GPS APPS REFERENCED FOR WOODS MANAGEMENT VOLUNTEERS

Location Services must be turned on in order for any cell phone GPS app to operate.

You may be tempted to use the Compass app that came with your iPhone or Smart Phone. Don't rely on that for GPS coordinates; there are better apps that use the GPS capability in your phone, but give more useful results, and we will recommend a few.

COMPASS: The free Compass app that comes with the iPhone gives GPS coordinates but is crude and "not recommended to determine precise location" (see below) and the compass direction is easily knocked out of calibration by nearby electronic devices. However, in so much as any compass, together with the provided topo map, can help the volunteer navigate to the adopted site, this cell phone app can be useful if volunteer does not have a regular compass.

Compass at a glance

Find a direction, see your latitude and longitude, find level, or match a slope.

See your location. To see your current location, go to Settings > Privacy > Location Services and turn on Location Services and Compass. For more about Location Services, see Privacy on page 41.

Stay on course. Tap the screen to lock in the current heading, then watch for a red band to see if you're off course.

Important: The accuracy of the compass can be affected by magnetic or environmental interference; even the magnets in the iPhone earbuds can cause a deviation. Use the digital compass only for basic navigation assistance. Don't rely on it to determine precise location, proximity, distance, or direction.

Bear in mind that at the equator, an arc-second of longitude equals approximately one arc-second of latitude, which is 1/60th of a nautical mile (101.27 feet). Thus, a latitude or longitude coordinate readout that gives no decimal digit is giving you a reading in increments of 101.27 feet. Think of it this way: even if your cell phone's GSP knew your location with perfect accuracy, it could only tell you that answer within +/- 50.6 feet, unless it gave it to you with decimal place figure. Since cell phone GPS accuracy is typically no better than +/- 30 feet to start with, you need to use an app that gives the "seconds" with a decimal place increment.

NavClock for iPhone or iPad: $0.99 We tested this one and we recommend it. It's read-out has sufficiently high resolution (10$^{\text{ths}}$ of arc seconds, or roughly 10-foot increments). See pasted image to the side. It also has a "constant-update" mode that allows you to see changes in the latitude and longitude coordinates as you walk along, rather than having to stand still and repeatedly hit the "refresh" arrow (in the lower corner). For the best reading with this cheap app, stand still for a moment, take mental note of varying decimal digit, and average in your head. For a few bucks more you can get an app that gives an "accurate" read (see below), but all it does is do that averaging for you—not really needed for our purpose. The constant update mode eats battery life, though, so you won't want to leave it on for long. Also, if you hold your finger on the coordinates, you can readily copy and paste the coordinates into another app, if you like. See also link below:

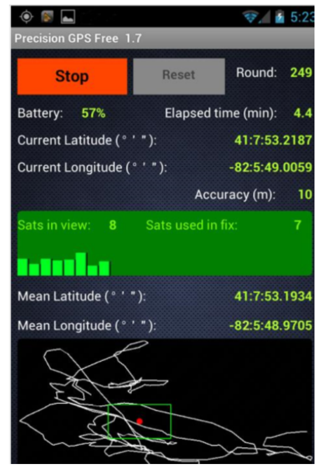
http://www.macobserver.com/tmo/article/how-to-display-and-locate-gps-coordinates-with-iphone1

For Android phones, NavClock is available for $1.99:
http://www.ollapp.com/app/nav-clock/android

Here is another Android GPS App (*Android apps not yet tested by the FMC for our purpose*):

http://m.downloadatoz.com/apps/com.sciencewithandroid.precisiongpsfree,110526.html

Precision GPS Free App for Android:



Precision GPS Free Description from Publisher:

> 'Precision GPS Free' uses your device's GPS sensor to measure your location more accurately than is possible with typical GPS apps. Turn your phone or tablet into a precision GPS instrument.
>
> Normally, software on your Android device determines your location from individual GPS readings. This is fine if your are interested in getting your location to within about 10 meters. However, it is possible to do better than this if you average many readings at a particular location.
>
> This app is designed to do just that -- average many readings of a stationary Android device to get a more accurate location; it actually calculates a weighted average, accounting for the accuracy of each reading. The trade-off is time. You will need to wait a least a few minutes to get a high accuracy average location.

Additional Links for Cell Phone Apps:

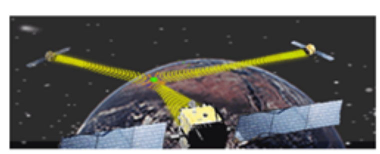
http://en.softonic.com/s/gps-software-free-download:android

http://sectionhiker.com/reader-poll-gps-device-or-smartphone-app-navigation/

http://www.iphonefaq.org/archives/971696

http://lifehacker.com/5870515/the-best-turn-by-turn-navigation-app-for-android

Future Promise: High accuracy GPS is available (see last section below), but are currently not cheap, and not yet accessible by the ubiquitous cell phone. Someday, soon perhaps, cheap and highly accurate consumer GPS will become available so that we will be able to download an app form our BRCA website that can actually show you the boundaries of your adopted plot in the woods *and where you are relative to the plot boundaries*. (See http://developer.android.com/training/location/geofencing.html) Until then, we must work with inherent inaccuracies of what is cheap and available.



Fun Fact: In order to work, satellite navigation systems must take into account the curvature of space. In the (Euclidian) geometry that we all learned in grade school, the three angles of a triangle must add up to exactly 180 degrees. But in reality, due to the curvature of space under the influence of the mass of the earth, the angles of a large triangle relating geo-positioning satellites can add up to as much as 180.0000002 degrees. Sounds like not much, but if GPS systems didn't correct for the relativistic curvature of space, we'd be driving off cliffs in no time.

Science History: Here is a gem of a book on how mariners came to measure longitude in 18th century: Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time, Dava Sobel http://www.amazon.com/Longitude-Genius-Greatest-Scientific-Problem/dp/080271529X

Additional GPS Info:

http://water.usgs.gov/osw/gps/

http://www.gps.gov/applications/survey/

http://www.oc.nps.edu/oc2902w/gps/gpsacc.html

http://www.oc.nps.edu/oc2902w/gps/accfact.html

https://www.e-education.psu.edu/natureofgeoinfo/book/export/html/1620

Excerpt: The U.S. Federal Aviation Administration (FAA) estimated in 2006 that some 500,000 GPS receivers are in use for many applications, including surveying, transportation, precision farming, geophysics, and recreation, not to mention military navigation. This was before in-car GPS navigation gadgets emerged as one of the most popular consumer electronic gifts during the 2007 holiday season in North America.

Basic consumer-grade GPS receivers, like the rather old-fashioned one shown below, consist of a radio receiver and internal antenna, a digital clock, some sort of graphic and push-button user interface, a computer chip to perform calculations, memory to store waypoints, jacks to connect an external antenna or download data to a computer, and flashlight batteries for power. The radio receiver in the unit shown below includes 12 channels to receive signal from multiple satellites simultaneously.

Figure 5.17.1 Recreation-grade GPS receiver, circa 1998.

NAVSTAR Block II satellites broadcast at two frequencies, 1575.42 MHz (L1) and 1227.6 MHz (L2). (For sake of comparison, FM radio stations broadcast in the band of 88 to 108 MHz.) Only L1 was intended for civilian use. Single-frequency receivers produce horizontal coordinates at an accuracy of about three to seven meters (or about 10 to 20 feet) at a cost of about $100. Some units allow users to improve accuracy by filtering out errors identified by nearby stationary receivers, a post-process called "differential correction." $300-500 single-frequency units that can also receive corrected L1 signals from the U.S. Federal Aviation Administration's Wide Area

Augmentation System (WAAS) network of ground stations and satellites can perform differential correction in "real-time." Differentially-corrected coordinates produced by single-frequency receivers can be as accurate as one to three meters (about 3 to 10 feet).

The signal broadcast at the L2 frequency is encrypted for military use only. Clever GPS receiver makers soon figured out, however, how to make dual-frequency models that can measure slight differences in arrival times of the two signals (these are called "carrier phase differential" receivers). Such differences can be used to exploit the L2 frequency to improve accuracy without decoding the encrypted military signal. Survey-grade carrier-phase receivers able to perform real-time kinematic (RTK) differential correction can produce horizontal coordinates at sub-meter accuracy at a cost of $1000 to $2000. No wonder GPS has replaced electro-optical instruments for many land surveying tasks.