

## **Tips for Using a GPS in the Field to Help Locate Approximate Property Corners and Property Lines**

By Joseph Elfelt, December 2013

[PropertyLineMaps.com](http://PropertyLineMaps.com)

These tips were developed using a Garmin Oregon 600 GPS but for the most part will apply to any GPS. To make sure that a Garmin GPS is using the **most recent firmware** you can try this free tool from Garmin: <http://www8.garmin.com/products/webupdater/howtoinstall.jsp>

For other GPS tips related to finding approximate property corners and property lines please visit our [GPS tips page](#).

**Reminder:** The property corner coordinates you receive from us and the online map link are only approximates and do not constitute a land survey. **If you need to know where your property corners and property lines are actually located on the ground, then you must hire a licensed surveyor.**

### **Read this if you received a GPX file from us and need help loading it into your GPS**

Our service produces approximate latitude longitude coordinates for each corner of your land. We use those coordinates to put both waypoints (wpt) and routepoints (rte) into a GPX file. If you have one of our GPX files and open it with Notepad or any text editor, then you can easily see both kinds of points.

If you need help to load the GPX file that we provided to you into your GPS, then see our article: [How To Load a GPX File Into a Garmin GPS](#)

### **How to get the most accurate readings possible from your GPS**

A Garmin GPS can display a data value called “GPS Accuracy”. A smaller number is better. Assume you see a GPS Accuracy reading of 12 feet. That means:

- There is a **50% chance** that the true location of the coordinates displayed by your GPS are within 12 feet of where you are standing.
- There is a **95% chance** that the true location of the coordinates displayed by your GPS are within 24 feet (double the accuracy value) of where you are standing.

You should find out the typical best “GPS Accuracy” value that your GPS is capable of providing under **ideal conditions**. To test the accuracy of your GPS under ideal conditions:

- If your GPS **cannot** receive data from the Russian GLONASS satellites, then use the online tool described below to pick a good day and time of day for this test.  
At the time of this writing the Garmin handheld GPS models with GLONASS capability are the eTrex 20, eTrex 30, Oregon 600, Oregon 650 and 't' versions of those models.
- Go to a large area with no nearby trees, buildings or hills. Any kind of sports field will work fine.
- Make sure that WAAS is on and GLONASS (if you have it) is on.  
Although most GPS satellites appear to always be moving, the three WAAS satellites always appear to be stationary. The WAAS satellites transmit correction data that improves the accuracy of your GPS.
- Hold the GPS away from your body so the GPS antenna has an unobstructed view of the sky.
- Display the satellite screen and (1) **wait** until the GPS finds your position and then (2) **wait some more** until the WAAS correction data is downloaded to your GPS and used to refine your position. How long do you need to wait? Keep reading.

If your GPS does not already have a current almanac then one will have to be downloaded from the satellites and this could take up to 20 minutes.

Each satellite has a unique ID number that is displayed on the satellite screen. Here are the ID numbers for the WAAS satellites and the bearing to each one and the part of the country where each one is usually the easiest for your GPS to see. Since I live near Seattle, my GPS sees WAAS satellite #48.

ID #46	Bearing 98°W	East coast USA
ID #48	Bearing 133°W	West coast USA
ID #51	Bearing 107.3°W	Middle of USA

If you turn your GPS on and the satellite screen **does not** display one of these ID numbers after a few minutes, see if you can move so you have a clear view of the sky on one of these bearings.

If you turn your GPS on and it can see a WAAS satellite then that satellite number will likely be **blinking**. This indicates the WAAS correction data is being downloaded to your GPS. **This may take 1 to 2 minutes**. When this initial WAAS data download is finished, then (1) the ID number for the WAAS satellite will stop blinking and remain on, (2) a **white 'D'** will appear on **several data bars** for various satellites and (3) the GPS accuracy value displayed near the top of the satellite screen should go down - indicating a more accurate position.

For a very useful diagram showing what you see on the satellite screen when your GPS starts up, scroll down to "Signal strength" on this page:

<https://garminoregon6xx.wikispaces.com/Applications+-+Satellite>

On my Garmin Oregon 600 with firmware 3.6, GLONASS 'on', a good view of most of the sky and 6-7 satellites showing a white "D", my GPS accuracy values are in the range 10-15 feet.

If you know your typical best accuracy value and then see a much higher accuracy value when you are looking for property corners, then you can take steps to try and improve the accuracy. These steps can include:

- Make certain that WAAS and GLONASS (if you have it) are both on
- Look at the satellite screen to see if you are still receiving the WAAS correction. If not, then try moving a bit. The satellites that broadcast the WAAS correction data are stationary and maybe a tree is preventing the WAAS data from reaching the antenna in your GPS.
- Hold the GPS so your body is not blocking the GPS antenna. Holding it near your belt buckle is not good.
- Use the online tool described below to come back on a day and at a time when there is a better satellite constellation.

Tip: Assume you obtained a GPS file from us with approximate coordinates for your property corners and your GPS says you are at one of your corners. Also assume your GPS accuracy data field says **50 feet**. Move around that area and see if you can get a better accuracy reading. Maybe you lost the lock on the WAAS satellite due to a tree being in the way. Now assume you are standing at a nearby spot with a GPS accuracy of **12 feet** and your GPS says your approximate property corner is 22 feet away on a bearing of 127 degrees. Get out your compass, set it to 127 degrees and sight on something on that bearing that you can walk towards. Either pace off 22 feet or measure it with a 50 foot tape measure. **That GPS accuracy you achieved of 12 feet should transfer fairly well to this new spot.**

### **Be nice to the GPS antenna**

A GPS only works if its antenna can receive data from the satellites. On an Oregon 6xx the antenna is near the bottom (odd but true) and near the back. If you hold this model by wrapping your hand around the back of the GPS then you would think that at least some of the data being broadcast by the satellites will likely be prevented by your hand from reaching the antenna. However, when I have wrapped my hand around the lower back of my GPS the accuracy value has only gone up a couple of feet. And of course that might have been due to changes in the satellite constellation.

Since it is often not practical to carry the GPS in your hand all the time, you need to put it somewhere. A good solution is to carry a pack and get a small case of some kind that you can attach to your pack strap. Remember - If you have an Oregon 6xx GPS slip it into your case with the screen facing you and the antenna facing away from you.

Now here's an idea. How about slipping your 6xx into that pack-strap case with the screen facing you and upside down! Unfortunately it is not very practical to hold it in your hand upside down since the screen will not rotate so north is 'up' when the GPS is held in this manner.

And if you have a different model of GPS it likely will be worth experimenting a bit by holding it different ways while you watch the “GPS accuracy” value or the satellite screen. With a bit of thoughtful observation you should be able to figure out how to hold the GPS so your hand does not block the antenna and how to orient the GPS for best reception.

### **Pick a good day and good time of day to use your GPS**

If your GPS can accept data from the Russian GLONASS satellites, then this might be a non-issue for you. Currently, Garmin models that can read GLONASS data are the eTrex 20, eTrex 30 and Oregon 6xx plus the ‘t’ versions of these models. Since these GPS models can obtain data from a larger number of satellites, there almost always is a reasonably good constellation of satellites. If you have one of these models and you have turned on the GLONASS feature, then the timing of when you use your GPS is not that important. However, it is still worth your time to read the rest of this section and play with the following online tool a bit so you have a good understanding of this issue.

Simply by picking a **good day** and **good time of day** you can increase the accuracy of your GPS. Doing this costs you nothing. Most of the GPS satellites move around in the sky. Think of this as a constellation that is always changing shape. Some of the constellation shapes result in your GPS having worse accuracy and some result in better accuracy. Several free online tools are available that can predict bad times and good times (i.e. a good satellite constellation) for you to use your GPS. For example, below is a link to a tool produced by Trimble. Since this tool requires Microsoft’s Silverlight plugin I use Internet Explorer to open this tool.

Online tool that predicts good and bad times to use a GPS:

<https://trimble.com/GNSSPlanningOnline/#!/Settings>

Here are some tips for using this tool.

Open the online map link you obtained from us, put the cursor on your property and right click. Copy the latitude and longitude.

When Trimble’s tool opens, the settings screen is displayed. Paste in the latitude and longitude for your land. Pick a day. A interval starting at 8 AM and a time span of 12 hours are good choices. Finally, be sure to set the correct time zone. When you are done making these settings, click “Apply”.

Now go to the “Satellite Library” screen. Check the GPS box. If your GPS has GLONASS then be sure to also check that box (and have GLONASS turned on in your GPS). Make sure the other boxes are not checked.

Now click the DOPs button and a graph will be displayed. The dark brown line is an estimate of the amount of horizontal position error a GPS will have as a result of the satellite constellation shape at different times of the day. If you compare this graph with and without the GLONASS

satellites then you will immediately see that the time of day when you use your GPS is more important if your GPS is not GLONASS capable.

### Compass considerations

Now that you have loaded your GPX file into your GPS, no doubt you are anxious to head outside and start looking for your property corners. However, to make the best use of your time is worth reading through the rest of this article and particularly this section on compass issues.

One of the main things your GPS can do is display the approximate distance and bearing from your location to a property corner you wish to visit. In order to know what direction you need to walk, you need a compass of some kind.

If your GPS has a compass and you decide to use it then (1) you will spend more on batteries, (2) you may need to re-calibrate the compass at inconvenient times and (3) you will not be able to sight along a property line as well as you can with a hand compass that has a mirror.

It is also important to keep in mind the differences between the 2 or 3 **data fields** your GPS can display related to direction. Those differences are shown in the following table:

<b>Data field ==&gt;</b>	<b>Compass heading</b>	<b>Heading</b>	<b>GPS heading</b>
<b>Stand still</b>	Direction the GPS is pointing	Direction the GPS is pointing	n/a
<b>Moving</b>	Direction the GPS is pointing	Direction you are moving	Direction you are moving

If you decide to turn off the compass in your GPS in order to reduce battery consumption, then you need to do two things. **First**, you need to turn the compass off in the compass application. **Second**, you need to make sure that none of the screens that your GPS can display include either the “Compass heading” field or the “Heading” field. **Both of these data fields cause the electronic compass circuitry to be used even if the compass is “off”**. Even if an application such as the “Trip computer” is not presently open on the screen, the “Compass heading” and/or “Heading” field might be using battery power if the “Trip computer” (or any other screen) is configured to display these data fields. By contrast, the “GPS heading” field determines the direction you are moving just by using the satellite data and therefore does not cause a significant increase in battery drain.

If you read our article on setting up as GPS and copied the “Corners” profile we made to a Garmin Oregon 6xx GPS, then your compass is off and none of your screens are configured to display the “Compass heading” and/or “Heading” field.

[https://propertylinemaps.com/p/pdf\\_setup\\_oregon\\_6xx.pdf](https://propertylinemaps.com/p/pdf_setup_oregon_6xx.pdf)

**Important hand compass tip:** If you use a hand compass then it is essential that both the GPS and the hand compass use **true north** or both use **magnetic north**.

Personally, I use true north and that is how the Corners profile is setup. Using true north means that you have to adjust your hand compass for magnetic declination. Do not use the magnetic declination printed on the bottom of maps. Declination changes over time and more than you might think. Instead, look at your property with the **online map link you got from us** and then click Menu ==> Declination On/Off. The magnetic declination for the center of the map is displayed in the lower left corner of the map.

Some hand compasses have a small screw you can turn to ‘dial in’ the declination. This certainly makes life easier. For example, my compass is an earlier model of this one <http://store.silvacompass.com/sighting-ranger-cl>.

If you decide to use magnetic north then here is how to tell a Garmin Oregon 6xx GPS to do so: Compass application ==> 3 bars ==> Setup Heading ==> North Reference ==> Magnetic

If you need help using a compass, a quick **google search** on ‘compass navigation’ will turn up plenty of tutorials.

And since we are talking about compass issues, did you know that the bearings you see on a survey are based on an **artificial north**? If you assume those bearings are based on true north then you are most likely going in the wrong direction by up to several degrees. For more explanation please see [https://propertylinemaps.com/p/plm\\_how\\_it\\_works.html](https://propertylinemaps.com/p/plm_how_it_works.html).

### **Using waypoints to locate property corners and property lines**

The **waypoints** in the GPX file we gave you are named **c1, c2, c3...** . The number in the waypoint name corresponds to the corner number you see when you click the online map link we gave you. You can use those waypoints to navigate to property corners. To do this:

1. Open the “Where to” application
2. Select Waypoints
3. Select one of your corner waypoints
4. Touch “Go” on the map screen

The GPS screen now displays the map with **2 lines** that connect your location to the corner waypoint you selected. The **thick line** is fixed in place and does not move. One end of the **thin line** will move and follow your location as you walk toward the corner waypoint you selected.

Each waypoint in the GPX file you obtained from us is marked with a **red pin**. If you followed the recommendation in our article on how to setup your GPS, then the map screen also shows the bearing (true north) and distance to the corner waypoint you selected.

Use your compass (manual or electronic) to sight along that bearing, pick out a landmark and walk toward it. Repeat as necessary until you reach the next corner waypoint.

### **Using a route to locate property corners and property lines**

Be sure your GPS is using the latest firmware. Garmin has made some changes in the firmware for how routes are handled on the Oregon 6xx models and I expect they will make additional changes. Here are two sites that track firmware changes:

Oregon 6xx: <https://garminoregon6xx.wikispaces.com/Firmware>

eTrex 20/30: <http://garmin-etrex.wikispaces.com/firmware>

The GPX file we gave you has a **route point** at each property corner. These route points are named c1, c2, c3. In other words, your GPX file has both a waypoint and route point at each property corner. The firmware in your GPS does different things with these two different types of points.

The route in your GPX file is named “001 Property Line Map”. To make the route ‘active’, do “Where to” and select this route. When the route appears on the screen, touch “Go”. The screen will refresh and the entire route will be displayed with a **blue pin** at each route point (i.e. property corner). The complete route represents the approximate property lines for this land.

**Note:** Some versions of the GPS firmware will assume you want to start by visiting route point c2 and draw a **thin line** that always connects your location to route point c2 as you move around. If you setup your GPS as I recommend then the map screen will show the distance and bearing to that property corner.

**Option 1:** Before leaving home, make a printout of your GPX file and take that printout with you. (A GPX file is a text file. You can open and print it with Notepad.) Make the route ‘active’ as described above. Walk until you get close to a corner you want to visit. Zoom in on the GPS screen and keep moving until the marker showing your location is at the blue pin that marks the corner. To fine tune your location display the “Trip computer”. If you are using the current “Corners” profile then the top of that screen displays the coordinates for your location in a large font. Now move a bit more until you can make those displayed coordinates as close as possible to the coordinates for that corner on the GPX file you printed. Remember that latitude changes as you go north-south and longitude changes as you go east-west.

**Option 2:** Make the route ‘active’ as described above. Open the “Active route” application and select the route point you want to visit next. Now go back to the map screen. The GPS screen now displays the map with **2 lines** that connect your location to the corner route point you selected. The **thick line** is fixed in place and does not move. One end of the **thin line** will move and follow your location as you walk toward the corner route point you selected. If you followed the recommendation in our article on how to setup your GPS, then the map screen also shows the bearing (true north) and distance to the corner route point you selected.

**Note:** There is one thing a bit odd with option 2. Let’s say you used the “Active route” application and selected route point c3. The lines connecting c1-c2 and c2-c3 disappear from the

map. In other words, all of the route lines prior to the routepoint you select will disappear from the map. If you then use the “Active route” application and select routepoint c1, then all the route lines around the property reappear on the map.

### **Understanding the “Off course” data field**

The instructions below show how to use the “Off course” data field to tell how far away you are from your approximate property line as you walk toward your next property corner. If you read our article on setting up as GPS and copied the “Corners” profile we made to a Garmin Oregon 6xx GPS, then the “Off course” data field is displayed on the map screen and trip computer screen.

[https://propertylinemaps.com/p/pdf\\_setup\\_oregon\\_6xx.pdf](https://propertylinemaps.com/p/pdf_setup_oregon_6xx.pdf)

**Here is the trick.** In order for “Off course” to work in this manner, you have to be **standing at one of your property corners**. Then use either (1) “Where to” and pick a waypoint or (2) “Active route” and pick a routepoint. The waypoint/routepoint you pick has to be an **adjoining** one along your property boundary. As you then walk toward the next corner, “Off course” will show how far away you are from the **thick line** that connects the corner you just left to the adjoining corner you selected.

When you pick a waypoint or routepoint as described above then you will see two lines on the GPS screen. (It looks like one line at first.) The thick line connects the **location you were at** when you picked the next point and the point you picked. If you were standing at a property corner and picked an adjoining property corner, then the thick line represents your approximate property line between those two corners. The “Off course” value is the distance between your current location and the closest point on the thick line. The second line is thin and will follow your location as you move around.

If you want to walk along close to your property line then (1) follow the above instructions and (2) walk in a direction that keeps the “Off course” value close to 0.

**Reminder:** The corner coordinates we provide are only approximate and are not exact. There is a certain amount of error in those coordinates. Likewise, a consumer GPS also has a certain amount of error. Even if you carefully follow all of the above instructions and your GPS shows an “Off course” value of 0, all you really know is that your property line is somewhere in the vicinity. **If you need to actually locate your property lines on the ground then you need to hire a licensed surveyor.**

**Note:** I have recommended to Garmin that they add a feature to the GPS firmware that (1) will allow all of the route ‘legs’ (i.e. property lines) to remain on the screen and (2) a data field that will always display the shortest distance to the active route ‘leg’ no matter where you are when you select the next routepoint to visit. My 10+ year old Magellan GPS has this feature.

## **Final tips**

For many years now surveyors have marked property corners by pounding a length of rebar into the ground and placing a plastic cap on the top of the rebar. As time goes by, these rebar stakes often get 'lost' as property changes hands and vegetation grows. If you are using the approximate corner coordinates we produce to help find lost rebar, then consider taking along a digging tool (I carry a sturdy garden trowel) and a metal detector. Our coordinates will get you close to the corner. Then use the metal detector to look for the rebar. Once the metal detector beeps you might need to dig a bit to uncover the top of the survey rebar.

You might also want to take along some weather resistant flagging tape or some other way to mark the location of the survey stake you just found and thus preserve your hard work. Once upon a time, deep in the bush of the Upper Peninsula of Michigan, I found a survey stake on property I owned. Once my GPS got me close to the corner, that rebar stake was easy to find since a prior owner had marked it by sliding a beer bottle over the top of the rebar. Gotta love low tech.