

Sampling design and preparation

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Operating a basic handheld Global Positioning System unit for an investigation or compliance inspection

1 Purpose and scope

This document describes the method for sound locational data collection using a basic handheld Global Positioning System (GPS) unit for an investigation or compliance inspection. It does not provide details for using a differential or relative positioning GPS.

GPS is the United States of America (USA) system of global positioning and is the most commonly used way of describing positioning systems. However, in reality a number of positioning systems are now used such as GLONASS (Russian satellite system) and Galileo (European satellite system) and the more appropriate term is Global Navigation Satellite System (GNSS). In this document the term GPS is used to encompass all systems, not just the USA global positioning system.

2 Associated documents

Sampling design and preparation: Background information on the Global Positioning System and handheld units

3 Health and safety

Before following the methods contained in this document, a detailed risk management process (identification, assessment, control and review of the hazards and risks) must be undertaken. All work carried out must comply with the Queensland Work Health and Safety legislative obligations.

4 Permits and approvals

No permit is required to carry out the procedures within this document.

5 Skills, training and experience

No skills, training or experience is required to conduct the procedure within this section.

6 Equipment

Equipment should include:

- handheld GPS unit or a smart phone, iPad or tablet as a primary device if it has been set up appropriately (e.g. with specific software to record positions)
- a smart phone, iPad and tablet may be used as a secondary device to confirm readings
- GPS device manual.

7 Procedure

7.1 Prior to undertaking fieldwork

7.1.1 Pre-field trip check of GPS

1. Check the GPS settings to ensure standard settings are used. Recommended settings are outlined in Table 1. Record settings in your notebook.
2. Check the time and date on the GPS against your computer or smartphone.
3. Make sure GPS unit has sufficient memory for all new waypoints and tracks.

Note:

- It is good practice to regularly synchronise your smartphone clock with broadcast time services on TV or radio. If time is critical to your observations use a designated time service such as the VNG radio service (http://tufi.alphalink.com.au/time/nsc_vng_leaflet.pdf).
- If using points in open water it is recommended that two GPS units are used to confirm the readings as there are no land marks to check positions against. Use a smart phone or tablet with GPS as a third method of checking position if both handheld GPS units show coordinates that are significantly different to each other.

Table 1: GPS unit settings

Setting with options	Select option
Units	Metric
Datum	GDA 94 (Geodetic Datum of Australia)
Location Format	UTM UPS
North Reference	True

7.1.2 Pre-field 'calibration' of GPS

1. Find a datum permanent survey mark that is accessible both before and after sampling, preferably close to the investigation area. Permanent survey marks (PSM) in the area of interest can be located using the Google Earth™ and Queensland Globe (<https://data.qld.gov.au/maps-geospatial/qld-globe>). Load the Location Globe to find details of PSM in the area. Download the survey control report (SCR) for the PSM to be used by clicking on the PSM in the globe.
2. Go to the permanent survey mark, turn GPS on and place GPS next to the survey mark.
3. Turn on the GPS and allow time for the GPS to initialise.
4. Ensure that the GPS is set to calculate 3D positions, and that enough time has elapsed for the GPS to acquire enough satellites to provide a 3D position.
5. Take a photo showing both the permanent survey mark and the GPS next to it (Figure 1).
6. Take a photo of the GPS's serial number with the permanent survey mark.
7. Record the:
 - date, time and location (e.g. street and town) of the calibration
 - PSM number
 - GPS reading
 - GPS serial number or make and model of the GPS
 - the uncertainty reading on the screen.
8. Note that photos were taken.

9. If working in pairs, note the name of the corroborator who also witnessed the testing process.
10. Compare GPS reading to the coordinates in the SCR for the PSM being used. Check that the difference between the coordinates on the GPS and coordinates of the survey mark are within the accuracy defined for the GPS unit in the user manual for that unit. An example is given below (Example 1).

Note: Having UTM UPS selected as the location format on the GPS makes this comparison easier, as each easting or northing equates to meters (e.g. 503993.422 m E is 2 m from 503995.422 m E). If using latitude and longitude, record values to the nearest point of a second (i.e. 27° 29' 42.6" and 153° 01' 47.7").



Figure 1: GPS next to permanent survey mark 55309

Example 1: Comparison between GPS and survey control report (SCR) for the permanent survey mark (PSM)

- The SCR states the PSM is at:
56 J 503993.422 m E / 6958558.367 m N
- The GPS manual states the accuracy of the GPS is to 10m.
- Therefore the GPS can be within a radius of 10m of the SCR coordinates.

7.1.3 Reference points

When investigating a remote site that may be difficult to return to, it is advisable to collect GPS location data at permanent landmarks that are visible on remotely sensed imagery in the area of investigation to allow remotely sensed imagery to be georeferenced after the field inspection has been completed.

Prior to undertaking the investigation, use remote imagery (such as recent aerial photographs or Google Earth™) to select approximately 10 reference points evenly spread over the investigation area. Not all 10 points need to be surveyed, but it is recommended 10 are chosen initially in case it is not possible to access all points.

Ideally five reference points will be recorded during a field inspection. The reference points need to be:

- permanent (not mobile)
- in a clear area
- not underneath high voltage power lines
- where two obvious features meet, e.g. where two roads cross, where a road crosses a creek at a bridge, where two fenced boundaries meet (intersections of fences also serve to provide a control linkage to the cadastre and may be used to upgrade the accuracy of the DCDB if property boundary definition is important to your study)
- clearly identified on the remote imagery (aerial photograph or Google Earth™ image).

These localities and their GPS reference locality should be described in a field notebook so that they can be recalled later.

7.2 Undertaking fieldwork

7.2.1 Reference points

1. If reference points are to be collected, take a GPS reading at each of the reference points prior to attending the investigation site using the method in Section 7.1.3.
2. After leaving the investigation site, repeat readings (if possible) to obtain a duplicate reading at each reference point.

7.2.2 Recording coordinates

1. Upon reaching the site, where possible choose a location where the sky can clearly be seen to take the reading.
2. Satellite signals can be weakened by vegetation cover, water bodies, metal surfaces (e.g. vehicles), glass (including vehicle windscreens), buildings and similar objects. Hold the GPS away from your body.
3. Ensure the reading is not taken underneath high voltage power lines as power lines create magnetic fields and can cause destructive interference to satellite signals passing through the magnetic field.
4. Hold GPS stationary for at least 30 seconds. Before taking readings, ensure that the GPS is able to calculate a 3D position. It is recommended that you do not collect 2D positions because of the problem encountered with the altitude measurement. When you set the receiver to calculate 2D positions, you are replacing one satellite measurement (altitude) with a fixed measurement. If this altitude is incorrect, the latitude and longitude will also be incorrect.
5. It is recommended that the coordinates in the GPS unit are saved as a waypoint. Name the waypoint appropriately so it can be identified later and use this same name in the field notes.
6. Record the coordinates of this site in the field notebook and/or take photo of coordinates on the screen. Record relevant features in a notebook.
7. Take photographs of the site as a visual confirmation of the site and record photo directions in a field notebook. It is recommended that they are taken in:
 - four directions - downstream, right shore, upstream, left shore are photographed if surveying an aquatic environment (rotating in a clockwise direction)
 - eight directions - N, NE, E, SE, S, SW, W, NW, so that photographs all have side-lap and can be joined in a panorama of the site for terrestrial systems.. Always include a hat/person/bag in the first photo (north) and always rotate in a clockwise direction looking down at your point.
8. It is recommended that you turn your GPS unit off and on again, cross check the GPS readings against a secondary unit. It may be useful to intermittently cross check with a secondary unit throughout the day.

Note: Many GPS units include an electronic compass. In some GPS models the compass reading is only accurate whilst you are moving. When stationary, and if you change your orientation (direction), the GPS unit compass may not reflect a correct directional reading until you begin to move again.

7.2.3 Post-field 'calibration' of GPS

1. Before returning to the office, go back to the permanent survey mark used in the original pre-field 'calibration'
2. Follow steps outlined in section 7.1.2.

7.3 Upon return to the office

7.3.1 Data handling

1. Download waypoints and track log files from the GPS unit and store securely as an unaltered clearly labelled master copy. Preferably on CD or DVD.
2. Create a working copy for use in GIS applications.