Arizona State Forestry

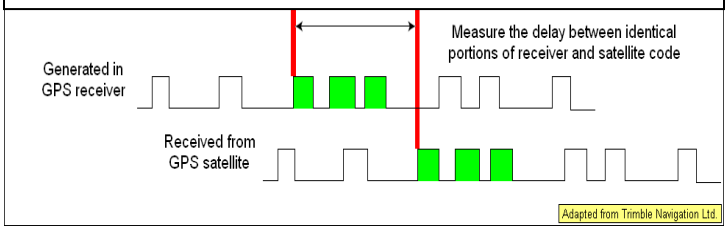
Basic GPS Class

For the Garmin GPSMap 76SCx

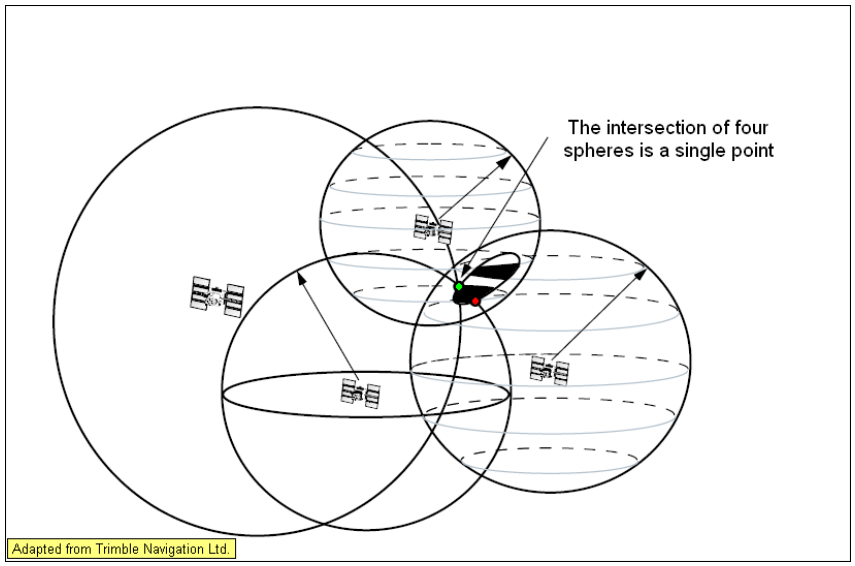
How it Works

- 24 or more GPS Satellites orbit the earth every 12 hours
- Each satellite transmits
    - PRN Code-

GPS receivers examine incoming code from each satellite and calculate how long ago the receiver generated that same bit of code. The observed time difference is applied to the speed of radio waves to establish the receiver's distance from each satellite.



    - Ephermeris data-Satellite orbital information
    - Atmospheric data- Helps GPS account for signal delay due to atmosphere
    - Clock Information- Defines exact time of satellite transmission
    - An Almanac- Schedule of satellite positions
- Satellite Trilateration



Accuracy and Error

Source of Error	Amount of Error
• **Selective Availability**	**Currently set to zero**
• **Satellite clock errors**	**1.5 to 3.6 meters**
• **Orbital errors**	**Less than 1 meter**
• **Ionosphere**	**5.0 to 7.0 meters**
• **Troposphere**	**0.5 to 0.7 meters**
• **Receiver noise**	**0.3 to 1.5 meters**
• **Multi-path**	**0.6 to 1.2 meters**
• **Sky obstructions**	**Depends on amount**
• **User mistakes**	**Depends on the error**
• **Control mistakes**	**Depends on the error**

All errors are cumulative!

Selective Availability was an intentional degradation of GPS signals by the Department of Defense prior to May, 2000. Currently, Selective Availability has been suspended, and is set to zero.

Satellite clock errors are caused by slight discrepancies in each satellite's atomic clocks. Errors are monitored and corrected by the Master Control Station.

Orbital errors pertain to the altitude, position, trajectory, and speed of satellites. Orbits may fluctuate due to gravitational pull and solar pressure. Orbital errors are also monitored and corrected by the Master Control Station.

Ionospheric interference occurs when GPS signals slow down and scatter as they pass through the ionosphere. GPS signals contain information to help correct about half of the interference.

Tropospheric interference is caused mostly by water vapor and, to a lesser extent, temperature and pressure changes in the lower layer of Earth's atmosphere.

Receiver noise is the electromagnetic field generated by a receiver's internal electronics. Electromagnetic fields can distort radio waves, and affect the travel time of GPS signals just before they can be processed by the receiver. External antennas may help alleviate receiver noise, but can't compensate for other electromagnetic fields associated with power lines, generators, two-way radios, and so on.

Multi-path interference is caused by GPS signals reflecting off surfaces near the GPS receiver that can either interfere with, or be mistaken for, the "true" signal that follows a straight-line path from a satellite. Common sources of multi-path include rock outcroppings, vehicles, and buildings.

Sky obstructions include vegetation, terrain, buildings, your body, or anything that blocks a receiver's view of the sky. In severe cases, a GPS receiver may not even be able to "see" enough satellites to calculate a position. In less severe cases, a GPS receiver may

have to use a less than optimal combination of satellites, resulting in less precise positions.

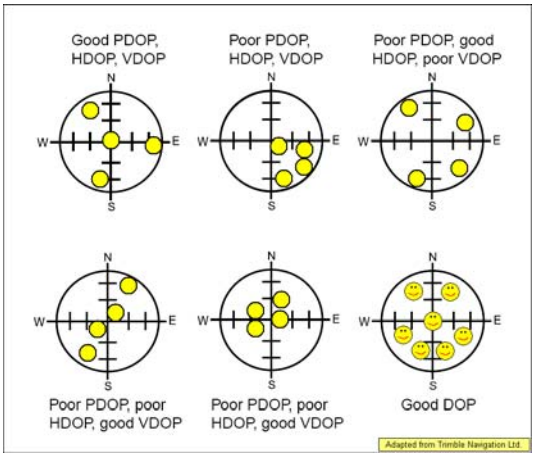
User mistakes include incorrect datum or transcription errors during manual coordinate entry, relying on 2-D positions instead of 3-D positions, or holding a GPS receiver too close to the body.

Control segment mistakes arising from human or computer error could occur, but are unlikely.

GPS errors are cumulative, and are compounded when the shifting arrangement of satellites creates poor DOP conditions. DOP concepts will be covered next.

Satellite Geometry and DOP

- Satellite geometry (arrangement) can affect the precision with which receivers calculate positions.
- Dilution of Precision (DOP) is an index of how well satellites in a receiver's working constellation are distributed across the visible sky, and the effect of that distribution on the quality of calculated positions.
- There are five kinds of DOP.
- Position Dilution of Precision (PDOP) is the value most commonly used by GPS practitioners to determine the overall quality of data collected by receivers.
- GPS receivers automatically select the combination of satellites that provide the best (lowest) DOP.
- Advanced GPS receivers can suspend data collection when poor DOP conditions occur.

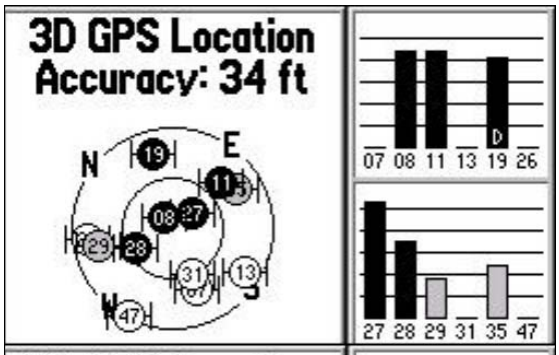


BOTTOM LINE-Accurate enough for everything, but legal locations. Averaged points can easily get with 15m and close at 2m with good PDOP and low error and WASS. Sub-meter accuracy has been reported using similar GPS Units.

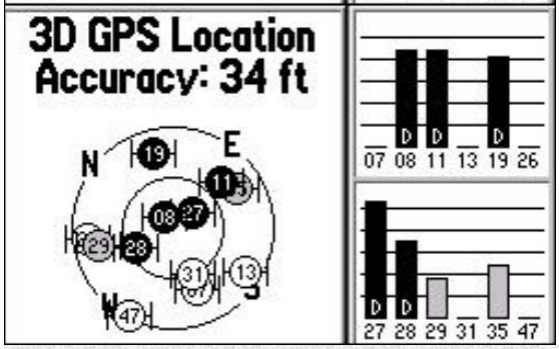
WASS- Wide Area Augmentation System

The Wide Area Augmentation System (WAAS) is designed to enhance GPS positioning over the United States, as well as portions of Mexico and Canada. There are 25 Wide Area Reference Stations positioned across the United States (including three in southern Alaska, and one each in Puerto Rico and Hawaii) that monitor GPS satellite signals. These stations continuously receive and calculate GPS satellite timing corrections. Each reference station then transmits those timing corrections to one of two WAAS Control Stations located on the Pacific and Atlantic coasts of the U.S. The control stations, in turn, transmit timing corrections to two geosynchronous WAAS satellites for re-broadcast to GPS receivers in the field.

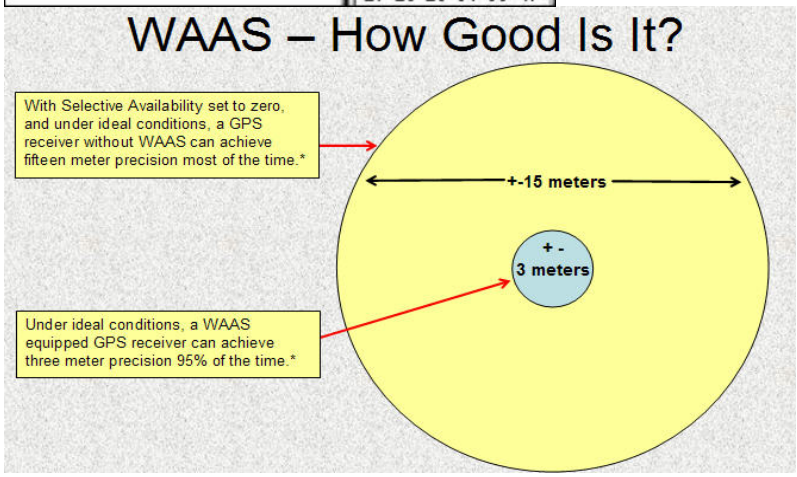
WAAS is available to any GPS receiver capable of receiving the WAAS signal. WAAS limitations include signal blockage by vegetation and terrain, poor coverage over portions of the northern U.S., and very slow signal acquisition time.



WAAS should **NOT** be enabled if receipt of the correction message for **EACH** satellite in the working constellation is incomplete, or intermittent.



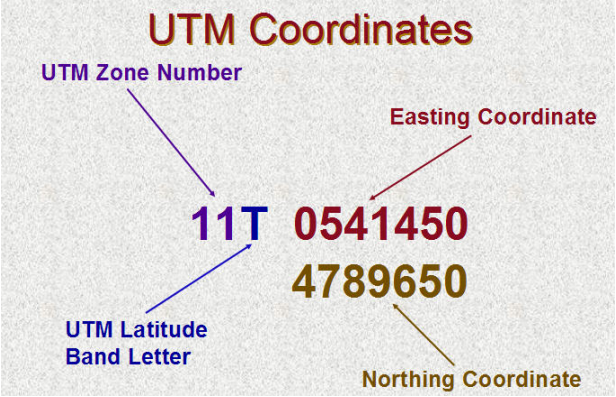
WAAS **MAY** be enabled if receipt of the correction message for **EACH** satellite in the working constellation is continuous and complete.



Coordinate Systems and Datum

- Coordinate Systems
  - Geographic- Latitude and Longitude
    - 3 ways to express Lat/Long
    - Degrees Minutes Seconds (NWCG STANDARD)
      Ex: **hddd^0 mm' ss.s": N 43^0 40' <u>55.8"</u> X W 116^0 17' 14.1"**
    - Degrees decimal minutes (AIRCRAFT STANDARD)
      Ex: **hddd^0 mm.mmm': N 43^0 <u>40.93'</u> X W 116^0 17.235'**
    - Decimal Degrees (GIS and Computer applications)
      Ex: **hddd.ddddd^0 : N 43.68216^0 X W 116.28725^0**

  - Cartesian- Universal Transverse Mercator (UTM) (Military)
    - UTM Zone- The earth is divided into 60 UTM Zones. UTM zones are 6° wide, 3° to either side of a Central Meridian. This narrow shape permits UTM zones to be projected from Earth's spherical surface to a flat map with minimal distortion.
    - UTM coordinates are composed of a Northing and an Easting



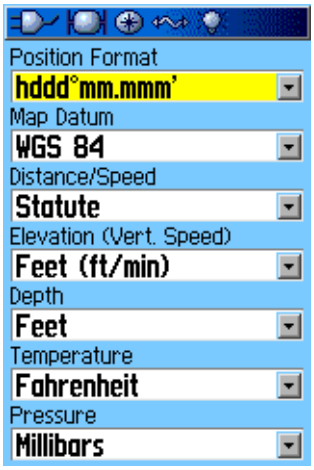
    - Benefit is that it represents a consistent distance…one unit is equivalent to one meter.

- Datum: Point-of-origin for a coordinate System
  - Each datum will have a different point-of-origin based on different "models" of Earth's size and shape. S
  - Switching Datums changes the value of coordinate system!
  - GPS users need to verify Datum and provide the datum for other users
  - Datum should be on every map
  - Datum Shift in Arizona
    - NAD 27 to NAD 83--- 210 m difference!
    - NAD 83 to WGS 84---4 m difference.

Unit Setup:

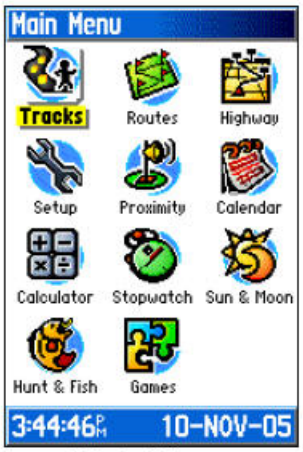
- Turn the unit **ON** by pressing the red **POWER** button.
- To ensure your unit is set up correctly follow these steps.

  1. Press **MENU** twice to open the main menu
  2. Select the **Setup** icon l press **ENTER**
  3. Scroll down to the **Units** icon press enter.
  4. Ensure that your **Position Format** and **Map Datum** fields look like the ones below. All other fields can be left as they are.

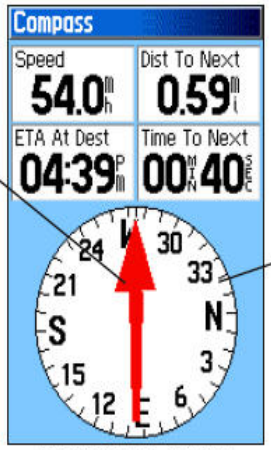


To change any of the fields highlight them and press **ENTER**
When you are finished press **QUIT** three times to exit.

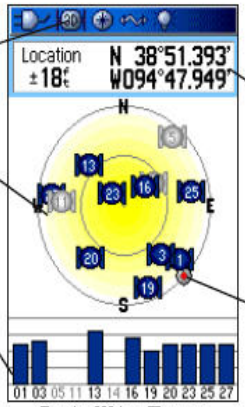
Basic Screens:



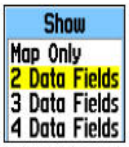
Main Menu



Compass Page

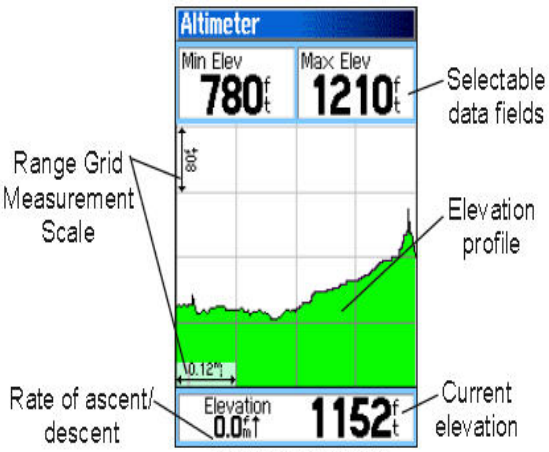


Satellite Page

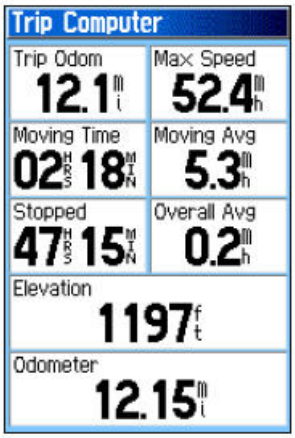


Show sub-menu

Map Page with data fields

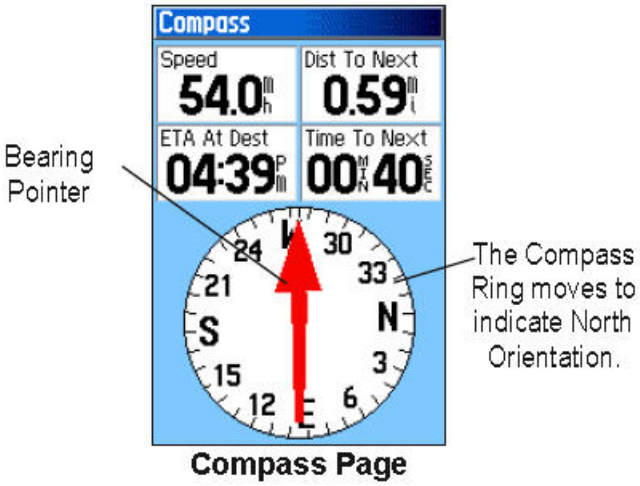


Altimeter Page



Trip Computer Page

Compass Calibration



Compass Page

Step 1: Go to **Compass Page**

Step 2: Press **Menu** to open the compass page options menu

Step 3: Highlight **Calibrate Compass,** and press **Enter**, and follow the on-screen directions for holding and turning the unit.

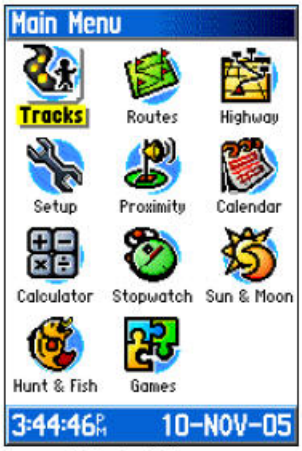
A message appears notifying you to adjust your turning speed as needed. Hold the unit level while turning.

A "**Calibration Successful**" message appears when finished.

If a "**Calibration Failed**" message appears, repeat the process.

Step 4: Press **Enter** to return to the compass page.

Datum and Coordinate System Setup



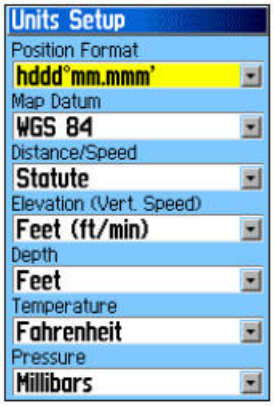
Main Menu

Step 1: Go to **Main Menu** page.

Step 2: Highlight **Setup** and press **Enter.**

Step 3: Highlight **Units** and press **Enter.**

Units icon



Step 4: Highlight field to be changed…Select desired change and press enter.

Collect a Waypoint (page 1 of 2)

-Fire and Treatment point features-

(Note: Garmin refers to all point features as "Waypoints")

1. **Mark Point:**
   - From the main screen press (hold for 2 seconds) the **ENTER/MARK** button. This will bring up the Mark Waypoint dialog.
   - (If the "**No map information…**" message appears select "**Yes**" and press **ENTER**.)

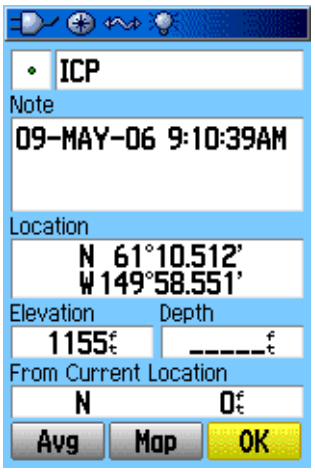
2. **Name the Point:**
   - Using the rocker, highlight the name field and press **ENTER** to bring up the on-screen keypad.

   - Name the point
   - On this screen, you can also:
     - Change the symbol used for the point on the Garmin GPS map.
     - Add notes to the "note" field"

Collect a Waypoint (page 2 of 2)

3. **Save the Point:**

   After entering your Waypoint name highlight and press **OK** to save it.



Optional Step:

- This process increases the accuracy of your GPS points.
  - Highlight the "**Avg**" button and press **ENTER**.
  - Watch the "**Estimated Accuracy**" field as the unit collects points. When the Estimated Accuracy levels off, or is near 10ft (3m) press **ENTER**.
  - Highlight **OK** and press **ENTER**.

Edit a WayPoint (page 1 of 2)

-Fire and Treatment point features-

(Note: Garmin refers to all point features as "Waypoints")

4. **Access the Point data:**

   - From the main screen press the **FIND** button to open the menu.
   - Using the rocker, select the "**Waypoints**" icon and press **ENTER**
   - Highlight the Waypoint that you wish to edit from the Waypoint list and press **ENTER**.

Edit the Point:

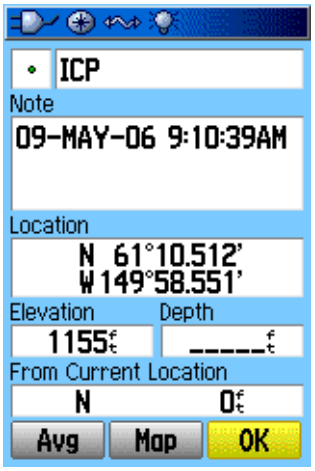
- Using the rocker, highlight the "**NAME"** field and press **ENTER** to bring up the on-screen keypad.

- Re-Name the point using the on-screen keypad.
- On this screen, you can also:
  - Change the symbol used for the point on the Garmin GPS map.
  - Add notes to the "note" field"

Save the Point:

After entering your edits, highlight and press **OK** to save it.

Edit a WayPoint (page 2 of 2)



5. **Return to Waypoint List:**

   - When you are finished with your current Waypoint press **QUIT** to return to the Waypoint list page.

6. **Exit:**

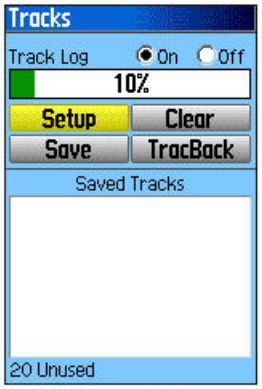
   - If you are finished editing all your Waypoints press **QUIT** twice more to return to the main screen.

Collect a Line (Page 1 of 2)

-Fire and Treatment perimeters, other linear features-
(Note: Garmin refers to lines as "Tracks")

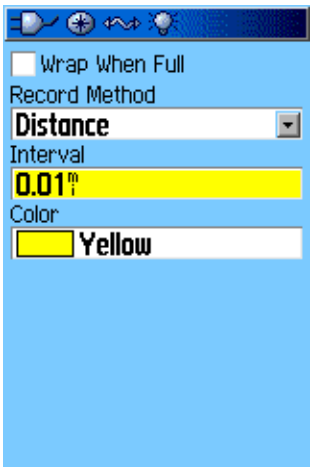
1. **Clear the tracklog:**
   - From the main screen press **MENU** twice to open the main menu
   - Select the **Tracks** icon and press **ENTER**
   - Highlight **Clear** and press **ENTER** then **OK**.

2. **Setup for tracking:**
   - If at the main screen press **MENU** twice to open the main menu
   - Select the **Tracks** icon and press **ENTER**
   - Highlight **Setup** and press **ENTER**
   - Using the rocker, select and set the "**Record Method**" to **Time**.
   - Set the "**Interval**" to between 2 and 5 seconds. You may need to make this interval smaller if you need more perimeter detail or larger depending on the size of the perimeter
   - Make certain that "**Wrap When Full**" is un-checked.
   - Press **QUIT** once when done.



Tracks Page

Track Log Setup



Collect a Line (Page 2 of 2)

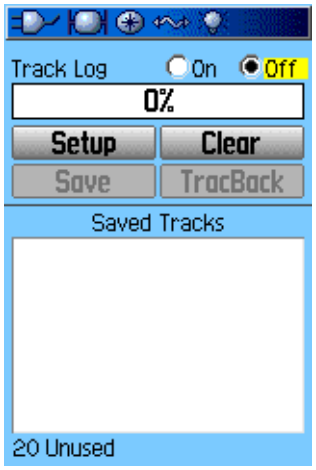
3. **Begin tracking:**

- If at the main screen press **MENU** twice to open the main menu
- Select the **Tracks** icon and press **ENTER**
- Set your track log to "**On**" by clicking the radio button as shown below.

- Press **QUIT** twice to return to the main screen.
- Make sure you have at least "3D" in your satellite status before you begin walking or driving the perimeter you are mapping.

4. **Finish tracking**

- Once you have finished mapping the perimeter press **MENU** twice
- Select the **Tracks** icon and press **ENTER**
- Select the "**Off**" radio button and click it.



- Press **QUIT** twice to return to the main screen. You may now download your track.

Area Calculation of a Track

Step 1: With the **track Log page open** and the **Track Log on**, Press **Menu** to open the options menu.

Step 2: Highlight **Area Calculation**, and Press **Enter** to open the Area Calculation Page.

Step 3: Press **Enter** to start the area calculation. As you begin to move and define the area's boundaries, a **Stop** button appears at the bottom of the page.

Step 4: When finished defining the area, press **Enter** to open the page with a **Save** button.

Start calculation

Save calculated track

Step 5: Press **Enter** to save the new track to the Saved Tracks List on the Track Page

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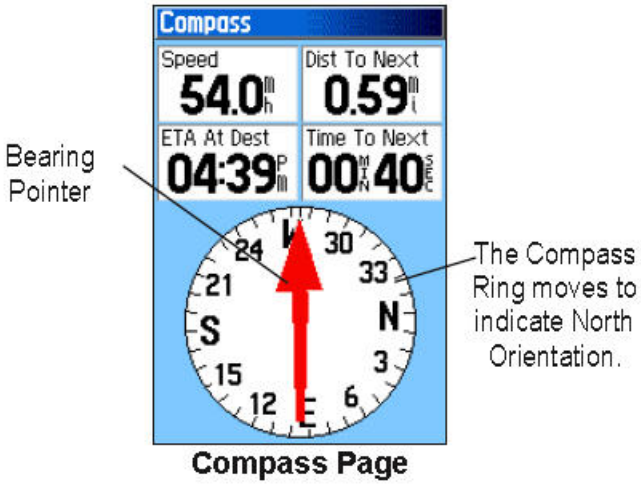
NOTE: When ever you save any track your GPS unit will report a calculated area. This can be much easier but requires a single track file.

Saved Track Page

Projecting Waypoints (Sight and Go)



Compass Page

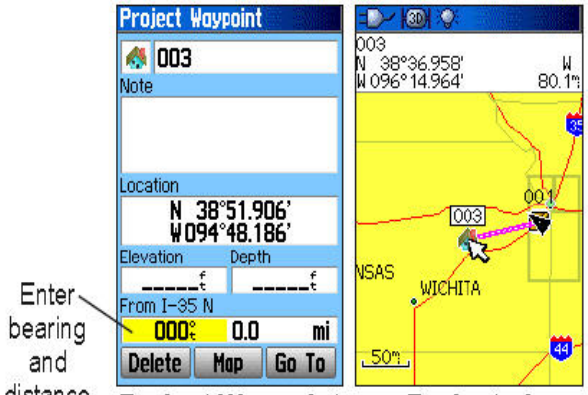
Step 1: Take a waypoint from your current location.

Step 2: Go to **Compass Page**

Step 3: Press **Menu** to open the compass page options menu

Step 4: Highlight **Sight 'N Go,** and press **Enter**

Step 5: With the GPS unit level, sight the desired azimuth using white tick mark and black triangle. Press **Enter** to lock the azimuth. (Make note of locked azimuth for **Step 10**)



Project Waypoint Page

Projected waypoint on the map

Step 6: Highlight **Project Waypoint** and Press **Enter**

Step 7: Distance from current point will be highlighted. Press enter and edit the distance to the projected waypoint.

Step 8: Edit the name of the projected waypoint

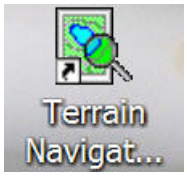
Step 9: Highlight "**Go To**" and press **Enter**

Optional Step

Step 10: In notes section record the locked azimuth and the name of the waypoint in **Step 1**

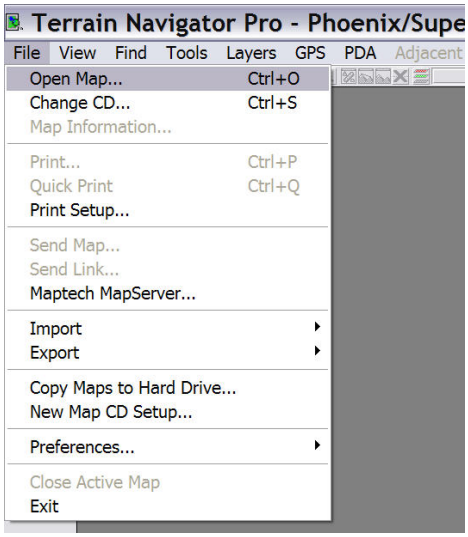
Map Tech- Terrain Navigator Pro

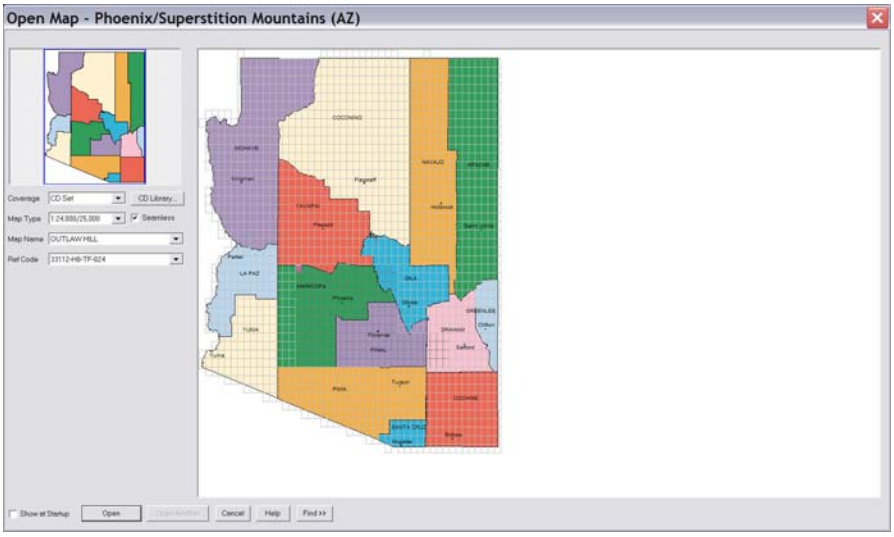
<u>Setup and Preferences</u> (Page 1 of 2)



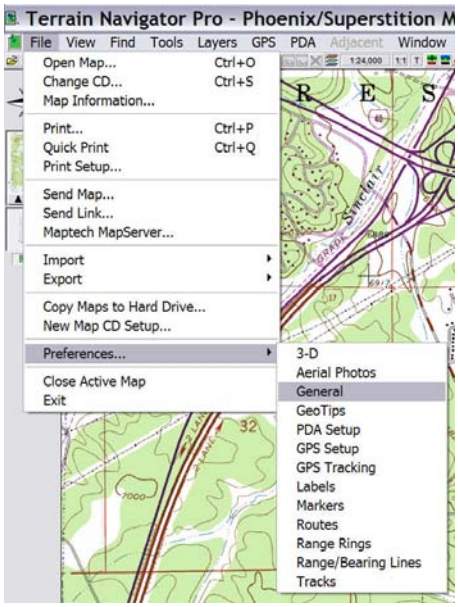
Step 1: Open **Map Tech Terrain Navigator Pro**

Step 2: Choose to open a map. Depending on the settings a pop up will either present you a selections of maps to open or you will need to left click on **File** and choose to open a map. Click on an area on the map that you want to start with and left click on **Open**





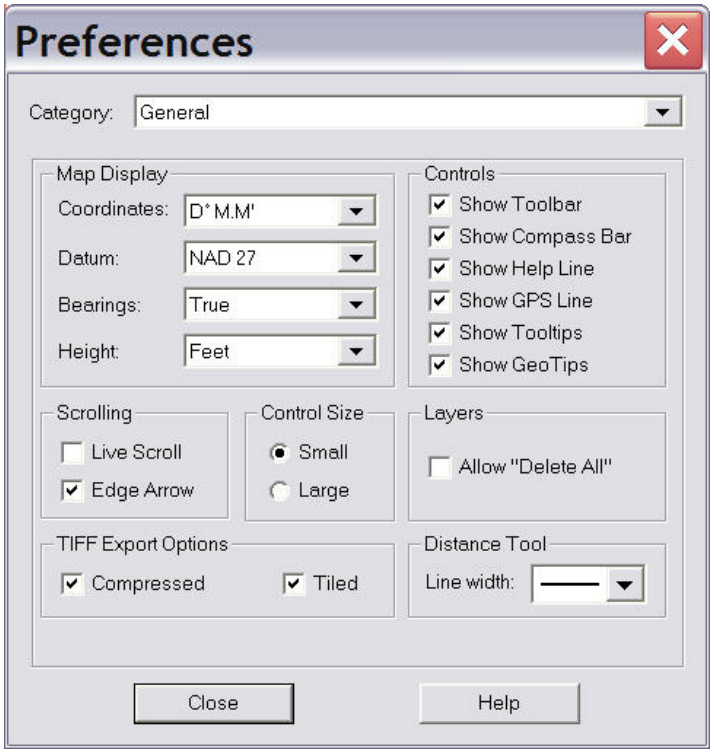
Step 3: Set preferences for datum and coordinate system. Go to **File,** and then **Preferences,** and then select **General.**



Map Tech- Terrain Navigator Pro

<u>Setup and Preferences</u> (Page 2 of 2)

Step 4: Within the General Preferences choose the coordinate system and Datum you prefer.



Step 5: Select **Close** when done.

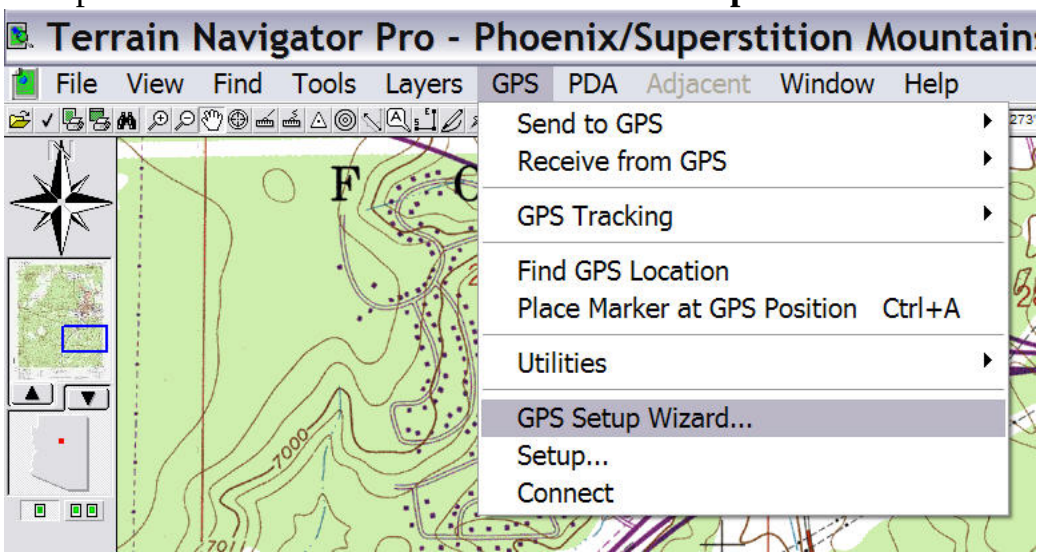
Map Tech- Terrain Navigator Pro

GPS Setup Wizard

Note: You will need to update your Map Tech software and your GPS software for it to recognize a USB port

Step 1: Plug your GPS unit in to your computer and turn on your GPS unit

Step 2: Under the **GPS** menu select **GPS Setup Wizard.**



Step 3: Follow the steps of the GPS Setup Wizard, when asked select **Garmin** as the type of GPS Manufacture.

Step 4: You should receive this as a conformation that everything was successful. You are now ready to upload and download from Map Tech to and from your GPS. Select **Finish.**

* If you did not receive this message there are 2 common causes.

1. Your MapTech Software is not up-to-date. Go to: http://www.maptech.com/support/downloads.cfm?plid=31 and download the latest update for your version of MapTech

2. You GPS Software is not up to date. Go to: http://www8.garmin.com/products/webupdater/howtoinstall.jsp and download the Web Updater. Once installed the Web Updater will keep your GPS with the most current software updates.

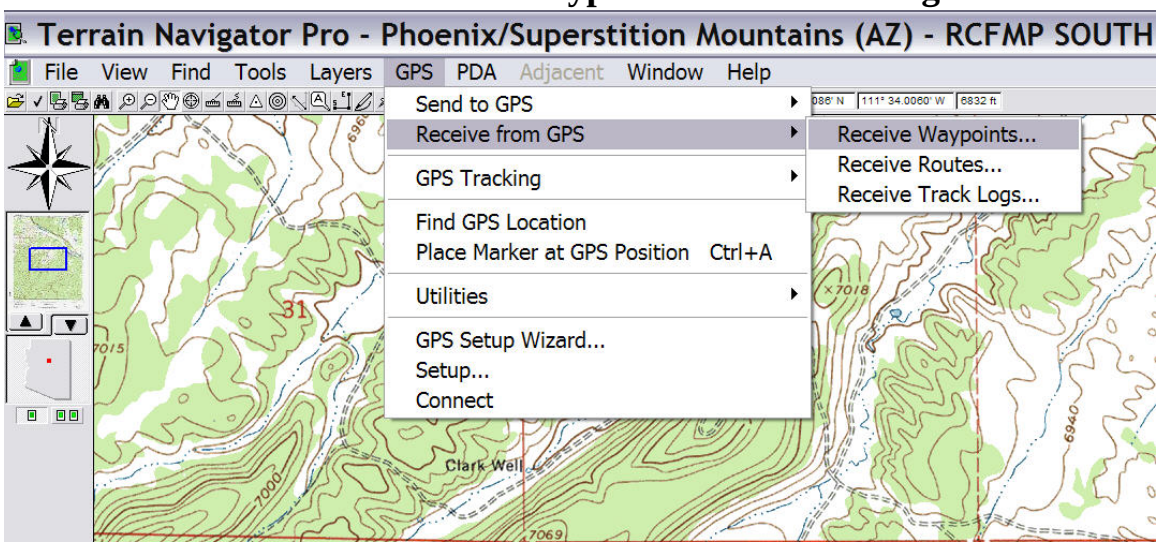
Map Tech- Terrain Navigator Pro

<u>Uploading Waypoints or Tracks from a GPS to MapTech</u> (Page 1 of 2)

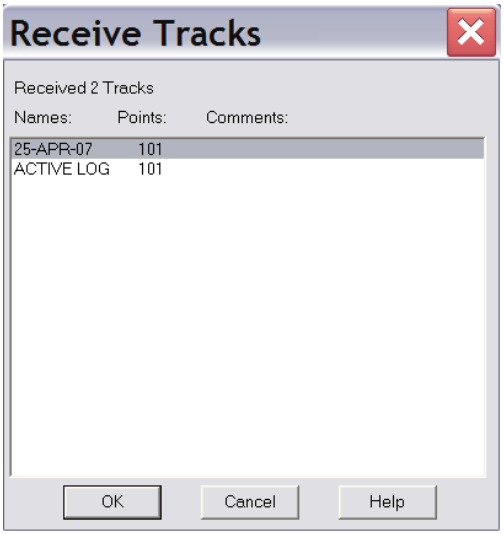
Step 1: Connect your GPS Unit to your computer

Step 2: Run the GPS Set Up Wizard

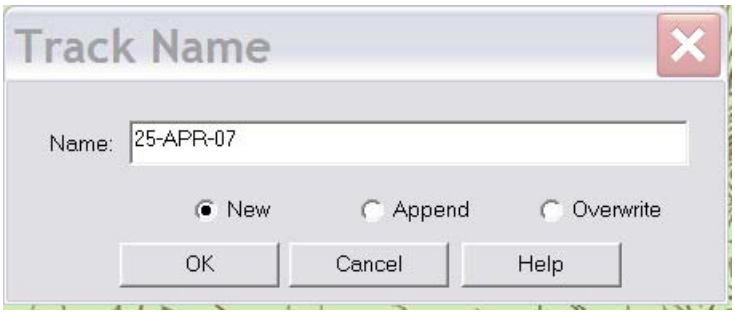
Step 3: Under the **GPS** menu in your main tool bar highlight **Receive from GPS** and choose to receive either **Waypoints…** or **Track Logs…**



Step 4: Choose the **Waypoints** or **Track logs** that you would like to receive from the GPS. You can select multiple Tracks or Waypoints using the shift and the control keys.



Step 5: When you have selected the desired **Waypoints** or **Track Logs** select **OK.**

Map Tech- Terrain Navigator Pro
<u>Uploading Waypoints or Tracks from a GPS to MapTech</u> (Page 1 of 2)

Step 6: You will then be given the option of renaming your track files, appending a current track file or overwriting an existing track file. In most cases select **New**, rename the track file if you want and select **OK.**