigator software
- How GPS is used in forestry and how Terrain Navigator can help perform jobs better.
- 9:15 Setting up Terrain Navigator
- Updates, save CD maps to hard drive, connecting to GPS units, setup preferences, selecting a location, navigating the map, map scale and zoom
  - Brief review before moving on
- 9:45 Terrain Navigator Tools
- The hand, center, distance tools, marker tool, creating a label, drawing a route, route information, creating a track by hand, information tool, layers
  - Brief review before moving on
- 10:45 Creating Routes & Waypoints Using Bearings
- Creating routes using bearings
  - Locate plot in USA Photomaps and Terrain Navigator
- 11:15 File Management & Printing
- Saving GPS data, saving maps, emailing maps
  - Setting up the map for printing, printing options
- 11:45 Reviewing functions of the GPS receiver
- Brief powerpoint to reacquaint users with functions of Garmin GPSMap76Cx unit
- 12:00 Lunch

- 1:00 Case Study Worksheet Exercise
- Provide scenario and worksheet check list which will require going to USA PhotoMaps to find start location, transfer bearings to azimuth and create route and waypoints for area of interest. Participants then download waypoints and routes to GPS unit and a map will be provided for field use.
- 1:45 Outside Skills Session
- Carpool to field site
  - Clear and turn on tracks
  - Walk perimeter of area. Re-mark and average corners. Use tracks to mark an open field and road.
- 2:45 Download Field Data and Produce Map and Data
- Download data taken in field to truth-test initial locations. Delete original points. Change color of waypoints and route.
  - Produce final map
- 3:45 Fill out evaluation and adjourn

# Activity 1

## Setting Up Terrain Navigator

### Updates for Terrain Navigator

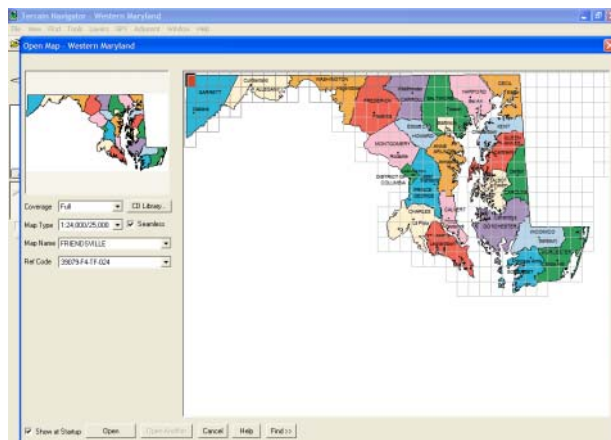
After loading the software on your computer, check the Maptech website to find out if there are updates available. Go to [www.maptech.com](http://www.maptech.com) and click on Downloads on the top navigation bar. Under Land Map Software, click on Terrain Navigator. Select the most recent update and install it onto your computer.

### Save CD Maps to Hard Drive

Once you have the latest software update, you will be able to save to your computer the maps found on Terrain Navigator CDs. This way, if downloaded on a laptop, you'll have the topo maps with you when traveling in the field without needing the CDs.

To load the maps, open Terrain Navigator with the maps CD in your CD drive. The Open Map window appears by default (you can change this default by unchecking the box in the lower left corner). Close the map window. In the top navigation bar, click on File, then Copy Maps to Hard Drive... Select the maps from the CD you would like to save and click OK. Keep in mind that the maps take up memory on your computer, so you may want to load just the maps you need. Follow the directions that appear on screen.

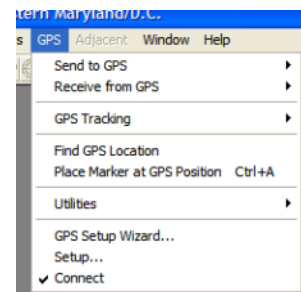
The next time you open Terrain Navigator, the Open Map window will appear and the area covered by the grid represents the USGS topographic maps that are downloaded and available for viewing. Close this map window. You can open this window later by clicking on the Map Selector (down arrow on left side of screen).



### Connecting a GPS Unit

You need to configure Terrain Navigator to be able to communicate with your GPS unit. In the top navigation bar, click on GPS. For your first time setting up a GPS connection, select GPS Setup Wizard. Follow the directions on the screen. Once you are comfortable with this, or if the wizard didn't work, you can go through the setup directly by clicking GPS > Setup...

In the setup window, select the unit's manufacturer and model number. Test the connection by clicking GPS > Connect. If no error message appears, you should be connected. In the top navigation bar, click GPS. On the dropdown list, there should be a check mark next to Connect if the unit is properly connected.



## Transferring Data

Transfer data by selecting GPS > Send to GPS or Receive from GPS. Once you have transferred your data, it is a good idea to turn off the unit. If the unit shuts off on its own, it could freeze Terrain Navigator, requiring using Ctrl+Alt+Delete to shut down the program, and unsaved data could be lost. By manually turning off the unit after data transfer, the data should be saved in Terrain Navigator without risking freezing problems.

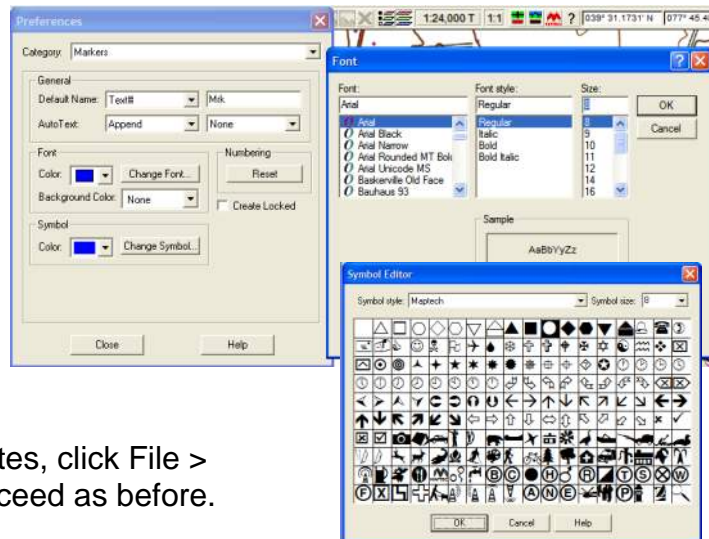
## Setup Preferences

You can change the color and size of fonts and symbols used for markers, routes, and tracks.

**To make changes that will apply to all markers**, on the toolbar at the top of the screen, click File > Preferences > Markers.

Click Change Font. Under Size, Choose 8 (a larger font will take up too much space when mapping smaller parcels). Click OK.

Now click Change Symbol. Choose the filled-in circle and symbol size 8. Click OK and Close.



To change the settings for Routes, click File > Preferences > Routes, and proceed as before.

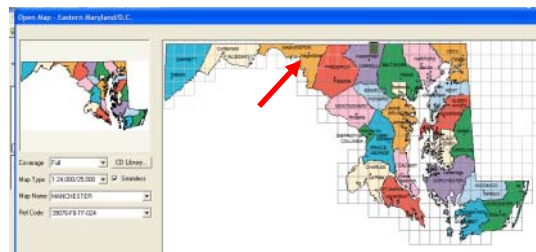
**To change the color, symbol, or font of a specific route or waypoint**, right-click on that item and select Edit.

## Selecting a Location

There are several ways to find the map that you want.

### 1) **Choose a topo quad from state map:**

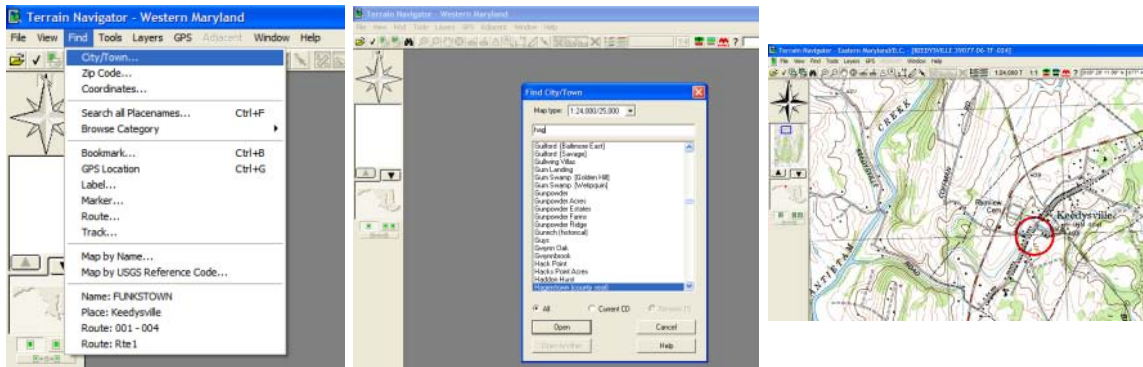
When you first open Terrain Navigator, a window will pop up showing Maryland. If it is not open, click on Map Selector (the down-facing arrow on the left side of the screen). Double-click on the rectangle representing the topo quad you want to view and the map will open.



2) **Search by City/Town:** Close the map screen if it appears. Click Find on the menu bar. Choose City/Town. On the window that pops up, scroll down to the location you want, or type the first few letters of the town to quickly find it, and highlight the correct town. Click "Open" and a map will open with a red circle

around the center of that town. The Find function also can be used to search by zip code or lat/long coordinates.

3) **Search by Marker, Route or Track:** Click Find on the menu bar. Choose Marker. On the window that pops up all markers that are currently in the program memory are displayed. Highlight the marker you want and then click “Replace active” and a map will open with a red circle around the center of the marker. This same process can be use for finding routes or tracks that are in the program memory.

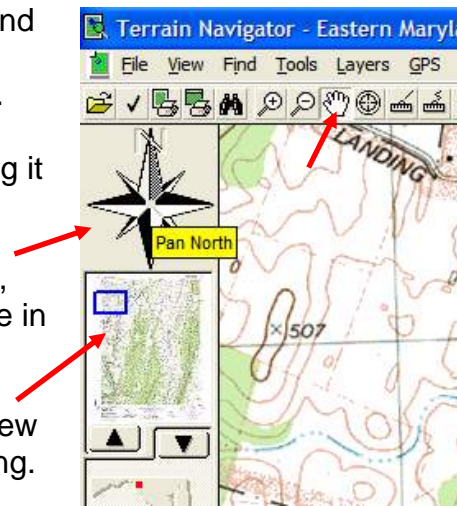


### **Navigating the Map**

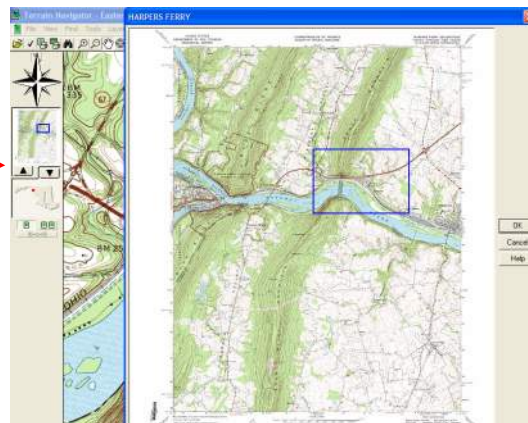
**Click and drag:** Select the drag tool; it is the hand icon on the tool bar. Now when you move your mouse over the map, your cursor will be a hand. Hold down the left mouse button and move the mouse. The map will move as if you are dragging it with your cursor hand.

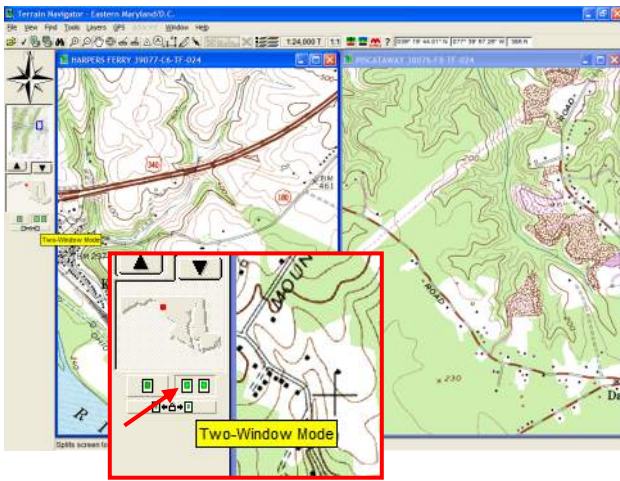
**Compass:** To pan in a certain cardinal direction, click on the appropriate arm of the compass rose in the top left corner.

**Map overview:** Below the compass is an overview of the whole USGS map you are currently viewing. To jump to a point on the map, simply click that spot on the overview map. Or, drag the blue box to the area you want to view.



The **up-facing arrow** below the map overview will bring up a window with a larger view of the whole topo quad map. The area you are currently viewing is outlined by the blue box. The **down-facing arrow** opens the state map window, allowing you to select a different topo quad to view.



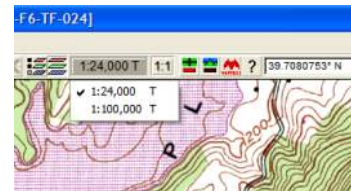


**Two-Window Mode** allows you to view two maps simultaneously. When you first click on the two-window mode button, another copy of your active map will appear. The maps can be moved and altered individually. To select a different map, right-click on the map and select Open Map, or click on the down arrow on the left side of the screen. The state map window will appear and you can choose any map.

To remain in two-window mode, the second map you choose must be from the same CD map group. For example, you can open two maps from Western Maryland at the same time, but if you try to open an Eastern Maryland map, the program will switch to single map view. This only applies to opening maps from the state map. You can right-click on either map and use Find to go to a marker or city from any other area while remaining in the two-window mode.

### Map Scale and Zoom Level

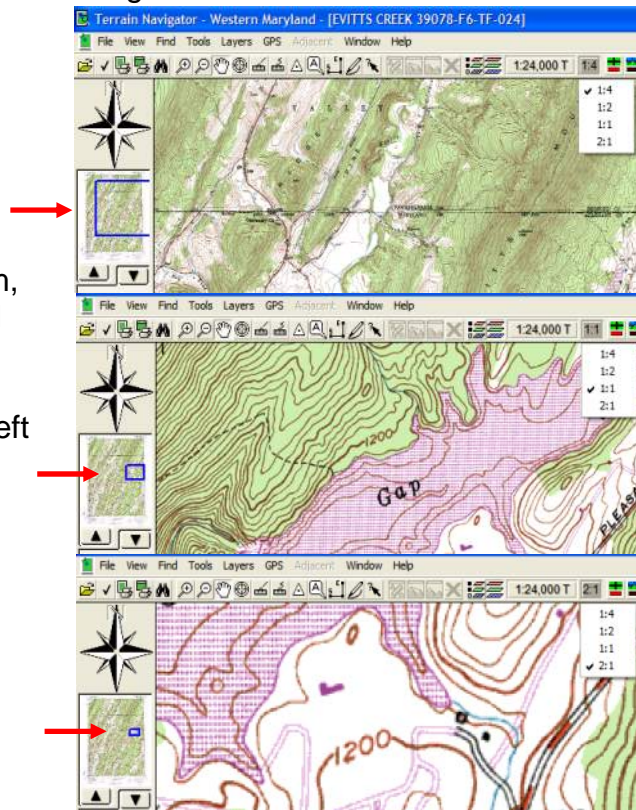
The options for **map scale** are 1:24,000 and 1:100,000, but many maps are only available in the more detailed 1:24,000 scale, which is the standard 7½ minute “USGS topoquads.” The ratio 1:24,000 means 1 inch on the map=2,000 feet on the ground.



The **zoom levels** available are 1:4, 1:2, 1:1, and 2:1.

Viewing in 1:4 level is like zooming out to 25% of actual scale, so instead of 1 inch=2,000 feet, 1 inch would equal 8,000 feet. At 2:1 zoom, the map is magnified by 200%, so 1 inch=1,000 feet.

Look at the topo quad map on the left side of the screen. Notice how the size of the blue box outlining the current map view changes with the zoom level.

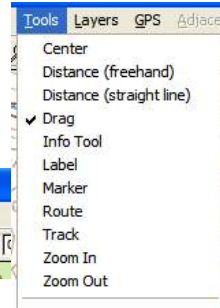
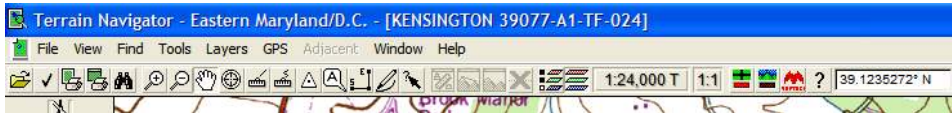




# Activity 2

## Terrain Navigator Tools

All of the tools in Terrain Navigator can be accessed in two ways: 1) by clicking on “Tools” on the navigation bar at the top of the program, or 2) by clicking on the symbol on the toolbar that represents the specific tool you want to use.



### The Hand

The hand is the default tool when you open Terrain Navigator. By clicking on the map and dragging your mouse, the map moves with the hand.



### Center

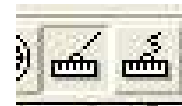
The center tool looks like a circle with crosshairs. This tool allows you to bring your work area into the center of the screen. Wherever you click on the map while using this tool, the map will shift, making that point the center of the screen.



### Distance Tools

Distance Tools allow you to draw lines on a map and obtain distance and area information.

**To draw straight lines:** Select the distance tool that looks like a ruler with a straight line above it. On the map, click where you would like to start your line. Move your cursor to where you'd like the end of the line to be, and click there. You can make as many of these connected lines as you would like. Use the Backspace key on your keyboard to erase the last segment you've made. To erase the whole line, press Escape, or right-click on the line and select Clear.

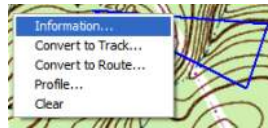


**To draw freehand:** Select the freehand distance tool, which is a ruler with a curvy line above it. Click and drag on the map to draw a line freehand. Use the Backspace key on your keyboard to erase part of the line. To erase the whole line, press Escape, or right-click on the line and select Clear.

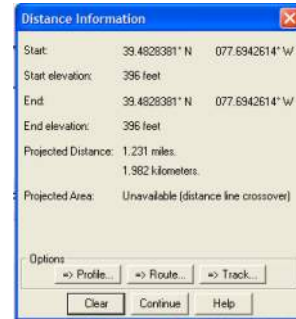
**Find Distance:** To find the distance of the line you've made, right-click on the line and select Information. If you've outlined an enclosed shape, the information will include area in acres, square feet, etc, as well as the elevation of the start and end points.

**Potential problems:** If your line overlaps itself, the information will not include area. To prevent this from happening, zoom in as close as possible (2:1 zoom level), press Backspace to delete the overlapping line, and re-draw so that the line does not overlap itself.

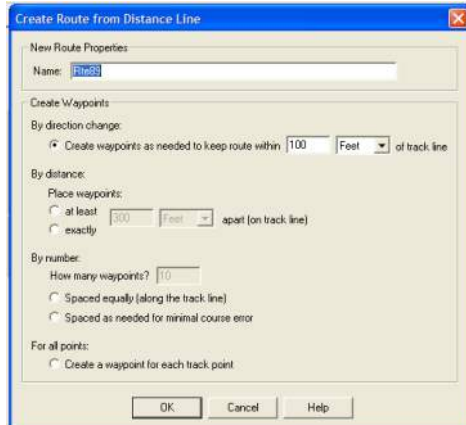
## Right-click on a distance line for several options



**Information:** This brings up information about that line including elevations, distance, and area.



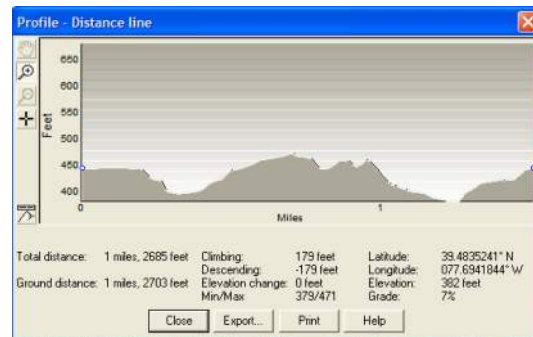
**Convert to Track:** This makes a track out of the line. The track can be sent to your GPS unit. (Lines cannot be sent to your GPS unit.)



**Convert to Route:** Since a route is a series of waypoints, the program must create waypoints along your line to make a route out of it. You are given 4 options to create waypoints:

- 1) when there is a direction change
- 2) by a certain distance (like every 300 feet)
- 3) by spacing out a certain number of waypoints evenly distributed along the line
- 4) at every track point (track points are close together, so this isn't recommended unless you have a very short route).

**Profile:** Selecting Profile allows you to view a cross-cut view of the line as if it were stretched out to make a straight line. You can see the changes in elevation as if you were walking the path of the line.



**Clear:** This deletes the line.

## Marker Tool

In Terrain Navigator, waypoints are called Markers.

**To create a marker** on a map, select the Marker Tool, which is a triangle with a spot. Your cursor will now be a white triangle. Place your cursor where you wish to create a marker and left-click. Once created, the marker is saved in the program and will be there the next time you open it. However, it is best to back up your work by saving markers and routes somewhere else when you are done with a session (like on your GPS unit or in a program like EasyGPS).



**To move a marker**, move your cursor so that it is directly on the marker; the cursor will change to a hand with a triangle on the palm. Click and drag to move the marker.

**To delete a marker**, hover over the marker (cursor will change to the hand) and right-click; select Delete.

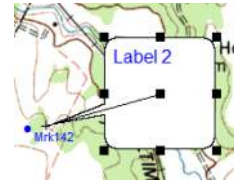
**To rename a marker**, place your cursor over the name box next to the marker; the cursor will change. Click to open the name box, type in the new name, and press Enter.



## Label Tool

The label tool allows you provide explanation about a particular point using a label balloon that can be resized and redirected.

**Create a label:** Select the tool that looks like a quote balloon with an 'A' in it. On the map, click where you would like the point of the balloon to be. To move the point, just click on it and drag. To change the size of the balloon, click and drag one of the corners. To move the balloon, click in the center and drag. Click on the text to edit.

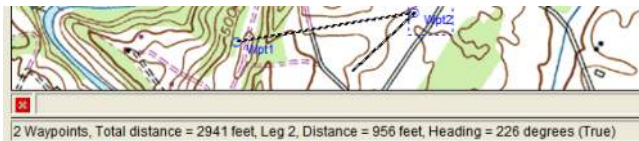


## Route Tool

The Route Tool is two connected lines labeled E and S. Once selected, your cursor is a shaded triangle.



**Drawing a Route (a series of waypoints):** Select the starting point for the route on the map and left-click. This will create a waypoint, which by default is named Wpt#. Click where you want your next point and so on until you have completed your route. Look below the map – you can see the distance and heading of the legs of your route.



If you would like to loop back to your first point, right-click on the first waypoint and select Toggle Route Loop. Right click again and select Finish Route. At any time, a waypoint can be moved by clicking and dragging. Once a route is created, it will be saved in Terrain Navigator even after you close the program.

**To delete a waypoint,** right-click on the waypoint and select Delete Waypoint. The waypoints on either side of the one deleted will then connect.

**To find out information about a route,** right-click on one of the waypoints in the route and select Information.

**To add a waypoint to a route,** click on the line connecting the waypoints between which you want to insert a waypoint. Your cursor will change to a white triangle with a + in the center. Click to create a new waypoint which can be moved by dragging. The waypoint will be connected to the adjacent route points.

## Route Information

When you create a route, additional options become available on the toolbar:



**Layer Information** – provides information about the route such as length, area, and distance between waypoints.



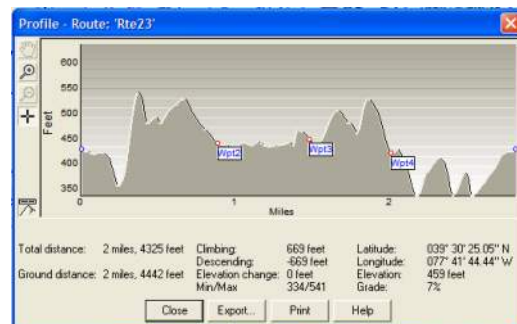
**Line of Sight** – This option is only applicable for a route made up of two waypoints. It shows the elevation change in a direct line between points.



**Profile** – illustrates the change in elevation through the course of a route.



**Delete** – deletes the selected route.



## **Track Tool**

This allows the user to draw a track around a location or from one place to another. The track is made up of small trackpoints that can then be converted into a route with waypoints according to preferences set by the user.

**To create a track by hand**, select the Track Tool (a pencil with a curved line). Click and drag to draw a curved track; or click, move your cursor, and click again to create a straight segment.



**To erase** the last portion that you drew, press Backspace or Delete once to erase a straight segment, or hold down the button to point-by-point erase a curved section. When you are finished, right-click on the track and select Finish Track. Once finished, the path of the track can not be changed.

**To convert a track to a route with waypoints** right click on the track and select Create Route. The window that appears allows you to name the route and provide a number of options on how waypoints will be located. If you want the route to closely follow your track, you may want to select By direction change: and within 10 feet of track line. Make your selections and press okay. Information on the new route will be displayed.

## **Information Tool**

The arrow pointing to a question mark allows you to find out information about an item. While using this tool, clicking anywhere on the map will open a window displaying the information for that point, including the map name, lat/long coordinates, and elevation.



## **Layers**

The three layers used in the program are markers (or waypoints), routes, and tracks. By clicking Layers on the navigation bar, you can then click on either Markers, Routes, or Tracks. A window will open listing the markers, routes, or tracks saved in Terrain Navigator. You can edit and delete these items in this window.

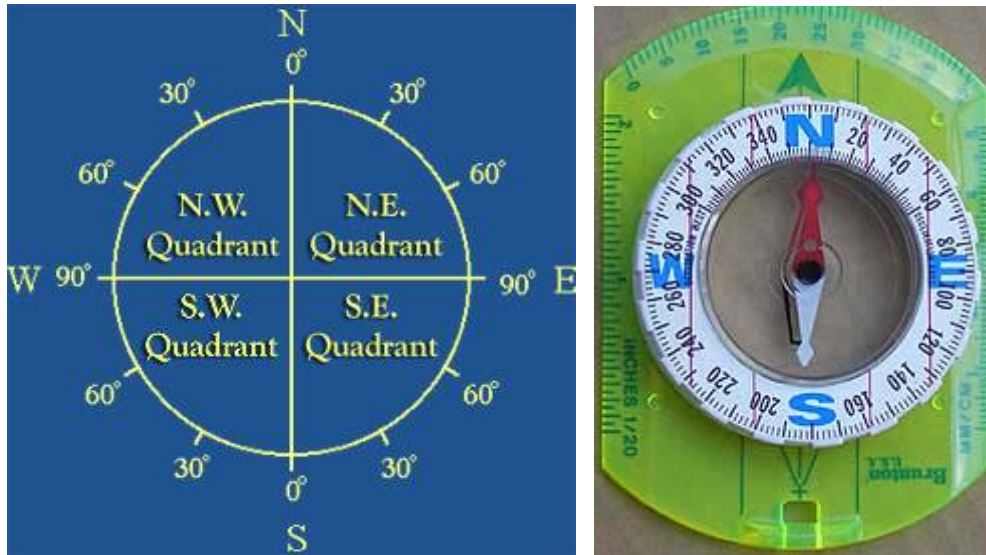
If you keep markers from many different projects, they will all show up in Terrain Navigator unless they are deleted. This can become confusing since the program will allow the same name to be used repeatedly. After saving your layer data in another program under a specific folder name, it is best to delete the data in Terrain Navigator to avoid confusion.

# Activity 3

## Creating Routes & Waypoints Using Bearings

**Bearings** describe direction by the number of degrees ( $0^{\circ}$ - $90^{\circ}$ ) and direction (E or W) away from true North or South (e.g., N  $30^{\circ}$  W). Most deeds provide boundary locations in bearings.

**Azimuth** is direction measured in degrees, with true North being  $0^{\circ}$  (or  $360^{\circ}$ ) and increasing clockwise (East =  $90^{\circ}$ , South =  $180^{\circ}$ , West =  $270^{\circ}$ ). Terrain Navigator, USAPhotoMaps, and the GPS unit use azimuth.



Source: [http://geology.isu.edu/geostac/Field\\_Exercise/topomaps/bearing.htm](http://geology.isu.edu/geostac/Field_Exercise/topomaps/bearing.htm)

Convert these bearings to azimuth:

N  $70^{\circ}$  W = \_\_\_\_\_

S  $56^{\circ}$  E = \_\_\_\_\_

### Creating Routes Using Bearings

There are several ways to create a route based on a property description given in distance and degrees from a certain starting point. You can enter the distance and compass direction (in degrees) into the GPS unit to create new waypoints, but entering in each digit is time-consuming.

In Terrain Navigator, you can, 1) type in the distance and compass direction for each leg of a property boundary, or, 2) move your cursor over the map until the correct distance and degrees is displayed (free hand).

You can also use this free hand method in USAPhotoMaps, but the displayed distance is the total distance of the route, not the distance of each leg. For this reason and because there are more editing options, Terrain Navigator is a better program to use for creating routes. However, USAPhotoMaps is great for locating buildings and wooded areas using the aerial photos (keep in mind that many of the maps and aerial photos are old and may not reflect recent changes in land use).

It can be useful to locate a site and mark a corner in USAPhotoMaps, then use that waypoint in Terrain Navigator to create a route.

Open USAPhotoMaps and GoTo this address:

**18330 Keedysville Road  
Keedysville, MD 21756.**

The create waypoint window will appear. Click OK. Just north of this point will be a triangular piece of wooded land.

Make a waypoint at the top point of the triangular piece of land. Name the waypoint **TOP**. Send this point to the GPS unit by clicking Waypoints > Show Current... > highlight **TOP** > To GPS.



Open Terrain Navigator. Import the TOP waypoint by clicking GPS > Receive from GPS > Receive Waypoints > highlight **TOP** > OK.

### Terrain Navigator

You are going to create a route using the TOP waypoint as the starting point, then creating legs using distances and directions.

Open Terrain Navigator. Select Layers > Routes > New. Choose Waypoint (radio button at top of window) and select New. Select **Top** from the dropdown box. Click okay. Now you have the first point in your route. You can now create a leg based on a given distance and direction from this point.

In the Route Waypoints/Legs window, select the Legs radio button and click New... A New Route Leg window will appear. Name it Right. If not already selected, select the buttons for Insert **After** and Distance/Bearing **From**. Enter data for bearing (in azimuth degrees) and distance. Click okay. Select New and name this leg Left. Enter the Left data and click Close.

*Right: Bearing 148 Degrees; Distance 1646 Feet.*

*Left: Bearing 281 Degrees; Distance 1012 Feet.*

Name the route you've just created **Triangle**. Check the box next to Loop so that the route will end with your starting point.

Change the waypoint, loop interior (and pattern), and line colors. This way, you will differentiate this route from others.



What is the distance of your route? \_\_\_\_\_

What is the area? \_\_\_\_\_

Delete the route from Terrain Navigator before drawing the free hand route.

## Free Hand Route in Terrain Navigator

Import the TOP waypoint. Select the Route Tool. Move your cursor to a point near the TOP waypoint and click once to make your first route location (you won't be able to make it directly on top of the waypoint). Place your cursor over your first route point and click and drag the point so that it is directly over the TOP waypoint. Move your cursor away from this point (a line should be connecting your cursor to the first location).

Look at the text box below the map. You will see the description of the leg of the route you are creating. Move your mouse until the leg distance and bearing (Heading) matches the information provided for you. Click where you want to make the next corner. Continue making all legs of your route. Right-click and select Toggle Route Loop. This will link the last waypoint with the first.

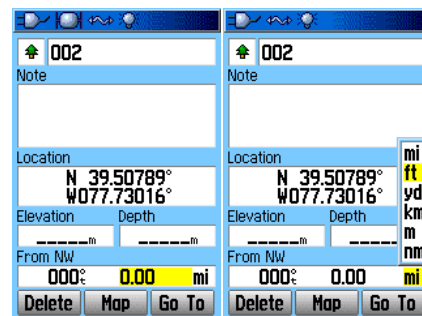


Right-click again and select finish route. To change the name of the route, put the cursor over one of the waypoints in the route, right click and select edit route. You can then change the name, edit points, change the font, etc.

## GPS Unit

To create waypoints on the GPS unit using bearings, you will need to have a starting waypoint saved in the unit.

To create a waypoint a certain distance and bearing from a saved waypoint, press FIND and select a starting waypoint (TOP). Press MENU once. Select Project Waypoint and press ENTER. At the bottom of the screen, a box will be labeled "From ..." naming the first waypoint you selected.



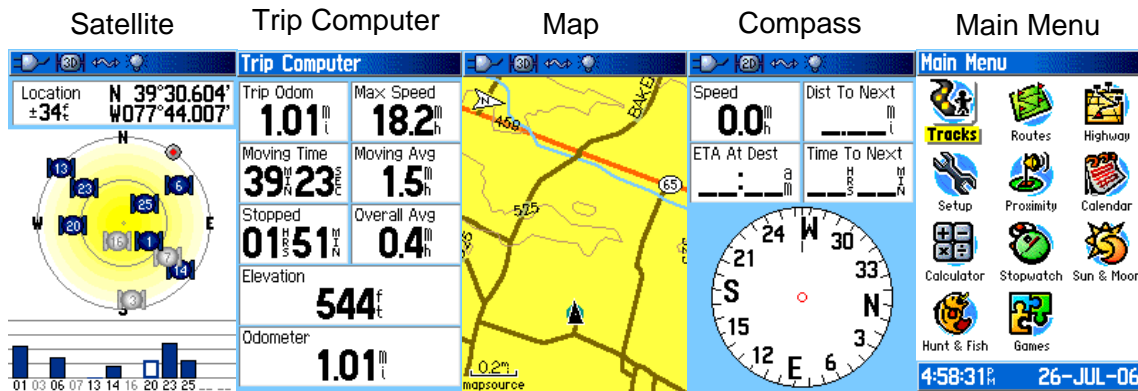
By highlighting and pressing ENTER, you can change the bearing and distance. To change the distance units, highlight the current unit (miles (mi) is the default) and press ENTER. Once you enter the bearing and distance, the latitude and longitude will automatically change to the correct coordinates for that location. Rename the waypoint and select Map. The new waypoint will be automatically saved. You can see the new waypoint on the map screen.

When you are ready to create the next projected waypoint, press FIND, select the waypoint you just created, and proceed with the same process. This method allows you to make waypoints. If you want to make a route out of these waypoints, you can do that by creating a route and adding each point in order.

# Activity 4

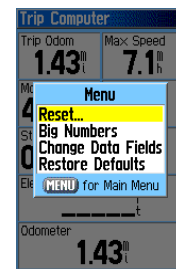
## GPS Receiver Functions

The unit used throughout this training is the Garmin GPSMap76Cx. There are five screens that can be viewed in sequence by pressing the PAGE button.



While on any screen, press the MENU button once to get options for various functions. Press the MENU button twice from any screen to return to the Main Menu screen.

Menu



The three major tools for this GPS unit are waypoints, routes, and tracks.

**Waypoints** are pinpointed locations. You can create waypoints on a GPS unit or on a computer. A waypoint is created by holding down the ENTER button until the Mark Waypoint window appears.

By default, the GPS unit marks your current position for the waypoint you created. You can use the averaging tool to get a better estimate of your current location. Create a waypoint, highlight the Avg box at the bottom of the Mark Waypoint window, and press enter. Remain at the same spot, and as the unit takes more location measurements, it will average these points and the accuracy of your waypoint should increase. When you are satisfied with the accuracy, highlight Save and press enter.

If you want to create a waypoint for a location for which you know the coordinates, create a waypoint by holding down the ENTER button. Highlight the Location box and press enter. Using the on-screen number pad, you can now enter the correct coordinates.

To mark a waypoint at a certain point on a map, go to the map screen. Using the rocker, move the cursor to the desired location for the waypoint and hold down the ENTER button. You can then change the name and characteristics of this waypoint as with any other.



**A route** is a series of connected waypoints. A route can provide directions while you travel to waypoints. A route can be created using any waypoint or point of interest saved on the GPS unit.

To create a route from waypoints you have saved, from the main menu, select Routes>New>Select Next Point>Waypoints>your first point>Use>Select Next Point... Continue selecting waypoints to complete your route. Remember to use your starting point for the last waypoint if you want to end where you started.

To follow a route, select Routes from the main menu. Select the route, and you are given the options Navigate and Map. If you choose Map, the map screen will appear showing your route. If you choose Navigate, the unit will show directions to get you from your current location to the first waypoint in the route. When you reach the starting point, the unit will direct you to the next waypoint and so on throughout the route. You can follow directions on the map or compass screen. Remember to turn navigation off when you are finished since other features of the GPS unit can be hindered while navigation is on. To turn navigation off, press the menu button once and select Stop Navigation.

**Tracks** mark the path you travel. A track shows up on the map screen as a line of small dots. Tracks can be turned on or off, and can provide information such as the distance traveled or the area within the track.

To use tracks, select Tracks from the main menu. Turn tracks on by highlighting the On button at the top of the window and pressing enter. Save the last portion of the track by selecting Save. On the Saved Track window that appears, you are able to name the track and view the distance and area of the track.

# Activity 5

## File Management

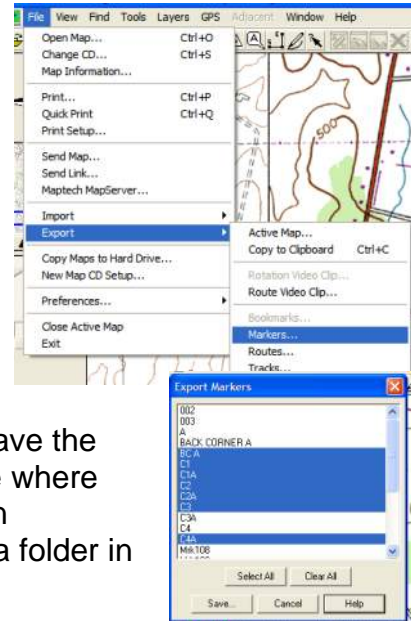
Once you have accumulated a lot of GPS data, it is important to save data in separate files to keep things organized. As soon as you transfer data from your GPS unit, save that data in a new folder. Once you have made any changes to that data set, save under a new name, such as Smith Property edit1. That way if you make a mistake, you will not lose your original data.

### Saving GPS Data

In **Terrain Navigator**, to save data, click File > Export and select Markers Routes or Tracks. A window will appear with the data available for saving.

To highlight a block of data, hold Shift while clicking on the first and last items to be included. To select several items, hold down Ctrl and click the items you want to save.

Click Save... and create a new folder in which to save the items. Give the folder a descriptive name, and note where the folder is (default is C: > Program Files > Terrain Navigator > your folder). It is usually best to create a folder in you're MyDocuments folder.



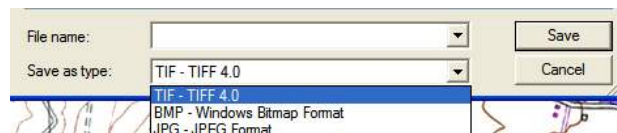
**USAPhotoMaps** automatically saves any waypoints that are created in or sent to the program from a GPS unit. Routes are saved as .txt files.

**EasyGPS** is a program you can use to easily save and alter GPS information. This program can only use .loc and .gpx files.

**GPS Utility** is a good program for saving GPS data if you need to use a particular file type. For example, ArcView uses shape files, which is one of the many file types GPS Utility can handle.

### Saving Maps

Maps from Terrain Navigator can be saved as .tif, .bmp, or .jpg files. (JPGs require a smaller file size, so take up less memory.) Select File > Export > Active Map... To change the file type, click on the dropdown box next to Save as type.



You can also copy maps to paste into other programs by clicking File> Export > Copy to Clipboard. This copies just the map part of the screen. The image can then be pasted in another program like Word or Photoshop. You can print or alter

the map as that program allows. (You will not be able alter layers like marker locations within the image file.)

If you want to include other items from the screen, press Print Screen, then paste into another program. This will include everything you see on your monitor screen.

### **Emailing Maps**

**To email a link to view your current map**, select, File > Send Link. You will be prompted to choose an email address from your default email program (such as Outlook). Once you enter the email address(es) and click Send, the recipient will receive an email from MapTech with a link to a website where they can view the map you were viewing. This map will not include any layers (such as waypoints or routes).

**To email an image file**, select File > Send Map. Your default email program will open with the .jpg of your current map attached. The image file will include layers such as waypoints and routes.

# Activity 6

## Printing from Terrain Navigator

### Set up the Map

The area of map in the active window will be what is printed, so be sure that it is centered as you want the printed map to come out.

**To center the map:** Select the Center Tool which looks like a circle with crosshairs. Click on the area of the map that you want to be the center and the map will shift to center itself.

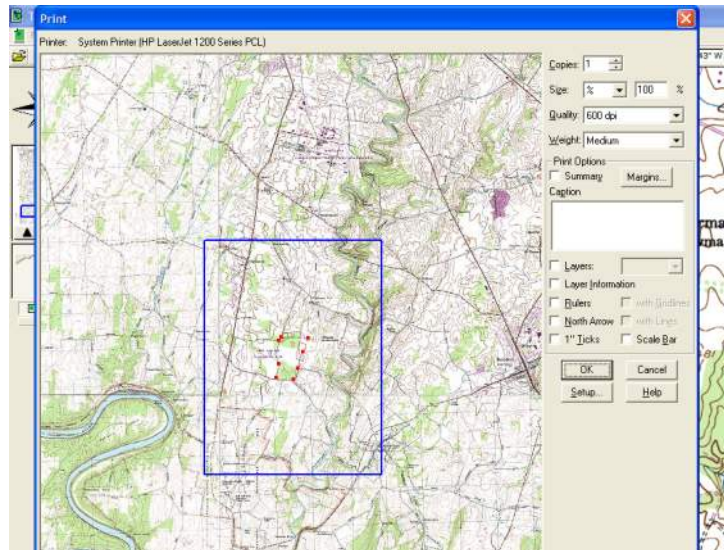
### Printing

#### **Quick Print**

By selecting File > Quick Print, the current map will print on your default printer. Everything you see on the map on your screen will be printed, including routes and waypoints, but the layer information (lat/long coordinates, route distances, etc.) will not be printed.

#### **Advanced Printing**

To set up printing options: Click on the Print icon in the toolbar or click on File > Print... A print window will appear showing the whole USGS map if you are in single map view, or portions of more than one map if you are in seamless view. A blue box outlines the area that will be printed. By clicking and dragging the blue box, you can change the area that will be printed.



**To change the scale of the printed map:** The area covered by the printed map (Size) can be changed using percentage or scale.

Percentage is the default, and can be changed by clicking in the number box next to Size and typing in your desired value. The higher the percentage, the smaller the blue box, and the printed map will be more zoomed in; 100% corresponds to a 1:1 zoom level (map will cover a smaller area), and 50% for 1:2 level (more zoomed out).

When size is determined by scale, a 1:2400 map will cover a larger area (more zoomed out) than a 1:4800 map.

**Quality of the print** can be set to 600 or 300 dpi (dots per inch). The higher dpi will produce a better quality printout as long as your printer is capable of printing at that setting.

**The Weight** setting determines the amount of ink that is used in the print, resulting in a lighter or darker map.

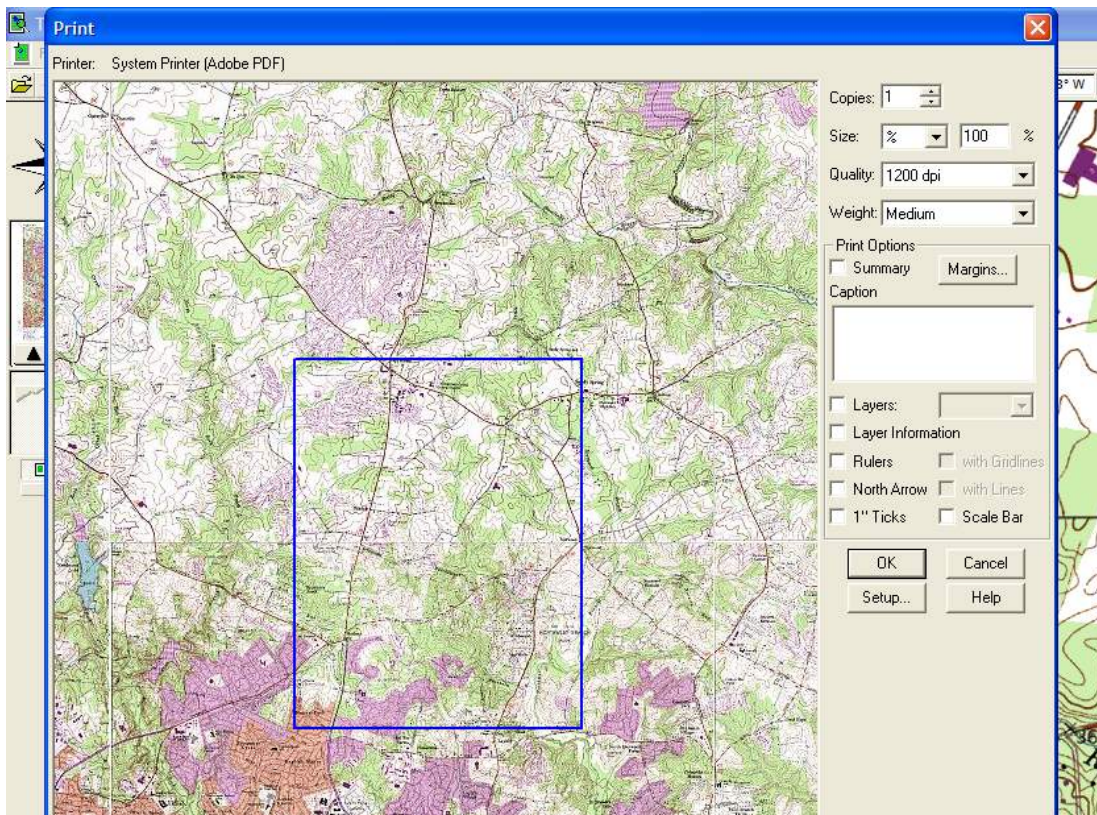
## **Print Options**

In the Print Option box, you can choose to include information that will be printed below the map in a box. By default, the name of the USGS map, the current date, the map's scale, and the lat/long coordinate appear below your printed map. If you want to include other information such as your name or information about the mapped location, type this in the Caption box. Check the Summary box to include your caption on the printed map.

**Layers** include the markers and routes on your map. **Layer information** prints as text separate from the map. The information includes details about routes and waypoints such as distance, area, and coordinates. Do not choose this option unless you really want this data since it will produce many pages of output.

**Rulers** can be included with or without gridlines. A **north arrow** can be included with or without lines. **1-inch ticks** and a **scale bar** are also options.

In Setup, you can choose whether you want your map printed in portrait or landscape (horizontal) orientation. Changing this option will change the orientation of the blue box outlining the printing area.



# Activity 7

## Putting It All Together

### Scenario

You have been asked to perform a timber sale assessment of land at the WMREC facility in Keedysville. The timber sale is located within a 40 acre wooded area near the entrance to WMREC. The address is:

**18330 Keedysville Road  
Keedysville, MD 21756.**

Your job is to map this area and produce a map showing the timber sale boundaries, several plot centers for inventory information, and a road location.

### Find the Site

It is sometimes easier to find a starting location by looking at an aerial photograph rather than a topographic map. Many deeds reference specific locations or some property boundaries are very obvious from an aerial photo. In this activity, you will find a corner of the site using an aerial photograph in USAPhotoMaps, transfer it to the GPS, then to Terrain Navigator.

Open USAPhotoMaps. GoTo the address of the site. View the topographic map (press T). If the screen is gray, press F to download the map or photos.

The timber sale is located within the 40-acre patch of woods at the northeast corner of Keedysville Road and the entrance to the Fort Ritchie Sharpsburg Site (WMREC). There is a blue-line stream running diagonally through the land. This is the site you will be working. Switch back to the black and white aerial photo view (press P).



In USAPhotoMaps, use Page Up to zoom out and Page Down to zoom in. Press F to download aerial photos to fill in any gray boxes.

Mark a waypoint at the northwest corner of the woods and name the point NW. Send this waypoint to the GPS unit. This will be your starting corner.



You have been provided with the following bearings and distances for the boundaries of the timber sale:

NW to NE: 584' at S 79° E	101°
NE to SE: 607' at S 6° W	186°
SE to SW: 635' at N 79° W	_____ (convert to azimuth)
SW to NW: 584' at N 11° E	_____ (convert to azimuth)

Open Terrain Navigator and transfer the NW waypoint from the GPS unit. Create a route based on the provided distances and bearings, using NW as your starting waypoint. Remember to first convert bearings to azimuth. Save this route in Terrain Navigator and on the GPS unit. (You could also create the route on the GPS unit by following directions provided in Activity 3.)

Instead of entering the final leg (SW to NW) bearing and distance information, you can just select NW as the last waypoint. This will ensure that your route is a closed loop. Sometimes when using distances and bearings, they numbers are not exact, so the final leg may not end exactly at the starting point.

### **Plot Centers**

Create additional waypoints to be used as plot centers within the site for inventory purposes. Envision an imaginary grid with blocks of about 25 square chains (5 X 5), or one plot per every 2.5 acres. Name these P1, P2, and so on. *Hint: You can use the measuring tool to create a rough grid pattern and then switch to the waypoint tool and create plot centers.*

### **Saving GPS Data**

After you create the route and plot centers, save your data in Terrain Navigator and EasyGPS under folders named Fort Ritchey Site1. Transfer the data to the GPS unit.

### **Printing**

Print a map from Terrain Navigator using a scale that will clearly show the area of interest. Be sure to include the route and waypoints. Print out an aerial photo of the site from USAPhotoMaps. These can be used as field maps.

*Note: to ensure a good printed image from USAPhotoMaps you should press the print screen key on your keyboard, paste the image in a Word document, then print the Word document.*

### **Site Verification**

Go to the site to verify your waypoints. Use your GPS unit to navigate the route. Each corner is marked with flagging. Stand at each corner and create new, more accurate waypoints using the average function. Name these new waypoints NWA, NEa, and so on.

### **Re-Entering Averaged Waypoints**

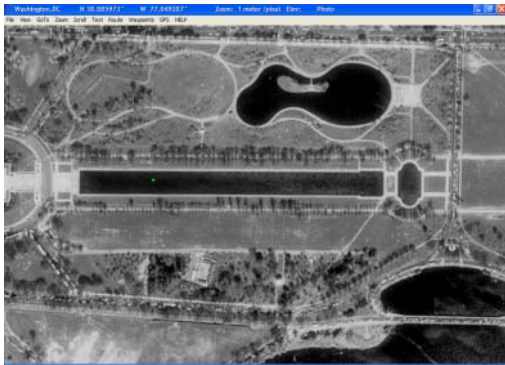
Download the new waypoints you created into Terrain Navigator. Notice the differences between your original points and those taken in the field.

Erase the waypoints you created in Terrain Navigator and replace them with the averaged points from the GPS unit. Save these in Terrain Navigator and EasyGPS as a new file (for example, Fort Richie Site2).

Print a new map from Terrain Navigator that shows the boundaries of the tract, the plot locations, and any other field points you may have taken. You should now have the information you would need to create a map for potential timber buyers or field crews.



# USAPhotoMaps- Short Tutorial



When you open the USAMaps program for the first time, a black and white aerial photo of the reflecting pool in Washington DC comes up.

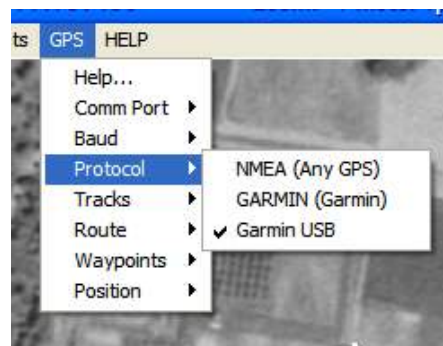
The Menu bar at the top of the screen has the following options: File, Zoom, GoTo, Zoom, Scroll, Text, Route, Waypoints, GPS, and Help.

If you are viewing an area for the first time, there may be gray boxes instead of photos or topo maps. **To download photo or map images, press F.** Once downloaded, they are saved on your computer.

To view topographic maps, press T, or click View on the menu bar. Select Map Type > Topographical Maps.

To view black and white aerial photographs, press P.

**To connect a GPS unit,** click GPS. On the dropdown menu, choose Baud. Select 9600. Then, on the GPS dropdown menu, choose Protocol. Select Garmin USB. You should now be able to transfer to and from the GPS unit. If you have not already done so, connect the GPS unit to the computer via the USB cable and turn the unit on. Once your unit is correctly connected, you should see a check mark next to your unit in the Protocol list.



**To transfer data,** go to the GPS dropdown menu. Choose Route > Receive. A "Transfer Complete" message box will appear on your GPS unit. Transfer your waypoints and tracks the same way.

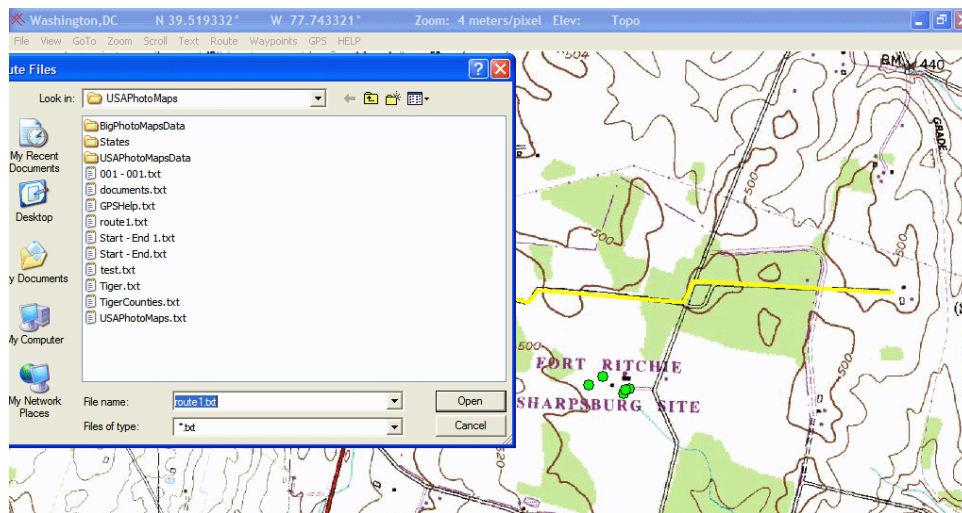
**To see your waypoints,** click on Waypoints in the menu bar. Click on "Show current..." Select a waypoint from the window that pops up and click "GoTo." Your waypoints should show up as green dots.

**To print from USAPhotoMaps,** select File > Print. A message will appear reminding you to set your printer preferences to Landscape Orientation (you will not be able to print without changing to landscape). Everything showing on the map (routes, waypoints, etc.) should show up in the printout.

**Create a new waypoint** by clicking anywhere on the map where you want the waypoint located. A window will come up which allows you to write a description or note (Comment) about the waypoint and give it a name.

**Create a route** by clicking Route > Create. An information window will appear; click OK. On the map, click where you want to start your route and a line will follow your cursor. Click where you want the next point to be, and the line will remain between those points. Continue in the same manner to create a complete route. To end the route, double click on what will be the last point of your route. A window will appear asking if you want to save your route. Select Yes. A window will come up allowing you to name and save your route as a text (.txt) file. Once saved, you can send the route to your GPS unit.

**To send a route to your GPS unit**, in the menu bar, click on GPS > Route > Send. Select the route you created and click Open (see picture below). The route will now be on your GPS unit for you to navigate or map.



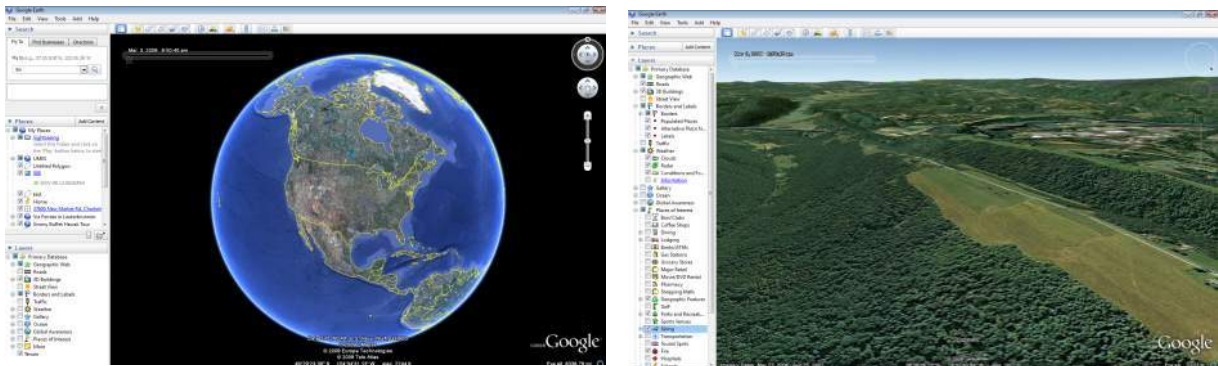
# Using GPS with Google Earth

Google Earth is a powerful free tool for visualizing geographic data and for browsing web content in a spatial interface. Although it does not allow for the measurement of area or include topographic map images, using several free programs in concert can give you many of the features that you would otherwise have to pay for.

## What is Google Earth?

Earth is a software program that displays satellite imagery from an online server overlaid on topographic data, creating a digital three-dimensional model of the planet Earth. Earth has many features, including a flight simulator, three-dimensional structures, and the ability to view user-created content, but this tutorial will focus on the features most relevant to forest stewardship.

A GPS data import tool was added to Google Earth 5.0, released in early 2009. The interface supports only Magellan and Garmin brand GPS units. Google Earth is available for free download from [google.earth.com](http://google.earth.com). Google Earth Pro has several additional features like quicker access to the image server, higher resolution print quality, and the ability to measure area, and costs \$400.



## Getting Started

After downloading and installing the software, plug in your GPS unit and open Earth. Under the Tools menu, click “GPS.” In the “GPS Import” box, select the appropriate brand name. If you have a Magellan, select “serial” if you have a 9-pin connector cable, rather than a USB cable. Otherwise, select “Explorer.” If you do have a serial cable, make sure that the baud rate in the setup menu of the GPS unit is set to 4800. If you have a Garmin, make sure that you have installed the USB driver that came with your GPS unit.

Select the data types you want to download. Under Options, choose your drawing preferences. Check “Draw icons at track and route points” if you want an icon to be displayed for every track/route point recorded by your GPS unit. This may clutter your display. Check “Draw lines for tracks and routes” to draw each GPS track and route as a solid line. Check the “Adjust altitude to ground height” check box to adjust all recorded points to ground level. This will ignore the altitude data stored with the points and make sure that your data appears on the surface. Now click “Import.”

Your data will appear under “Temporary Places” in the Places sidebar on the left. Right click on the name and select “Save to My Places” so that it will still show up the next time you open Earth. Click the plus signs next to the folders until you see a list of points. Double-click one of them to fly to its location in the viewer.

### **If your GPS unit is not supported**

The Earth GPS interface only supports Magellan and Garmin brand GPS units, and may not work with older models. If your unit is of a different brand or is an older unsupported model, you can still import your GPS data using free software like EasyGPS, GPS Utility, or GPS TrackMaker, and then saving your data as a [gpx, kml, or kmz] file.

Follow the instructions in this manual for importing data in one of these other programs, then under the File menu, select “Save As...” In the drop-down “Save as type” menu, select “GPS Exchange File (gpx)” or “Google Earth (kml).” Name the file something descriptive (e.g. “west woodlot”) and remember where you save it.

Then in Google Earth, click “Open...” under the File menu. Find the file you just saved and click “Open.” Your file will appear in the “Places” sidebar on the left under “Temporary Places.” Right click the name and select “Save to My Places” so that it will still show up the next time you open Earth.

### **Navigating Earth**

There are several controls for navigating through the viewer. You can start by double-clicking on one of the places listed in the sidebar, or by searching for somewhere new.

The easiest way to move around an area is the pan tool. Simply grab the image by left-clicking and then drag in the direction you want to move the image. Letting go of the mouse button while continuing to move the mouse will ‘throw’ the image, making the pan continue until you click the image again.

Zoom in or out by using either your mouse wheel, by double-clicking on the image, by right-clicking and dragging, or by sliding the zoom scale on the right side of the screen. The default view is from directly above, but if you want to see the topography of a location, you need to tilt the view. You can do this by holding down the mouse wheel and dragging, or by using the compass icon in the top right corner of the screen.

### **Viewing historical imagery**

You can view historical imagery to see how a property has changed over time. Click the clock icon in the toolbar to show the time slider. Each tick on the slider bar represents a different image. The number, quality, and age of the available images varies greatly from place to place.



## Measuring distances

You can measure distances in Earth by clicking the ruler tool in the toolbar. The line tab only allows one segment at a time, but allows tells you the heading of the line, while the path tab gives you the total distance of many segments. Google Earth Pro also has tools for measuring the area of polygons and circles.



## Creating shapes

You can create points, polygons, and lines to mark the corners and boundaries of property, stands, and management units and to keep notes on each. Click one of the shape tools in the toolbar.



*While the properties window is displayed*, draw the point, line, or polygon where you want it to appear on the map. You can move the properties window partly off the screen if it is in the way. Click and drag to create a curvy line, or click once on each corner for simple straight lines. You can add text and change the colors and other properties under the tabs at the top of the properties box. When you're done editing, click the OK button. To edit the shape or properties again later, right click on the shape's name in the Places panel and select "Properties."

## Exporting data

Earth does not have a GPS data export function. In order to upload data that you have created or modified in Earth onto your GPS unit, you must first save it and then upload it using another data management software program like EasyGPS, GPS TrackMaker, or GPS Utility.

To save data, right click on the name in the Places panel of the sidebar and select "Save Place As..." Choose a file name and file type. The [kml] file type is accepted by more software programs, while the [kmz] file type is compressed and can also store pictures. Open the data management software of your choice, select "Open..." under the file menu, and choose the file you just saved. Now you can upload it to your GPS unit as you normally would.

## More information

Download Google Earth and explore its many other features of at [earth.google.com](http://earth.google.com). Visit [earth.google.com/userguide/v4/](http://earth.google.com/userguide/v4/) for an in-depth instruction manual.

# Field Experience with GPS: Verifying Coordinate Data Using USAPhotoMaps Software

Prepared by: The  
Virginia Geospatial Extension Program

**Background:** USAPhotoMaps requires that the user understand and know how to operate a GPS unit, and organize and collect field data associated with each GPS unit. This software enables users to download GPS WayPoints (or tracks) from their GPS receivers onto their computer, and to superimpose the collected data on top of aerial photographs.

USAPhotoMaps prompts the user for a single WayPoint (for reference purposes). The software then “goes out” onto the Internet (i.e. Terraserver) finds the appropriate digital image associated with the user defined Waypoint, and downloads this digital photograph onto the user’s computer. The user can then superimpose collected WayPoints onto the image, or digitize new WayPoints on the image, and download them onto the GPS. The user should be aware of the limitations of USAPhotoMaps. This software only accesses aerial photography from Terraserver, which is primarily an archive of USGS imagery.

These aerial photographs are a bit dated (the majority of the photographs for Virginia date back to the mid 1990’s). None of Virginia’s high resolution BaseMapping Imagery (VBMP) is accessible through this software.

b. Reboot your computer (not always necessary, but it has made a difference before!).

**2. Collect GPS WayPoints, Tracks, etc.**

Head out into the field and have some fun. Refer to The Garmin Etrex Legend: An Introductory Handbook for Extension Agents or the Garmin Owner’s Manual...

**3.**

**Download the GPS Data onto a Digital Aerial Photographic Map** This involves 2 steps:

Step 1: “Initializing, downloading, and opening” the Digital Photographs; Step 2:

Downloading your GPS points on top of a digital aerial photograph (this is what the software is all about!) This manual will walk you through the two steps listed above...

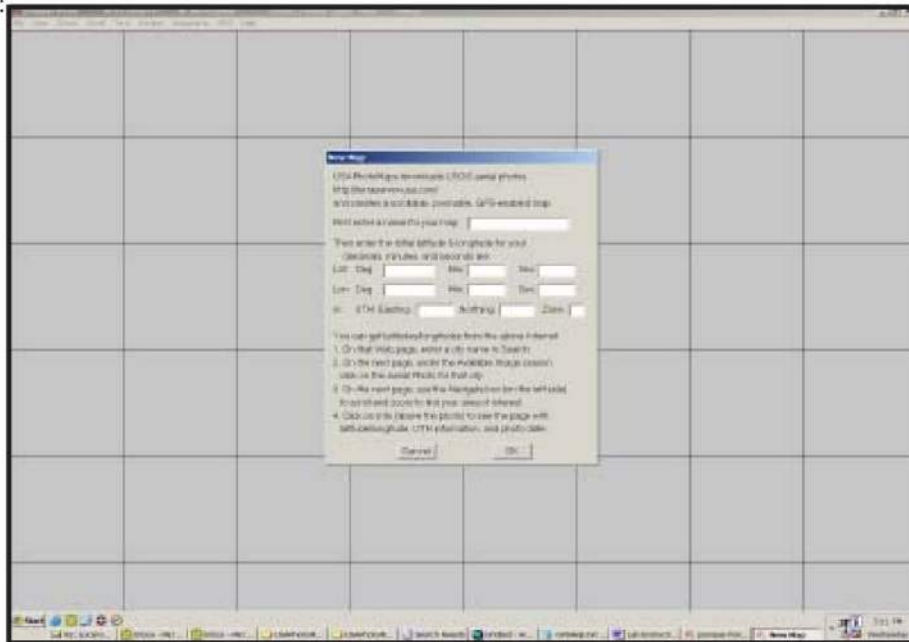
**Getting Started... Before you can actually get started using USAPhotoMaps, you need to do a few things...**

**1. Setup and Install USAPhotoMaps software**

a. Install USAPhotoMaps on your computer (<http://www.jdmcox.com/>)

## First, start with Step 1:

- A. Logon to your computer
- B. Start the USAPhotoMaps program. You should see a window like this appear on your computer screen:



- C. This dialogue box below is prompting you for some basic information so that it can find the appropriate aerial photographs...

**New Map**

USAPhotoMaps downloads USGS aerial photos  
http://terraserver-usa.com/  
and creates a scrollable, zoomable, GPS-enabled map.

First enter a name for your map:

Then enter the initial latitude & longitude for your  
(decimals, minutes, and seconds are)

Lat: Deg  Min:  Sec:

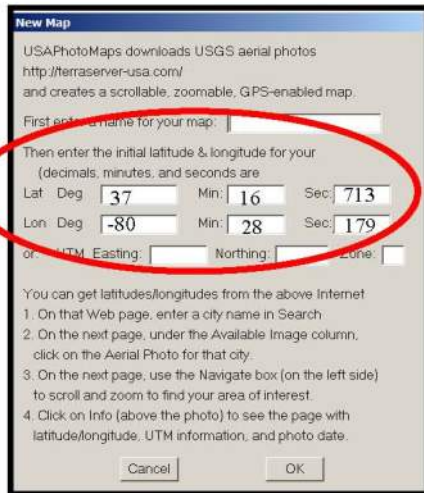
Lon: Deg  Min:  Sec:

or: UTM Easting:  Northing:  Zone:

You can get latitudes/longitudes from the above Internet

1. On that Web page, enter a city name in Search
2. On the next page, under the Available Image column, click on the Aerial Photo for that city.
3. On the next page, use the Navigate box (on the left side) to scroll and zoom to find your area of interest.
4. Click on Info (above the photo) to see the page with latitude/longitude, UTM information, and photo date.

1. Enter a name for your map



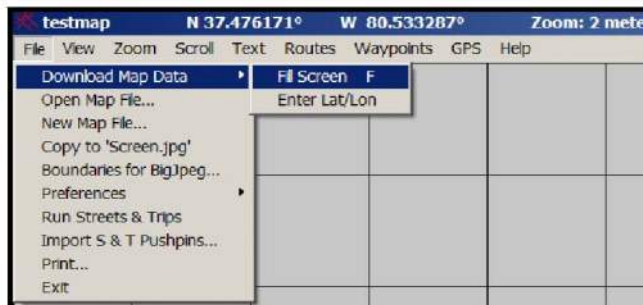
2. Now you need to enter the initial Latitude and Longitude coordinates from your GPS (a waypoint coordinate from your GPS...)

- ✓ Latitude is associated with either north or south, Longitude is associated with either east or west.
- ✓ Enter these values in the dialogue box. NOTE: In the United States, Longitude Degree Values should have a negative sign in front of them as shown in the example (your values will differ from the values in the example *but your longitudinal degree value must be negative*) if you are in the U.S.

3. Press the <OK> button on the bottom of the New Map Dialogue Box. Your coordinates have now been stored.

The software is now ready to go searching for an aerial photography for you to display.

4. Select the <file> menu, select <Download Map Data> and <Fill Screen> (see figure below)



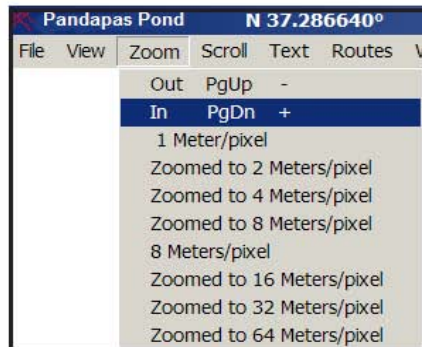
5. Your map should draw in the window. This could take some time if you have a slow internet connection...



*Note: your image should look different from the image below. The image below is from Pandapas Pond, Virginia. Your image should be from the area where you were conducting your field work!!!*



6. Zoom into your map if you can by going to the <Zoom> menu, and select <zoom in>



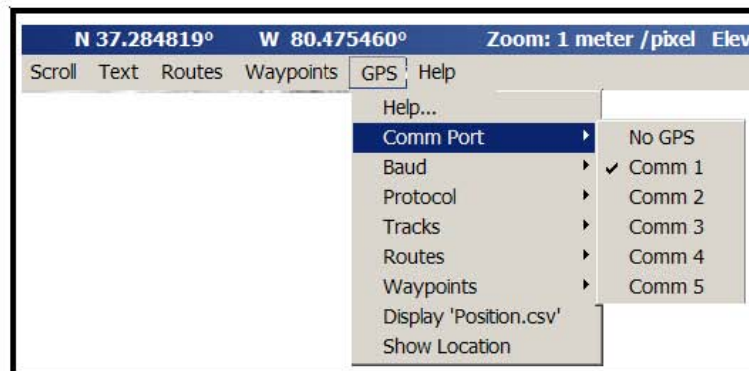
**Now you are ready for Step #2:  
Downloading your GPS points on top of the Digital Photographs.**

*Note: These instructions are for Garmin GPS receivers. If you are working with a different brand or model, your instructions, you should refer to the "official" instructions for USAPhotoMaps located in the Program Files/USAPhotoMaps/gps/help.txt document which is downloaded to your local computer after you download the USAPhotoMaps software.*

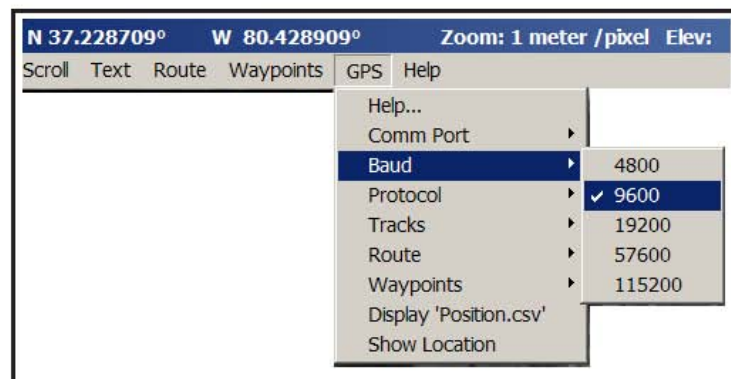
*The BAUD rate in USAPhotoMaps has to match the BAUD rate of your GPS receiver.*

1. Make sure that the GPS unit is configured to communicate properly with the USAPhotoMaps software program.
  - a. Attach the cable to your GPS receiver and to the serial port of your computer (it is probably the only port where the cable will fit properly).
  - b. Turn on your Garmin GPS Receiver

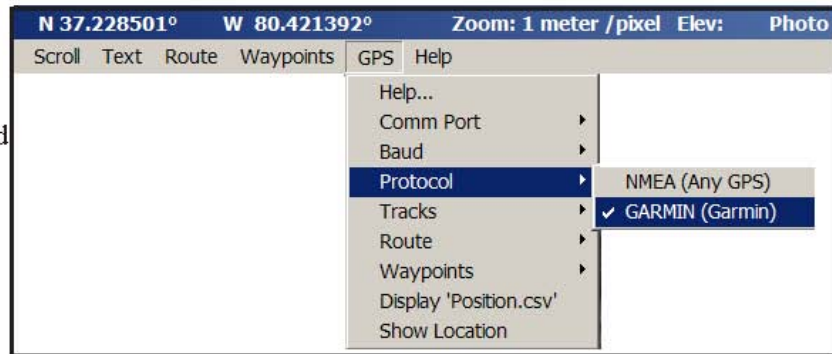
2. In USAPhotoMaps software, make sure that the communications port is set to "1"



3. Make sure that the Baud rate is set to 9600.



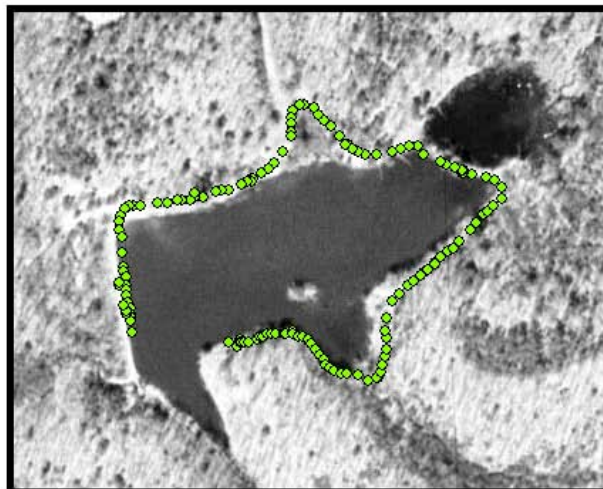
4. Under <Protocol>, make sure that <Garmin> is selected



5. Now you are ready to receive your Waypoints! If you get an error message, then let the computer sit idle for a couple of minutes, and try receiving the waypoints again...



6. You should end up with a map that looks something like this (each dot will represent a WayPoint)



- To identify the actual identification numbers of each Waypoint while scrolling across your aerial photograph, go to the <Text> menu, and select <DISPLAY>



This will “turn on” the identification numbers of each waypoint when you scroll over them. Use your data logging sheets to determine if these positions are correct or not.

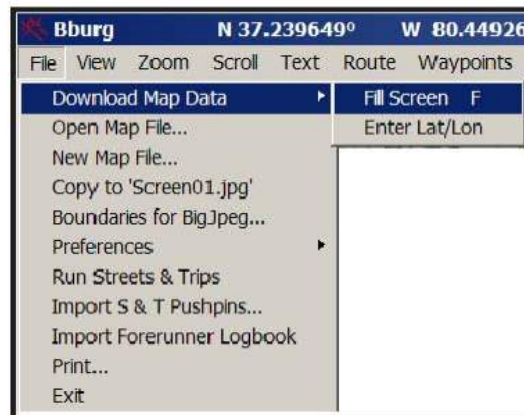
**Tricks and additional hints:**

In addition to adding aerial photography as a “backdrop”, USAPhotoMaps can also be used to bring up topographic maps in the background of your waypoints and routes!

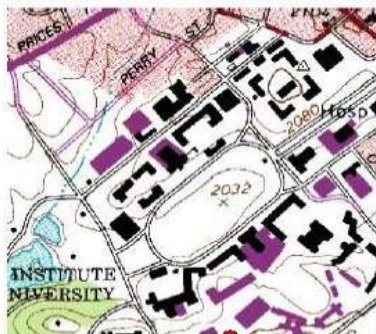
- Under the <View> menu, choose <New Type> and <Topo>



- If the topographic map does not draw, then go to the <File> menu, select <Download Map Data> and <Full Screen>



A topographic map should appear in the display window, and your waypoints / routes should draw on top of the topographic map!



# EasyGPS - Short Tutorial

EasyGPS is a free, downloadable program from TopoGrafix, and can be found at [www.easygps.com](http://www.easygps.com). EasyGPS is a quick and easy way to transfer waypoints, routes, and tracks between your computer and GPS unit. EasyGPS lists all of your waypoints on the left side of the screen, and shows a plot of your GPS data on the right. EasyGPS can be used to back up and organize your GPS data.

## **Setting up EasyGPS**

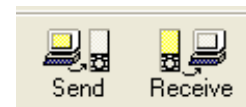
### **Connecting your GPS unit**

From the toolbar, click on Edit>Preferences... In the My GPS Receivers tab, click Add GPS... if your receiver is not listed. Click Settings and select the connection type you are using (USB or COM for a serial port connection).

Click on the Units of Measure tab and check to ensure that the units are set to your preference. Click the My Coordinates Format tab and choose the format you use for your GPS unit (usually, WGS 84).

### **Transferring Data**

**To receive data from your GPS unit**, connect your unit, turn it on, and click on the Receive icon. A Receive from GPS window will appear. Check the box(es) for the data you would like to receive (Waypoints, Routes, Tracks). Also, ensure that your GPS unit is selected from the dropdown menu. Click OK, and once the data has been sent, a Transfer Complete message should appear on your GPS unit. Sending data from EasyGPS to your GPS unit works in the same manner.



**To send select waypoints to your GPS unit**, hold down the Control key on your keyboard and click on each of the waypoints you wish to send, then right-click. Select Send Waypoints to GPS, and those waypoints will be sent. To select several waypoints that are adjacent to each other on the list, hold down the Shift key and click the first and last waypoints you'd like to include; those two and all points between will be highlighted.

Waypoints show up in the left side of the screen. The Label (name), Type, and Symbol for each waypoint is displayed. Each of these can be changed by editing the waypoint(s).

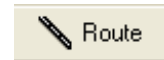
### **Waypoints and Routes**

**To edit a waypoint**, right-click on the waypoint listing and select Edit Waypoint from the menu that appears. Or, while the waypoint of interest is highlighted in the list, in the toolbar, select Edit>Edit and the Edit Waypoint window will appear.

**To create a waypoint**: In the toolbar on the top of the screen, select Tools>New Waypoint, or, click on the Add icon. An Edit Waypoint window will open, allowing you to enter the appropriate information.

**To delete a waypoint**, right-click on the waypoint in the waypoint list or on the map (the select arrow cursor must be selected).

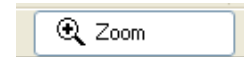
**To create a route**, select the Route tool. Your cursor will become a small diamond, and when you hover over a waypoint, it becomes a larger circle with a + above it. Click on the waypoints in the order you want them in your route. When you are finished, right-click to stop the route.



**To delete a route**, while the route or select tool is activated, right-click on the route and select Delete Route. Click Yes on the Confirm Delete window that appears.

### **Zooming**

**To zoom in**, select the Zoom icon. Your cursor will become a magnifying glass with a + in the center. Click in the center of the space where you want to zoom. The zoom level shows up at the lower left hand corner of the map side of the screen.



**To zoom out**, hold down the Alt key while using the zoom cursor.

### **Saving Data**

You must save your information in EasyGPS before closing, or it will be lost. Click on the Save icon. If this is the first time you are saving this information, a Save As window will appear. Choose the folder in which you want to save your data, and type in the file name. Be descriptive, such as Smith Property March 12 2007. The file is saved as a GPS Exchange File (.gpx). This file format is not used with most other programs, so if you need to transfer data to another program such as ArcView, you are better off using a program like GPS Utility that can save as other file formats.

# GPS Utility

## A User Guide for Educators

Prepared by: *The Virginia Geospatial Extension Program*

### Overview

GPS Utility is an easy-to-use software application that allows you to manage, manipulate and map your GPS information. This is a “point and click” software package.

While there are a number of things that GPS Utility software can do, some of the functions most applicable to extension agents include the following:

- ◆ Extension agents can use this software package to **transfer** GPS data between a GPS receiver and a PC.
- ◆ GPS Utility can **convert** GPS data to one of several different text formats (i.e. compatible with spreadsheets, ESRI shapefiles, and other GIS compatible formats, etc.).
- ◆ The program **converts GPS data** (i.e. waypoints, routes, etc.) between different map datums and many coordinate formats (Lat/Long, UTM/UPS, country grids etc.).
- ◆ Information can be **filtered** in various ways and waypoints **sorted** according to specified criteria. Route and track statistics are available and can be transferred into other programs for analysis (i.e. spreadsheet programs).

GPS Utility also has (some very basic) mapping capabilities. This will at least provide you with some confidence that the data that you have collected with your GPS “looks correct” before you begin downloading your data.

GPS Utility works with a variety of GPS receivers. This guide is written to support the Garmin eTrex series. Most Garmin GPS receivers will follow the same protocols. If you are using a different GPS receiver, then refer to the GPS Utility documentation, or contact the Virginia Geospatial Extension Program.

### Before Using GPS Utility

The instructions in this handbook assume the following:

1. You have already installed GPS Utility software on your computer (if not, refer to *GPS Utility Installation Instructions*. These instructions have been prepared by the Virginia Geospatial Extension Program, with educators in mind. These step-by-step instructions are available online:  
<http://www.cnr.vt.edu/gep/tools.html>
2. You have already collected GPS Data (i.e. waypoints, routes, tracks, etc.), and have stored the GPS data on your GPS receiver (if not, refer to *The Garmin Etrex Legend: An Introductory Handbook for Extension* for additional information and instructions. The Garmin handbook has been prepared by the Virginia Geospatial Extension Program. This customized Garmin handbook is also available online:  
<http://www.cnr.vt.edu/gep/tools.html>



*The Virginia Geospatial Extension Program*

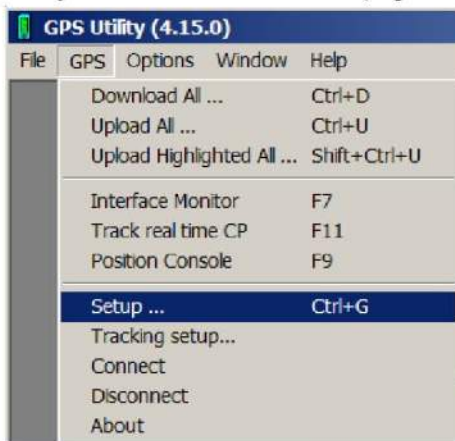
## Let's Get Started Downloading Waypoints

1. Start GPS Utility by selecting it from the Program list on your computer (Figure 1)



2. Make sure that the GPS Utility software is properly configured to work with your Garmin GPS receiver:

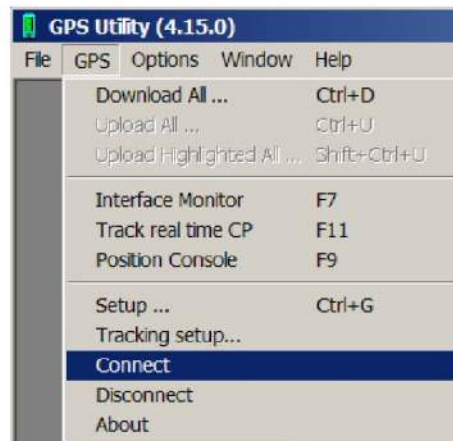
- a. Connect your GPS receiver to the computer using the data cable provided with your GPS receiver. Make sure that your GPS receiver is turned on.
- b. Select <GPS> and <Setup> from the GPS Utility software menu interface (Figure 2)



- c. The Interface Setup dialogue box will appear. Make (Figure 3). Select the <Garmin (serial)> option. The baud rate should be set to 9600. Click <OK>

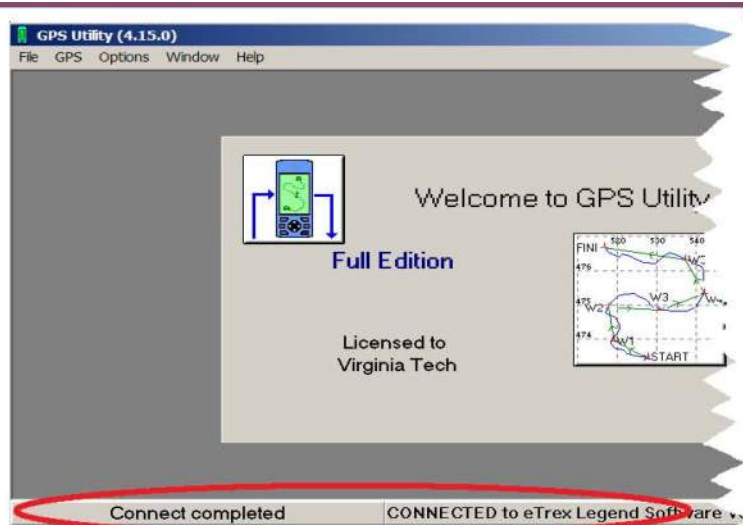


- d. Select the <GPS> menu again, and select <Connect>.





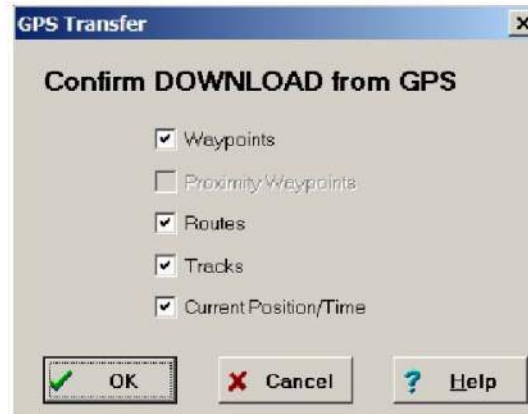
Your GPS should now be properly communicating with your PC through the GPS Utility software. To verify that your GPS receiver is communicating properly, look at the status bar at the bottom of the GPS Utility dialogue box. It should look something like this -->.



3. In GPS Utility, select the <GPS> menu option, and select <download all>



4. The GPS Transfer dialogue box will appear. You can download “everything” from your GPS at once (and “everything” would include Waypoints, Routes, + Tracks), or you can select the specific items that you need. In this example, I am going to go ahead and download everything.



5. After downloading, you should see a database that show data that is being read from your GPS receiver. In this example, there are 3 waypoints that have been saved on the GPS receiver. The names of these waypoints are AAA, BBB, and CCC.

ID	Coordinate	Symbol	T	O	Alt(m)	Comment
AAA	N37.223784 W080.421817	Waypoint	I	E	649.5	
BBB	N37.223792 W080.421828	Waypoint	I	E	640.8	
CCC	N37.223791 W080.421834	Waypoint	I	E	637.5	

Note: The <INFO> button on the status bar provides you with summary information about the data that you have collected with your GPS receiver.

Category	Count	Sub-category
Datum	WGS 84	
Waypoints	3	
	0	Hidden
	3	Normal
	0	Highlighted
Routes	0	
Tracks	3	
Trackpoints	186	
	0	Hidden
	186	Normal
	0	Highlighted
Annotations	0	

Valid Current/Reference Point

6. If you would like to view the other data that GPS Utility is reading from you GPS receiver, then you should select the <VIEW> menu, and select either <Routes> or <Trackpoints>. Refer to page 7 for a description of Trackpoints

Menu Item	Shortcut
Datum ...	
Coordinate Format	
Waypoints	Ctrl+W
Routes	Ctrl+R
• Trackpoints	Ctrl+T
Track Summary	Ctrl+Y
Position/Time	Ctrl+.
Annotation	Ctrl+A
Map	F6
Reports...	Ctrl+I

Review of terms:

- a. **Waypoints:** These are “virtual points” or marks that you have saved in individually. Waypoints can be assigned customized names (the GPS receiver assigns them numerical names [001, 002] by default).
- b. Trackpoints: **Tracks** are a previous path of travel. Basically, you turn on your GPS receiver, and it will start to “map your movements” (similar to dropping virtual bread crumbs). **Trackpoints** are individual points that are used to create a track (if you connect these points, with a line, you would have a track)
- c. Routes: A route is a “path to a destination with intermediate stops along the way”. The “stops” along the way are defined by Waypoints. You can define your route in the field, or wait to define a route from existing waypoints when you return to your office.
- d. Tracksummary: a log that summarizes your tracks (time and date stamps, etc.)

### Viewing GPS Data

GPS Utility provides some basic viewing capabilities that enable you to “see” if the data that you have collected “looks correct”. I typically use this to verify that waypoints, tracks, etc. “look” correct before downloading the data onto my PC. However, the best (more failsafe) way to verify that your data “looks” correct is to use a (free) software program called USAPhotoMaps (<http://www.jdmcox.com>) You can not add additional layers of information as a “background” to GPS Utility. However, you can change the colors and symbols associated with waypoints, tracks, etc.

To visually examine your data, click on the <Map button>



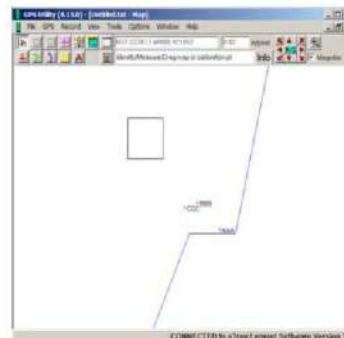
A graphic image of all of your waypoints and tracks should appear. Waypoints are identified (by default) with red crosshairs. Furthermore, their ID number/name should be located near the red cross hairs



In addition, there are some basic map interface tools that you can use to pan around, zoom in, zoom out, etc.



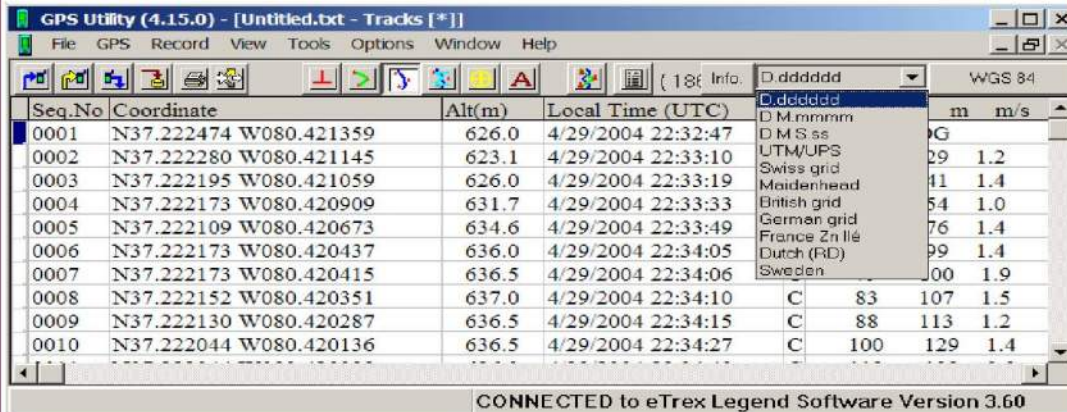
These mapping tools are a bit “clunky” but they get the job done.



### Converting data between different coordinate systems

Another nice capability associated with GPS Utility, is the ability to easily convert GPS data from one coordinate system to another (i.e. convert from Lat./Long. DMS to Lat./Long. DD, UTM, etc.)

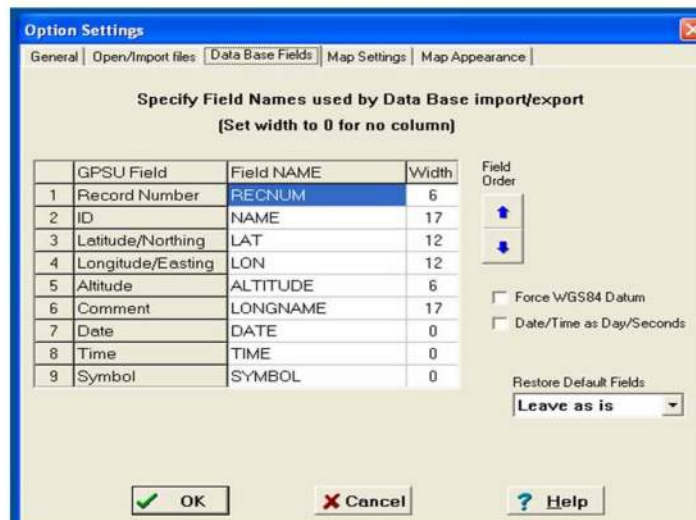
To convert GPS data from one coordinate system to another, simply select your desired coordinate system pulldown menu!



### Setting up Your database fields

GPS Utility allows you to set the fields that you would like to appear in the Attributes Table of you data once you have saved it. To do this, go to <Options> and the <Data Base Fields>. The “Options Settings” Dialog Box will appear and you will be on the Data Base Fields tab. A table listing possible fields is visible.

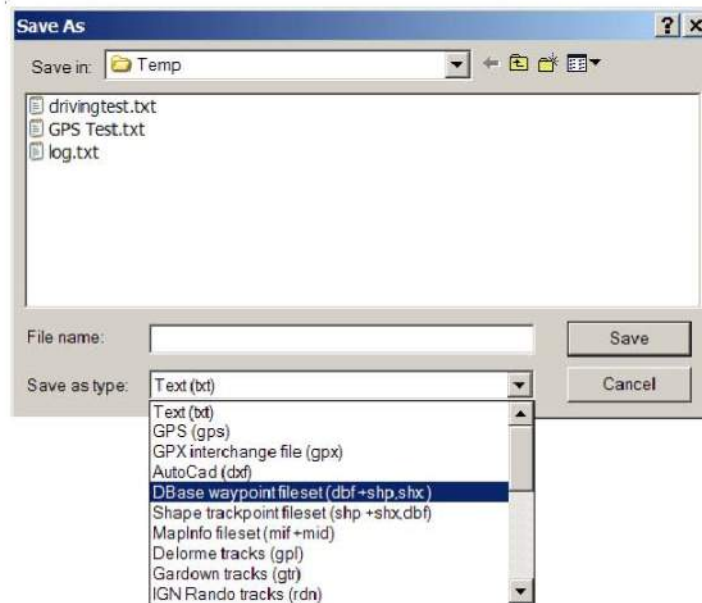
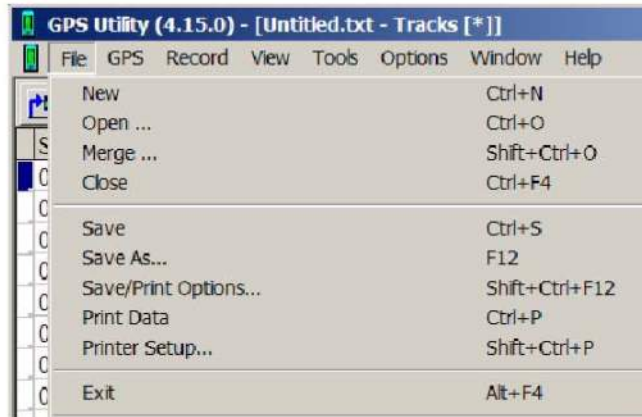
If the “Width” field has a numerical value other than “0”, the field will appear in your Attributes table. If “0” is in a field that you would like in your table, you must specify a column width other than “0” so the field will appear. Once you decide what fields you would like, you are ready to save your data!



### Saving Your data to a PC

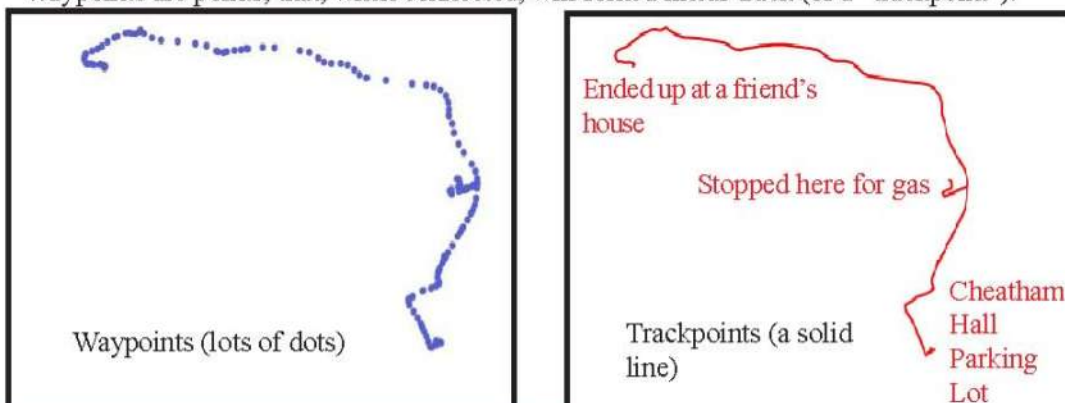
You can save the data that you have collected on your GPS receiver directly as a file in your PC as a "GIS readable" file (i.e. shapefile).

1. Make sure the file that you want to save (i.e. Waypoints, Tracks, etc.) is "visible".
2. Under the <File> menu, select <SAVE AS>
3. To save in a GIS compatible format,
  - a. enter a <Filename>
  - b. under the <Save As Type>, option, choose either:
    - ✦ Dbase Waypoint Fileset- this option saves waypoints, and saves Tracks as a series of points
    - ✦ Shape Trackpoint Fileset- this option saves Tracks as a linear feature. Refer to the figure below for a graphic depiction of these two options...



And Presto!. You have created a GIS compatible file from your GPS data!

Waypoints are points, that, when connected, will form a linear track (or a "trackpoint").



## Uploading data to your GPS

There are two simple steps to upload data (Waypoints, Tracks and Routes) from GPS Utility into your GPS unit.

### Step 1. Loading Data

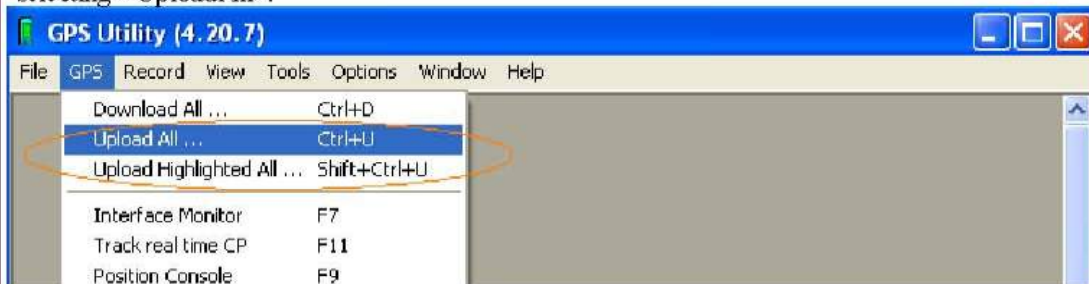
The first step is to load your data file into the GPS Utility data table. You will need to retrieve your previously saved data. To do this, go to select the <File> menu, then select <Open>. From the box titled “Open” you can select your data file. Be sure to select correct file type using the “File type” pull down menu. When the data has been loaded in to the Data Table you may edit it before uploading into your GPS unit.

### Step 2. Upload data to the GPS

In order to upload data your GPS unit must be connected to your computer and turned on. GPS Utility lets the user select what type of data to upload (Waypoints/Tracks/Routes). To Upload data to your GPS unit select the <GPS> pull down menu or select the upload button on your tool bar.



You have the choice of selecting individual points to upload by clicking <Upload Highlighted> (note data must be highlighted before selecting this option) or the other option is to upload all data by selecting <Upload All>.



Regardless of which method of uploading you select, a box should appear to confirm the upload of data. This is also your opportunity to select which type of data to upload (Waypoints/Tracks/Routes). Check only the type of data you wish to upload to your GPS unit and click OK.



The information bar at the bottom of the screen should verify the completion of the upload.



## How to Calculate Area and Perimeter

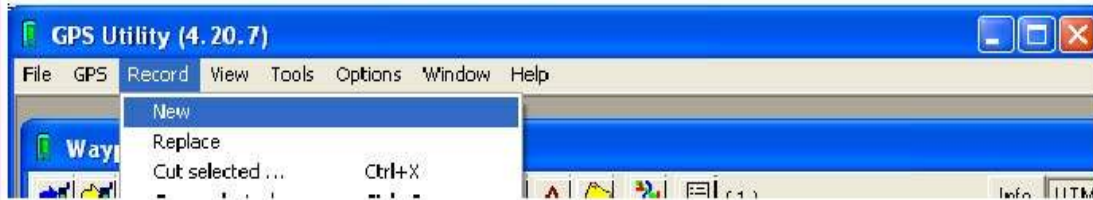
Area and Perimeter Calculations may only be determined from a Track or a Route.

### Creating a Route From Waypoints

Download waypoints from your GPS or open an existing file (for more information see previous sections). Open the <View> menu and select <Routes> or select the Route button from your tool bar.



To create a route from your existing waypoints open the <Record> menu and select <New>.



This will bring up a list of waypoints. Waypoints may be added to your route by a single click on each desired point. GPS Utility will close your route automatically so there is no need to start and end at the same point. You should be able to see the points you have added appear on the route data table. When you are finished close the waypoints box.

Waypoints		
Rte	00 (6 )	237432
---	017 - 002	
00	017	0
01	016	1
02	015	70
03	777	118656
04	010	118573
05	002	132
06		

Waypoints	
003	
001	
002	
003	
004	
005	
006	
007	
008	
009	

### Calculating Area and Perimeter

To view the calculated area and perimeter of your route open the <View> menu and select <Reports.> This will bring up a report of your route, the start to end distance (meters) and area in hectares can be found at the bottom of the report.

777	18S 274955 4167545	97.0	120	1
010	18S 374102 4102766	3.0	088	1
002	18S 374234 4102763	3.0		
End to Start(m)		49		
Area enclosed(hectares)		176.265		

For further information, contact the Virginia Geospatial Extension Program:

John McGee  
Virginia Geospatial Extension Specialist  
(540) 231-2428  
jmcg@vt.edu  
<http://www.cnr.vt.edu/gep>

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## Virginia's Geospatial Extension Program

*Member of the National Geospatial Technology Extension Network*

### Welcome Aboard!

Virginia's Geospatial Extension Program, in partnership with the Virginia Space Grant Consortium and Virginia Cooperative Extension, seeks to promote the integration of geospatial tools and techniques through a coordinated approach at the local, regional, and state levels. The program aims to extend opportunities and empower organizations and individuals across the Commonwealth of Virginia through training, assessing application needs, and providing increased access to data resources.

Initiatives associated with this program include:

- technology and application training,
- information sharing,
- course development and dissemination, and
- educational outreach.

This program meets crucial workforce needs by providing K-12 educational outreach, specialized workforce courses, and training through Virginia's Community College System (VCCS) and other Virginia Space Grant Consortium (VSGC) member universities, faculty development, and linkages to NASA and other geospatial resources for data and programs. A key component of this program is its participation with Virginia extension agents, through Agriculture and Natural Resource programs and 4-H Youth Educational initiatives, to support the dissemination of information, training, and application development at the grassroots level.

*GPS Utility: User Guide and Handbook*



# Using Google Earth

# Terrain Navigator

## A User Guide for Natural Resource Managers

Prepared by: *The Virginia Geospatial Extension Program*

### Overview

Terrain Navigator was developed by MapTech. Terrain Navigator (standard edition) is an easy-to-use mapping software that allows you to manage and manipulate your topographic maps and GPS information.



While there are a number of features included in Terrain Navigator software, some of the functions most applicable to average users include the following:

- ◆ Terrain Navigator can be used to **find** locations quickly and **view and print** topographic maps in 2D and 3D.
- ◆ Map datum and coordinates can be **specified** in a number of formats including UTM and Lat/Long.
- ◆ This software package can **transfer** GPS data (i.e. waypoints, routes, etc.) between a GPS receiver and a PC.
- ◆ Points, labels and routes can be added to topographic maps.
- ◆ Terrain Navigator can be used to for basic measurements such as distances, areas and elevation profiles.

Terrain Navigator has some very good mapping capabilities. This provides you with confidence that the data that you have collected with your GPS “looks correct” on topographic maps. Also it can help in determining imprecise GPS points that were collected. Terrain Navigator works with a variety of GPS receivers. This guide is written to support the Garmin Legend GPS receiver. Most Garmin GPS

receivers will follow the same protocols. If you are using a different GPS receiver, then refer to the Terrain Navigator documentation, or contact the Virginia Geospatial Extension Program.

### Before Using Terrain Navigator

The instructions in this handbook assume the following:

1. You have already installed Terrain Navigator software on your computer.
2. You have already collected GPS Data (i.e. waypoints, routes, tracks, etc.), and have stored the GPS data on your GPS receiver (if not, refer to *The Garmin Etrex Legend: An Introductory Handbook for Extension Agents* for additional information and instructions. The Garmin handbook has been prepared by the Virginia Geospatial Extension Program. This customized Garmin handbook is also available on-line:

<http://www.cnr.vt.edu/gep/tools.html>

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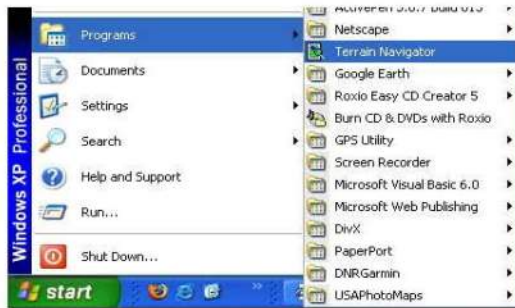
Opening Maps & Searching .....	2
Tools for Viewing Maps .....	3-4
Printing Maps .....	5
3-D Features .....	5-6
Working with your GPS .....	6-8
Layers (Markers, Tracks, etc.) .....	8-9
Measuring Tools .....	9-10
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*The Virginia Geospatial Extension Program*

## Let's Get Started -Opening Maps

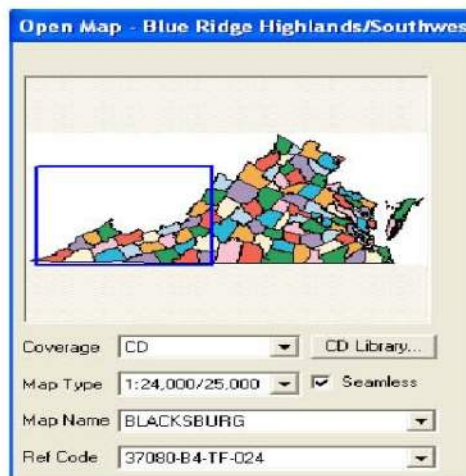
1. Start Terrain Navigator by selecting it from the Program list on your computer (Figure 1)



2. When you open Terrain Navigator, the Map Selector appears. You can also open the Map Selector by clicking File > Open or by selecting the Map Selector button on the tool bar.



The Map Selector will display an overview of the state of Virginia, the grid shows the area covered by each map. Terrain Navigator opens maps from the CDs provided with the package, and does not store maps on your computer. For this reason to you must insert one of the four "USGS Topographic Series" CDs for Virginia. It is important that you insert the correct CD for your county or area. Under the "Coverage" pull down menu select CD, this will show the available maps for the inserted CD.



3. Select a map scale  
Under the "Map Type" pull down menu you are given two choices of scale:

1:24,000/25,000 - The most commonly used because they provide good detail for hiking, hunting, etc.

1:100,000 - These maps don't provide much detail, but they cover large areas and provide a good landscape view.

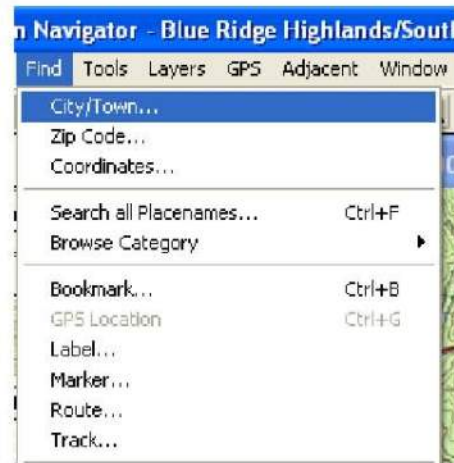
You can always change your map scale anytime during a project by using the map scale button on the tool bar.

1:24,000 T

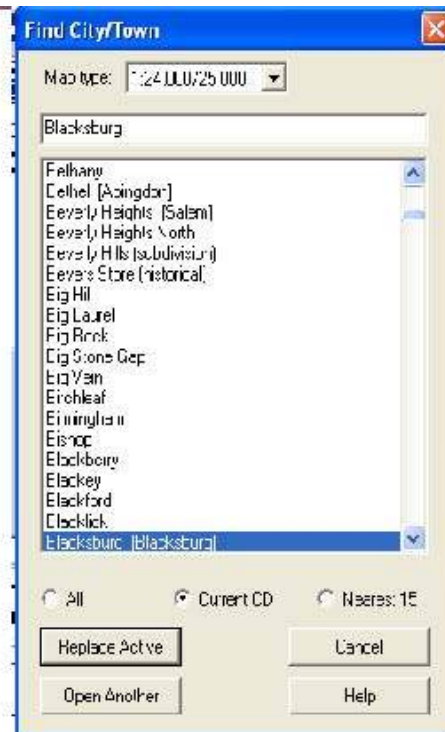
4. Opening Maps  
Using the "Map Name" drop down menu you can select maps by name. When you select a name of a map the a square on the grid will become highlighted indicating the location of the map. When you are sure of your map name press "Open." Another way to open a map is to double click on the map grid.

## Searching

Maptech software has a "Find" feature which is an excellent tool to search for and quickly locate a particular area. When you have a map open, click on the "Find" menu and select "City/Town."



Using the Find City/Town feature is simple, just type in the name of the town you wish to find and select from the available options in the list below. If the city name is common you may select to limit your search to the CD currently in the drive if you know you will be searching in that region. To open a map of this area you can click the bottom “Replace Active” or just double click on the name of the city/town you wish to view this will close whatever map you had been viewing and open the new map. You open the map in a new window by clicking the button “Open Another.” The opened map will have a red circle around the town or city selected.



The Find menu is an excellent tool and can be used to find locations in many other ways. Another great option is the “Zip Code” option on the “Find” pull down menu. This feature works very much like the find City/Town option except you can search using zip codes. The find feature also is great for finding bookmarks, waypoints, tracks, routes and labels that will be discussed in future sections.

### Viewing Maps in 2D

This section will introduce the major tools needed to navigate topographical maps in 2D.



The **drag tool** is the best tool for moving around the topo maps. To use this tool just click (hold) and drag the map on the screen. Another good feature of the drag tool is it changes to a scrolling Arrow when you hold the tool at the edge of the map (this feature works on almost all cursor tools). After the drag tool changes to a scrolling arrow just click and the map will scroll in the direction of the arrow.



### Map Overview

The Map Overview feature is located on the side tool bar, it is a thumbnail image of the map that you're viewing. The blue box represents the area of the map you are currently viewing. This feature is much like the drag tool, you can click (hold) on the box and move it to a new location or you can click on an area of the map to re-center the map. By clicking on the black arrow pointing to the map overview it will open up a window with a large version of the map overview.



### State Overview

This feature gives the general location of the map you are viewing with the location of the red dot. If you click on the black arrow pointing to the State overview, this will open up the “Open Map” window discussed in previous sections.



### Centering Tool

This tool can be found on the tool bar. To use this tool just left click on the map, and the map will be re-center around the point you have just selected. Also with this tool and most others as you use the mouse to move your tool the coordinates and elevation will be displayed on the tool bar.

037° 22' 03.04" N | 080° 44' 33.64" W | 2261 ft



### Compass Control

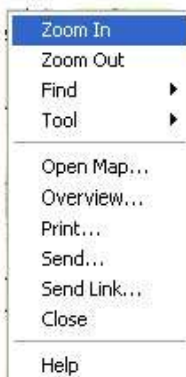
This tool provides yet another way to move the viewing screen. To use this tool just click on the compass direction you wish the map to scroll. For example if you want to view a map section to the north click on the north arrow on the compass.

### Zoom In / Out

**1:1** When Terrain Navigator is first open the scale will 1:1 or the actual scale of the map. This program offers four different zoom levels 1:4, 1:2, 1:1 and 2:1, where 1:4 (25% of actual scale) is the maximum outward view and 2:1 (200% of actual scale) is the maximum inward zoom level. Just use the “Zoom level” on the toolbar to select the zoom level desired.

Don't forget that there are also two different map scales 1:24,000 (detailed view) and 1:100,000. The four zoom levels are available on each of the different scale maps. If you find that you cannot zoom it to the desired level, change the map scale from 1:100,000 to 1:24,000 might solve the problem.

1:24,000 T

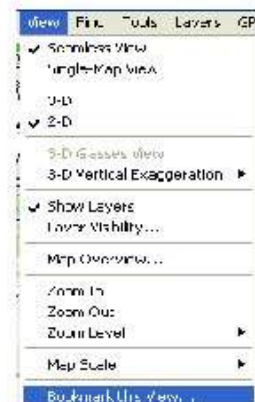


Terrain Navigator provides four zoom levels for viewing maps. To zoom select the Zoom In or Zoom Out tool, then click on the map. The map will center automatically on the point you clicked. Another option is to right click on the map and select Zoom In or Zoom Out from the menu that appears.



### Bookmarks

Bookmarks are used to save specific locations so you can return to them later at the same zoom level and map scale. To save a bookmark select “Bookmark this View” on the “View” pull down menu and enter a name for your bookmark. To find your bookmark use the find feature, “Find” menu then select “Bookmark” (mentioned in more detail in a previous section).



## Printing Maps

To the map you are viewing select the “File” menu and select “Print.” This will display a map that you are about to print. A blue box (similar to the map overview) will display the area to be printed. This box can be moved (dragged) or centered before you print. If there is no blue box present the whole map as seen will be printed. There are many options provided on the right side of the print window.

The size can be changed, this will essentially change the zoom level of the printed map and the size of the printing area. The size can be adjusted using the scale or percent, “%” is the default. Adjusting the “%” will adjust the percent of the actual scale. Simply a large percent like 200% will zoom in to great detail and a small percent like 10% will display a larger area but in less detail. As the scale is adjusted the size of the blue box will change indicating the area that will be printed. The scale limits are 25% to 1000%.

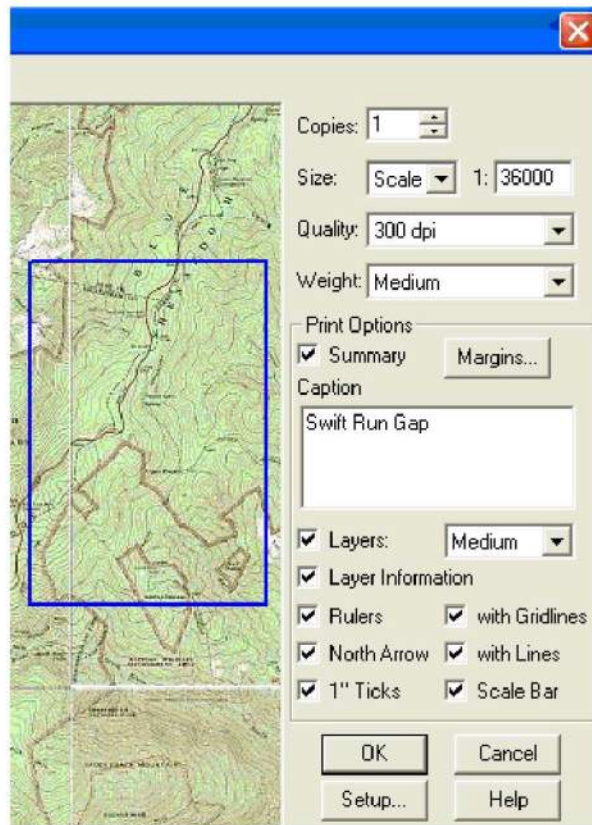
*Quality* - The quality of the print can be using the “Quality” pull down menu. All options are expressed in dpi (dots per square inch), the higher the dpi the higher quality of the printing. Quality can also be set by clicking the “Setup” button.

*Weight* – This refers to the amount or density of ink used in printing.


*Summary* – when this option is checked, a box will be included at the base of the map including the USGS map name, date, scale (1 inch = x feet), coordinates, and caption.

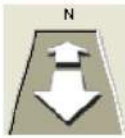
*Layers* - Layers are markers, routes, tracks and can be included on your printout when this box is checked. The pull down menu to the side is to choose the size (Small, Medium or Large) at which the layers will be displayed. The Layer Information check box will provide sheet printed in addition to your map that includes data about the layers.

Other map options include Gridlines, Scale Bar, North Arrow all good features for reading and interpreting maps. To Add these features just click on the checkbox next to the label.



## 3-D View

 Terrain Navigator features a 3-D View which provides an additional way to view the shape of the landscape. To use this feature click on the 3-D button on the main tool bar which will display a 3-D view of the terrain.



**Zooming In / Out (3-D)** - The controls differ from the 2-D view. To zoom in or out, click on the arrows on the side toolbar. The direction listed just above these arrows (in this case “N”) identifies the direction you are looking at the map.



**Raising / Lowering the Viewpoint** - This feature changes the height at which you are viewing the 3-D map. To adjust the viewpoint click and hold on the lever then drag it up or down. The elevation tool can be found on the side toolbar. The higher you drag the level the farther you will be from the map.



**Rotation** - The rotation tool lets changes the viewing angle of the map. The right and left arrows will spin the view around your centered point, thus giving the illusion that your rotating around that point. The up and down arrows change the view angle from by raising and lowering the view point, basically the same thing as the Viewpoint feature just above it.

**Using the Cursor** - The cursor can be used to change the view as well. Just click and hold on the map and drag to change the view. Using the cursor you can rotate and tilt the 3-D map.



**Height Exaggeration Buttons** - These buttons simply exaggerate the height of the terrain in 3-D display. The up arrow increases the height of mountains and hills and the down arrow shrinks them. These tools are found at the bottom of the side tool bar.



**Recording a 3-D Rotation Video Clip** - This feature allows you to make a recording of the 3-D rotation around a center point. To use this feature just select the video tool at the bottom of the side tool bar or select “File” menu >”Export” > “Rotation Video Clip.” This feature can also be used to make videos of routes in which case select “Route Video Clip.” Save this clip and click ok. Note the Route Video clip has additional optional settings that can be changed. The clip will only take a few seconds to be produced and can be opened using windows media player.



**3-D Glasses View** - You can view your 3-D map using the glasses provided with Terrain Navigator. Just click this button and it will take you to the 3-D glasses view. To exit the 3-D glasses view just left click on the mouse again. Note rotation of the map is not possible in 3-D glasses view.

### **Integrating Terrain Navigator with you Global Positioning System**

Terrain Navigator can be used as a software application to download waypoints, tracks and routes from your GPS receiver to the PC. These features can then be integrated with (ontop of) Terrain Navigator’s mapping capabilities.

### **Configure Your GPS**

Terrain Navigator software offers a way to setup your GPS automatically, using GPS Setup Wizard. This feature is offered during the initial software setup. However if you skipped this step or want to add a new

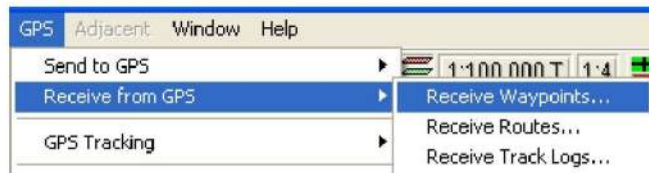
GPS you can run the feature by clicking on the “GPS” pull down menu then selecting “GPS Setup Wizard.”

The GPS Setup Wizard does require that you answer the questions on each screen. When the Wizard is complete, Terrain Navigator will recognize and communicate with your GPS unit.

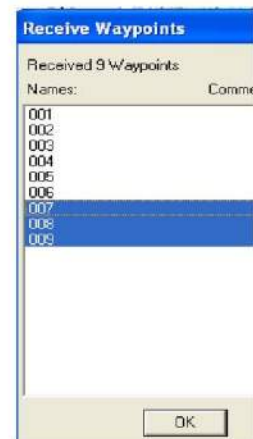
Note if you are unable to configure your GPS using the GPS Setup Wizard your GPS can be configured manually by selecting “Setup” from the “GPS” pull down menu. For more assistance with this feature consult Terrain Navigator’s help section.

### Receiving data from your GPS

Using Terrain Navigator waypoints, tracks and routes can be downloaded from your GPS to topographical maps. Before you begin make sure the GPS receiver is connected to the computer and turned on. To receive data from your GPS click on the “GPS” pull down menu then select “Receive from GPS” and choose a type of data by clicking “Receive Waypoints/Track Logs/Routes.”



Terrain Navigator will create a list of all data points that are on your GPS, these points will be displayed in a new window called “Received Waypoints/Track Logs/Routes.” To load points into Terrain Navigator the data must be selected from the list. Note to select more than one data point hold down the control key when using the mouse. When you selected the data you wish to download press the OK button. A message box will appear identifying the number of data points received.



After the data points are received from the GPS they will be displayed on the map. In this program GPS data is known as “Layers” and waypoints are also referred to as “Markers.” Layers can be viewed by clicking on the “Layers” pull down menu and selecting the type of data you are interested in (markers, tracks, routes). Layers can be turned off and on by clicking on the “View” pull down menu and selecting “Layer Visibility”

### Sending data to your GPS

A very valuable feature of Terrain Navigator is that you can transfer data or Layers from your computer to your GPS. This program lets you send all Layers (Markers, Tracks, and Routes) directly to your GPS so you can find these features in the field. Before you start this process make sure you have your GPS unit turned on and connected to your computer. Sending is much like receiving data, just click on the “GPS” pull down menu, select “Send to GPS” then choose what type of layer you wish to send your GPS by clicking “Send Markers/Tracks/Routes” A box will appear with all the possible points that can be sent to the GPS. Select the points you wish send, use the control key to select more than one point. When you have finished your selection click the send button. The data should appear in your GPS as waypoints, tracks, or routes.



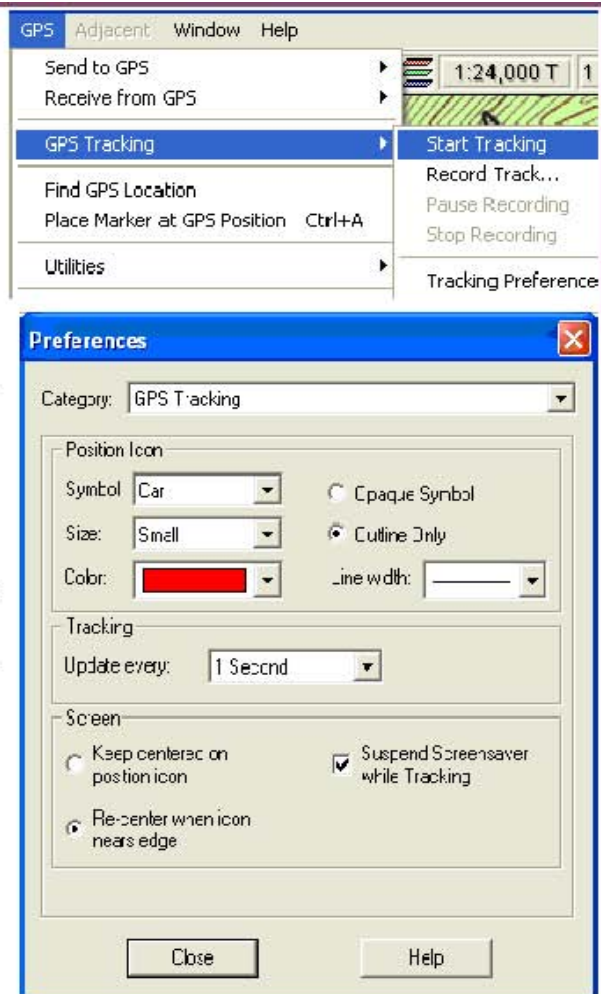
### GPS Real-Time Tracking

This feature is designed for use in a moving vehicle, as it monitors your movement on the map. Using this feature you can record your movements and save it as a track. To use this feature your GPS unit should be plugged in and turned on. Click on the GPS pull down menu and select "GPS Tracking" then select "Start Tracking" or to record your actions while tracking select "Record Tracking." When your GPS unit receives enough satellites Terrain Navigator will open a map marking your location on with a tracking Changing tracking Preferences

Using this feature you can change how Terrain Navigator tracks your position. To use this feature click on the "GPS" pull down menu and select "GPS Tracking" then "Tracking Preferences." Here you can change the icon displayed size and other visual features. The time interval between tracking points maybe changed, which may be important depending on your speed. Also screen features can be changed.

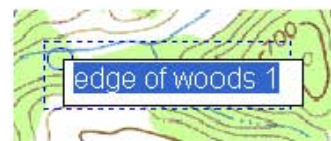
### Creating Layers (Markers/Tracks/Routes)

Creating layers is simple and can be invaluable for finding your way in new terrain because you can load these features to your GPS.



### Markers

To create new markers you can use the marker tool on the top tool bar or click on the "Tools" pull down menu and select "Markers." Markers can be used to indicate a place of interest and can be loaded on to your GPS as Waypoints. Because it is much easier to name and label points in Terrain Navigator than on your GPS this is a valuable tool. When the marker tool is selected, markers should be created on the map where you left click.



To change the text of the marker, just left click on the text, this will give you the option to change the marker name. If you wish to change more features or add comments right click on the marker and select edit. Using the right click menu you can also get information, hide the marker, and delete the marker and perform other tasks.






To move Markers you must be using the “Marker tool.” Hold the Cursor over the marker tool until the cursor icon changes to a maker/hand tool. At this point you can hold click and drag the maker to a new location

### Tracks and Routes


To add these features you must be using the Track or Route tools with can be found on the top tool bar or on the “Tools” pull down menu. Routes connect a series of waypoints where as tracks are just lines without points in between. Both can be loaded on to your GPS unit. To create these features just click on the map using the Track or Route tool to begin your line. Additional points or clicks should be added to change the direction of the line. When the Track or Route is finished, right click and select “Finish Track/Route” from the cursor menu. Editing and adding text and information can be done in the same way markers are edited. Tracks/Routes can be added to after completed by right clicking (using the track or route tool) and selecting append route/track. They can also be closed or looped by selecting “Toggle Route Loop” from the right click menu.

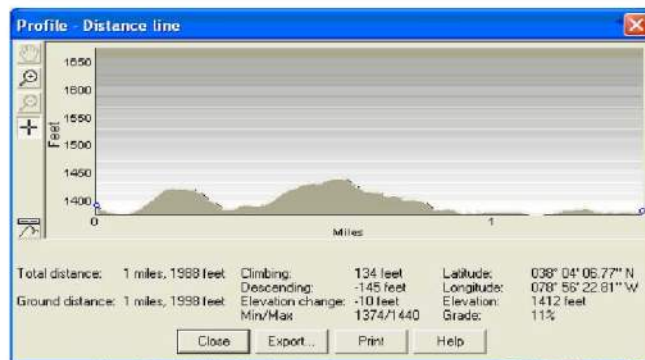


### Measuring Tools

Distance can be calculated by using one of two measuring tools. Use the Distance tool  for straight-line measurements, Terrain Navigator will provide the length and bearing, and elevation. The other distance tool  provides information for curved lines and measurements. Select one of the distance tools and choose at least points on the map to calculate distance. To delete the last segment draw use the backspace key one your keyboard. Hold down the control key if you need to drag the map. To create curved lines click and hold the cursor. To get information such as distance about the segment right click on the line and select “Information” from the menu. The right click menu also provides other tools such as option to covert to a track or route. To erase all of the line segments right click on the line and select “Clear” or use the Delete Tool. 

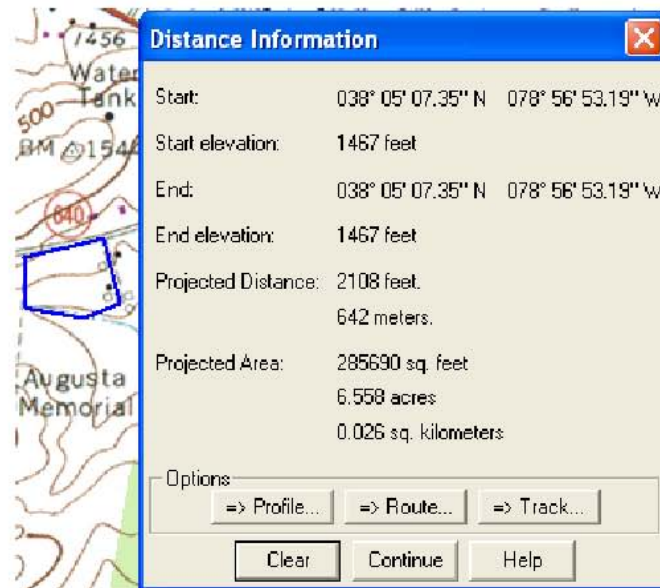
### Profile

Another option from the right click cursor menu (using Distance, Tracks or Routes) is the “Profile” feature, which can also be found on the top tool bar. This shows the elevation and terrain crossed by the route or distance line. This feature can also be found in the same way for tracks and routes. This feature is very similar to the “Line of Sight Tool”  which displays the profile with a line of visibility.



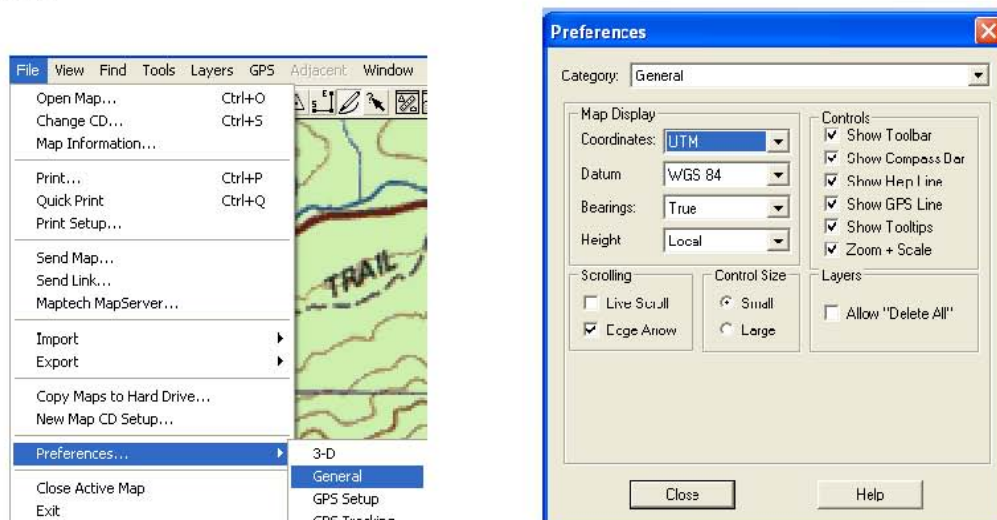
## Measuring Area

This feature can be used only if the line is looped or forms an enclosure. To obtain the area information just right click on the line and select "information." Area information is also collected for toggled routes under the information feature.



## Changing Datum

Basically datum is a way of calculating the location of the earth's center. The earth's center is used as a point for establishing coordinate locations on the earth's surface. There are three forms of datum used by Terrain Navigator. This becomes important when transferring points from your GPS because, the datum must match. To change the datum click on the "File" pull down menu select "Preferences" then select "General."



For additional updates and information about this digital resource, contact the Virginia Geospatial Extension Program:

The Virginia Geospatial Extension Program  
Virginia Tech  
319 Cheatham Hall  
Mailcode 0324  
Blacksburg, VA 24061

John McGee  
Virginia Geospatial Extension Specialist  
(540) 231-2428  
[jmcg@vt.edu](mailto:jmcg@vt.edu)  
<http://www.cnr.vt.edu/gep>

Acknowledgements: Luke Petre



# Converting Coordinates

Latitude and longitude coordinates can be presented in a variety of formats. Converting from one format to another mostly involves dividing or multiplying by 60, which is the number of minutes in a degree, and seconds in a minute. GPS units and most software programs can be set to display the following position formats:

DMS degrees:minutes:seconds  
DM (DM.m) degrees:minutes  
DD (D.d) decimal degrees

Where        D=Degrees  
              M=Minutes  
              S=Seconds  
              .m=decimal minutes  
              .s=decimal seconds

## To convert from DD to DMS:

Starting coordinate:  $121.135^\circ$   
The whole units of degrees will remain the same ( $121^\circ$ ).  
Multiply the decimal by 60 ( $0.135 * 60 = 8.1$ ).  
The whole number becomes the minutes (8').  
The decimal can remain as a decimal minutes (.m), or multiply by 60 to become seconds (6") ( $0.1 * 60 = 6$ ).  
Result:  $121^\circ 8' 6''$

## To convert from DMS to DMM:

Starting coordinate:  $121^\circ 8' 6''$   
Divide seconds by 60 ( $6/60=0.1$ )  
Add this decimal to the minutes ( $8+0.1=8.1$ )  
Result:  $121^\circ 8.1'$

## To convert from DM to DD:

Starting coordinate:  $121^\circ 8.1'$   
Divide minutes by 60 ( $8.1/60=0.135$ )  
Result:  $121.135^\circ$

Information sources:

<http://geography.about.com/library/howto/htdegrees.htm>  
[www.gypsymoth.ento.vt.edu/sts97/htmls/dms.html](http://www.gypsymoth.ento.vt.edu/sts97/htmls/dms.html)

# Common GPS Terms

**Accuracy** – A measure of how close an estimate of a GPS position is to the true location.

**Azimuth** – The compass direction from a position to a destination expressed as an angular measure from north and measured clockwise. Most commonly expressed as  $0^{\circ}$  –  $360^{\circ}$  degrees measured clockwise. GPS units use azimuth to express direction.

**Bearing** – The compass direction expressed as a measurement from a given quadrant, such as North  $36^{\circ}$  East. The angular measure (36 in this case) will reference the acute (less than 90) angle from the North or South meridian as measured to the East or West. Bearings will need to be converted to azimuth for use in the GPS unit.

**Coordinate Systems** – Such as latitude/longitude, represent your position on the earth to a flat surface like a map.

**Course** – The compass direction you are trying to follow from your starting point to the point you are trying to reach.

**Course Over Ground** – see Track

**Declination Setting** - GPS units can be adjusted to the amount of magnetic declination in the area of use.

**Differential GPS (DGPS)** - An extension of the GPS system that uses land-based radio beacons to transmit position corrections to GPS receivers. DGPS reduces the effect of selective availability, propagation delay, etc. and can improve position accuracy to better than 10 meters.

**Direction** – The direction between two locations is usually called a bearing, azimuth, or course.

**Error** – Measurement of horizontal position error in feet or meters based on a variety of factors including Dilution of Precision (DOP) and satellite signal quality.

**GOTO** – The selected point you wish to travel to or find. It may be a position fix or part of a route or track.

**Heading** - The direction in which you or your vehicle are moving. For boat or airplane operations, this may differ from actual Course Over Ground (COG) due to winds, currents, etc.

**Latitude** - A position's distance north or south of the equator, measured by degrees from zero to 90. One minute of latitude equals one nautical mile.

**Location** – The actual physical place you occupy. The difference between a position fix and location is that a location is where you really are and a position fix is where a GPS unit says you are.

**Longitude** - The distance east or west of the prime meridian (measured in degrees). The prime meridian runs from the North Pole to the South Pole, through Greenwich, England.

**Magnetic Declination** – The difference between true north and magnetic north at a specific location.

**Navigation** - The act of determining the course or heading of movement. This movement could be for a plane, ship, automobile, person on foot, or any other similar means.

**NAVSTAR** - The official U.S. Government name given to the GPS satellite system. NAVSTAR is an acronym for Navigation Satellite Timing and Ranging.

**Position fix** - The GPS receiver's computed position coordinates.

**Precision** – Measure of the “repeatability” of the data. Taking repeated readings from a point will improve the precision of the sample mean.

**Route** - A group of waypoints entered into the GPS receiver in the sequence you desire to navigate them.

**Track** - Your current direction of travel relative to a ground position (same as Course Over Ground).

**Trilateration** – Mathematical technique used by GPS navigators to determine user position, speed and elevation. The GPS unit constantly receives and analyzes radio signals from GPS satellites, calculating precise distance to each satellite. Four satellites are generally needed to determine an accurate elevation and distance.

**Waypoint/Landmark** - Waypoints are locations or landmarks worth recording and storing in your GPS. These are locations you may later want to return to or avoid. They may be check points on a route or significant ground features such as a campsite, the truck, a cultural resource, or a favorite fishing spot). Waypoints may be defined and stored in the unit manually by taking coordinates for the waypoint from a map or other reference. This can be done before ever leaving home. Or more usually, waypoints may be entered directly by taking a reading with the unit at the location itself, giving it a name, and then saving the point.

**Wide Area Augmentation System (WAAS)** - A system of satellites and ground stations operated by the Federal Aviation Authority that provide GPS signal corrections for better position accuracy for airplanes. WAAS consists of approximately 25 ground reference stations positioned across the United States that monitor GPS satellite data. Two master stations, located on either coast, collect data from the reference stations and create a GPS correction message. A WAAS-capable receiver can be adapted to ground use and give you a position accuracy of better than three meters, 95 percent of the time. It is only accessed if you are in the open, not in the forest.

Definitions courtesy of Garmin International, Inc.

# GPS Hardware and Software Resource List

## **Hardware: GPS Receivers (2006 prices)**

**Garmin:** [www.garmin.com](http://www.garmin.com)

*High-end*

Unit: GPSMap 76Cx

Cost: \$535.70

*Mid-priced*

Unit: GPSMAP 76

Cost: \$199.99

*Low-end*

Unit: eTrex Legend

Cost: \$160.70

**Magellan:** [www.magellangps.com](http://www.magellangps.com)

*High-end*

Unit: eXplorist XL

Cost: \$399.99

*Mid-priced*

Unit: eXplorist 500

Cost: \$199.99

*Low-end*

Unit: eXplorist 200

Cost: \$149.99

**Lowrance:** [www.lowrance.com](http://www.lowrance.com)

*High end*

Unit: iFinder Hunt Color Plus

Cost: \$449.95

*Mid-priced*

Unit: iFinder H2O Plus

Cost: \$249.95

*Low-end*

Unit: iFinder H2O

Cost: \$165.95

Prices listed are recommended list price from manufacturer website. Most units can be found for a lower price at various stores and online, such as [www.amazon.com](http://www.amazon.com), [www.tigergps.com](http://www.tigergps.com), and [www.thegpsstore.com](http://www.thegpsstore.com).

## **Software**

**Terrain Navigator** by Maptech: [www.maptech.com](http://www.maptech.com)

Cost: \$99.95 per state.

Features: USGS topographic maps; 2-D and 3-D maps; upload and download routes, tracks, and waypoints; shows profiles of elevation over a route; personalize, then print maps showing your routes and waypoints. By purchasing Terrain Navigator Pro, you can access aerial photographs.

**Mapsource TOPO USA 2008 DVD** by Garmin: <http://gpsnow.com/gmms.htm>

**Cost:** \$80 - \$120, depending on program

Features: view color maps; create waypoints, routes, and tracks, and transfer them between your GPS unit and computer. Send detailed maps from the computer to your GPS unit for maps that show minor roads and points of interest.

**Expert GPS:** [www.expertgps.com](http://www.expertgps.com)

Cost: \$59.95

Features: exchange data with Excel, Topo, Terrain Navigator and others; connects your GPS to internet mapping and information sites giving access to street maps, weather forecasts, and attractions.



**Topo USA 6.0 National** by DeLorme: [delorme.com](http://delorme.com)

Cost: \$99.95

Features: 2-D and 3-D maps, profiles show elevation gains between points, draw on maps, measure linear distances, embed photos and URLs to maps, link digital photos to a GPS log to show where the picture was taken.

**USAPhotoMaps** by JDMCox Software: [www.jdmcox.com](http://www.jdmcox.com)

Cost: free

Features: downloads USGS aerial photo and topographical map data from Microsoft's free TerraServer Web site, saves it on your hard drive, and creates maps with GPS accuracy. You can go to any address, landmark, etc. and view its photo or topographical map. Add waypoints, routes, and text; transfer to and from your GPS unit.

**Easy GPS:** [www.easygps.com](http://www.easygps.com)

Cost: free

Features: upload and download routes and waypoints, create routes. This program is very basic, but very easy to use. You can change waypoint symbols, view and print simple maps of your routes and waypoints, and enter new coordinates. It does not show maps or terrain features.

**GPS Utility:** [www.gpsu.co.uk](http://www.gpsu.co.uk)

Cost: free

Features: transfer data to/from a GPS receiver and store the data in PC files in one of several text formats. The program converts between different map datums and many coordinate formats. Route and track statistics are available and can be transferred into other programs for analysis (i.e. spreadsheet programs).

**Google Earth:** <http://earth.google.com>

Cost: free

Features: lets you fly anywhere on Earth to view current color satellite imagery, maps, terrain, and 3D buildings. You type in an address and the program will take you to that location. You can download GPS points onto google earth maps from a GPS unit. You can also create waypoints on google earth maps that can be saved as a [\*\*\*\*.kml] file and then transferred to GPSUtility and then uploaded to the GPS unit.

# Web-Based Resources

## **Information about GPS**

<http://gps.faa.gov/gpsbasics/index.htm>

Information from the FAA about GPS basics, how WAAS works, and much more.

<http://pnt.gov/101>

Information about GPS, national and international augmentation systems, and links to other government-based GPS resources from the National Space-Based Positioning, Navigation, and Timing (PNT) Executive Committee.

## **Mapping/GIS Resources**

[www.mdmerlin.net](http://www.mdmerlin.net)

Create free custom maps of locations in Maryland showing property lines, wetlands, roads, aerial photos, and more.

<http://seamless.usgs.gov>

U.S. Geological Survey (USGS) and the EROS Data Center (EDC) provide geospatial data through **The National Map**. View and download many geospatial data layers, such as National Elevation Dataset, National Land Cover Dataset, high resolution orthoimagery, and hydrography.

[http://sdatcert3.resiusa.org/rp\\_rewrite](http://sdatcert3.resiusa.org/rp_rewrite)

The Maryland Department of Assessments and Taxation Real Property Data Search offers information on property sales and ownership.

<http://websoilsurvey.nrcs.usda.gov/app>

Web soil surveys provide soil data via overlays on aerial photos.

## **Additional Resources**

[www.naturalresources.umd.edu/GPS.cfm](http://www.naturalresources.umd.edu/GPS.cfm)

The beginner and advanced GPS training materials from Maryland Cooperative Extension are available online, along with links to software programs and materials from other sources.

# Merlin Online

Merlin Online was developed by Maryland Department of Natural Resources. It is available for free use at [www.mdmerlin.net](http://www.mdmerlin.net). Merlin Online is an electronic atlas that allows a user to produce a custom "map" for any location in Maryland. The map can include any of the available layer data, such as property information, wetland delineation, soils, roads, USGS topo maps, and aerial photographs.

An internet connection is required. If you have a dial-up connection, it may take a long time to load parts of the program. Before trying to use Merlin Online, be sure your computer has a recent version of Internet Explorer or Netscape, and enable Java or Microsoft Virtual Machine.

## Making a map

Go to [www.mdmerlin.net](http://www.mdmerlin.net) and click Make A Map. You will be sent to a Notices page; scroll to the bottom and click OK. A new window will appear with the Map Selection Menu. (This window may take a moment to load.) Click County. Select a county from the list.

The county map will open. To zoom in to view a particular area, click on the Zoom Box icon. A red box will appear. Move the box to where you want to view, and click Zoom. You can re-size the zoom box by placing your cursor over the outline, then clicking and dragging.

The Layer Control box on the left side of the screen allows you to check the boxes next to the items that you want to appear on your map. Once you have checked what you want, click Submit

