

## Basic Receiver Operation

Like all electronic devices, GPS receivers come in many makes and models. While each may be slightly different in their design, the basic function of a GPS receiver remains the same and thus they all have similar features.

All receivers, whether a dedicated unit or integrated into a personal mobile device, contain an antenna. The antenna is usually in the top of each device and must have a clear view of the sky to work correctly. Because of this, the first step in using a GPS receiver is to go outside to a clear area before turning it on.

Once the receiver has started up, it will begin searching for satellites. When four or more satellites have been detected, the receiver will provide you with a position. This process often takes between one and two minutes to complete, but can sometimes be quicker.

## Satellite Visibility

All GPS receivers contain some form of satellite visibility display. Some receivers provide a signal strength indicator for each satellite being tracked, while some mobile apps will combine this into one 'signal' bar. This feature is useful for determining whether your view of the sky is clear enough, or whether you need to move to a different area. An estimation of the receiver's accuracy can often be found on the same page, often being quite poor when the receiver first starts up and improving as more satellites are tracked.

## Tracks and Waypoints

Tracks and Waypoints provide a way of recording where you've been and navigating to specific locations of interest. The 'track' feature on most GPS receivers acts like a digital trail of breadcrumbs, recording where the GPS has moved over time. Some receivers create tracks automatically, while others require you to manually record and save tracks. The track feature is particularly useful if you want to map a continuous feature such as a foreshore, property boundary or road, as you can import the track into various mapping programs as a continuous line. Tracks can also be useful if you want to retrace your previous steps with a GPS receiver, as you can see your current location relative to the previous track as you move along.

Waypoints on the other hand are used for marking individual points or features of interest, allowing you to save and return (i.e. navigate) to their location at a later stage. This feature is useful for recording the location of individual items (such as a home, school or shop), rather than continuous features (it's better to use tracks for these). Waypoints can be exported later on to show specific features on maps. Similarly, waypoints can be made on a computer and transferred onto a GPS receiver as well, allowing you to find your way to places you've never even visited before!

### FAST FACTS



1. While there are different makes and models of GPS receiver, their basic function is the same.
2. The antenna must have a clear view of the sky.
3. Four satellites are required to get a position; this can take one to two minutes.
4. 'Waypoints' can be used to mark individual points of interest, while 'tracks' can be used to map continuous boundaries or paths.
5. Each type of GPS receiver stores information in a slightly different format, and may need to be converted before it can be used for other things (e.g. making maps).

## Compass

Most GPS receivers also have a compass to show you where north is. In the majority of older receivers, the user must be moving for the compass feature to work correctly. More modern receivers have a dedicated compass that allows them to point to north even if you're standing still. To determine if your receiver has a dedicated compass, simply rotate the physical receiver while standing still. If the compass direction continues to point (roughly) towards north while rotating, your receiver has a dedicated compass. If the direction doesn't update, you're probably using an older receiver.

When using the compass feature on your GPS, it's important to check the compass settings. Most GPS receivers can be set to point towards 'True North' or 'Magnetic North'. While the difference between these two versions of North is beyond the scope of this exercise, it is important to realise that there is a small difference between the two, which varies depending on your location on the earth. Traditional handheld compasses all point towards Magnetic North, and unless your GPS is set to point towards Magnetic North as well, the resulting directions may be slightly different.

## GPS File Formats

When saving tracks or waypoints on your GPS receiver, they are saved in a specific file format that your GPS can understand. Each type of GPS receiver uses a different format, so when you export this information onto a computer, it often needs to be converted so your mapping software can read it. Google Earth can read files in 'KML' and 'KMZ' format only. If your GPS receiver doesn't store its information in this format, you may have to convert it using an online utility such as the 'GPS Visualizer GPS Data Converter' (see <http://goo.gl/VoUeZy>) or an application such as GPS Utility (<http://goo.gl/qcsjmE>). Once converted, you can open your files for viewing and plotting inside Google Earth.

## Further Information

For more detailed information, refer to the user manual of your specific GPS receiver or check out the following resources:

### GPS Receiver Tutorials

- A step-by-step guide to using a Garmin eTrex GPS Receiver (see additional handout).
- Quick start guide for the 'MotionX-GPS' app for iOS devices (see <http://goo.gl/7euDCV>).
- Getting started guide for the 'GPS Essentials' app for Android devices (see <http://goo.gl/3fqXNF>).

### GPS Data Transfer Tutorials

- Transferring GPS data with 'Easy GPS' (see additional handout).

### Google Earth Tutorials

- Inserting placemarks in Google Earth (see additional handout).
- Organising files and folders inside Google Earth (see additional handout).

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## Worksheet 2 – Part 1 (GPS Practical)

**Instructions:** Refer to your GPS receiver's user manual and the 'Basic Receiver Operation' guide to complete the following exercise. If you are using a mobile device for this activity (e.g. phone or tablet), the MotionX-GPS (iOS) or GPS Essentials (Android) apps are recommended.

1. Head to a clear area and turn on the GPS receiver or open the GPS app on your mobile device. Find the signal strength indicator and describe the signal strength at your location. What happens if you cover the receiver with your hand? Does your GPS display its accuracy? If so, does it decrease?

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2. With the receiver uncovered, walk until you're up against a building or other large object. What happens to the satellite signal now? Why?

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3. Find a long, straight-line feature (at least 100 m in length, e.g. the edge of a soccer pitch) and note its distance and bearing using a tape measure and traditional compass.

Distance: \_\_\_\_\_

Bearing: \_\_\_\_\_

4. Using your GPS app or receiver, start recording a track and walk along the edge of the straight-line feature. Once finished, save your track with a relevant name for use in Part 2.

5. Swap to the page that displays your speed. Walk along the same straight-line feature and note your average speed below.

Average Walking Speed: \_\_\_\_\_

6. Using a stopwatch, time how long it takes you (in seconds) to walk along the length of the straight line feature. Using this information, manually calculate your speed (in km/h) using the formula on the right. How does it compare with the average walking speed from Question 5?

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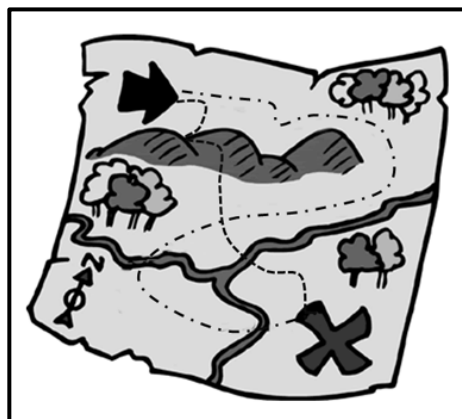
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$$Speed (km/h) = \frac{Distance (m)}{Time (s)} * 3.6$$

7. Split into groups of three or more people and find the waypoint function on your GPS receiver. Get one member of your group to go off and secretly mark a waypoint at a significant feature (e.g. the door to the science building, the swings in the playground or the goal post on the oval), but be sure not to tell the rest of your team what's been marked!

Once complete, get the remaining team members to use the GPS receiver to navigate to the secret waypoint. Repeat this process for each member of the team, so everybody has a chance to mark a waypoint.

Was your team able to accurately identify each of the secret features? Were the GPS directions reliable? Why/why not?




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8. Choose an identifiable feature with a clear sky view (e.g. edges of an oval, the shoreline along a beach or the edge of some bushland) that you would like to map. Trace out the boundaries of your chosen feature by recording a track on your GPS receiver and walking along the boundary. Be sure to save your track with a relevant name on completion, as it will be needed in Part 2.

## Worksheet 2 – Part 2 (Data Transfer and Mapping)

9. Download the two GPS tracks from Question 4 and Question 8 and the waypoints from Question 7 onto your computer. A cable will be required for most traditional GPS receivers, while most GPS apps provide a 'share' or 'export via email' function (see the information sheet for further details). Ensure your file is in 'kmz' or 'kml' format (if not, you will have to convert it – see the information sheet for further details).
10. Open Google Earth and load the track from Question 4. Measure the distance of the track using the 'Ruler' tool. How does it compare to the distance you measured with a tape in Question 3? Is it longer or shorter than the taped distance? Why?

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11. The table below lists several scenarios that require distance to be measured. For each scenario, tick whether you would use A) a 30m tape or B) a GPS to complete each task. Keep in mind the accuracy and practicality of each technique as it applies to each scenario.

Scenario	30m Tape	GPS
Setting out a 5m x 5m square on the oval		
Measuring the length of a runway		

Measuring the distance covered after running for 5 minutes		
Measuring the perimeter of a basketball court		
Measuring the distance travelled down a highway in a car		
Setting out a 100m running track		
Measuring the length and width of a large paddock		

12. Compute the bearing of the track in Question 4 using the 'Ruler' tool. How does it compare to the bearing you measured with a compass in Question 3? Is it larger or smaller than the compass bearing? Why?

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13. In Google Earth, load the track you saved from Question 8 and zoom in on it. Does the track accurately portray the feature you mapped? Describe any differences and explain why they exist.

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14. In Google Earth, load the waypoints you saved from Part 7 and zoom in on them. Right click on each waypoint and select 'Properties'. Change the name and marker icon to something more appropriate, and complete a detailed description for each feature that you've marked. Be sure to include details like name of the feature, construction material, what it is used for, how many students it can accommodate etc. Make a note your three waypoints below.

Waypoint 1: \_\_\_\_\_

Waypoint 2: \_\_\_\_\_

Waypoint 3: \_\_\_\_\_

15. How accurate are the positions of each waypoint compared to their actual location on the imagery? (Hint: Use the 'Ruler' tool to determine their accuracy). What causes the difference between the actual location and GPS location? You can adjust the position to the correct location in Google Earth when viewing the 'Properties' window for each waypoint by simply dragging the marker.

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## The Garmin® eTrex® H GPS

### Step 1: eTrex H Description and Buttons

Buttons on the GPS are:

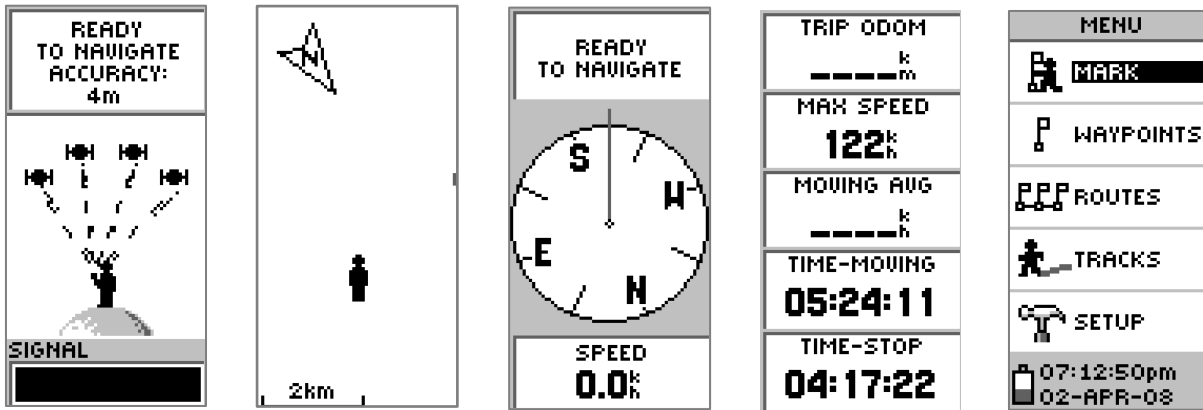
1. A prolonged press of the **POWER** button will start the GPS. Keep in mind that the GPS requires a clear skyview (even if cloudy) to work well. Stay clear of tall buildings, trees or similar that might block your (and therefore the GPS's) view of the sky.
2. The **PAGE** button allows you to scroll through the five main **PAGES** on the GPS.
3. The **UP/DOWN** button allows you to scroll to certain features on any of the five menu pages (such as waypoints).
4. The **ENTER** button is used to confirm menu selection and data (waypoint) entry.



### Step 2: Getting Started and Tracking Satellites

Press the **POWER** button to switch the GPS on, and then wait a few minutes. The GPS will tell you when it is '**Ready to Navigate**'. It will also give you an indication of the horizontal accuracy of the unit. This means that the point you mark may be within a radius of 4-8m (typically) from where you are standing. However, this varies with the constellation of the satellites in the sky and changes all the time.

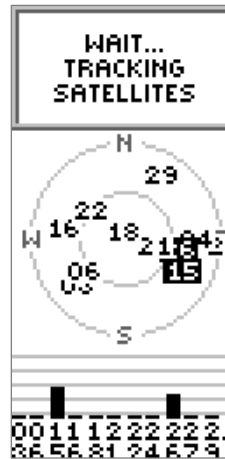
The Garmin eTrex H has five (5) main windows or **PAGES** (see below). Using the **PAGE** button (top right hand side of the GPS) allows you to scroll through those pages.



For a GPS receiver to work, it must receive at least four (4) satellites. There are two (2) ways of viewing if the GPS receiver has acquired enough satellites. They are Normal Skyview and Advanced Skyview:



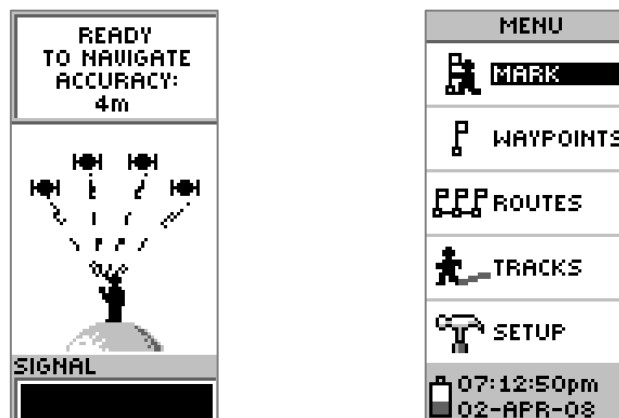
Normal Skyview



Advanced Skyview

To change the **VIEW** option, scroll through the **PAGES** until you get one (1) of the above views. Depress the **ENTER** button, toggle to the desired view (using the UP/DOWN buttons) and press **ENTER**.

**Step 3: Selecting a GPS Page**

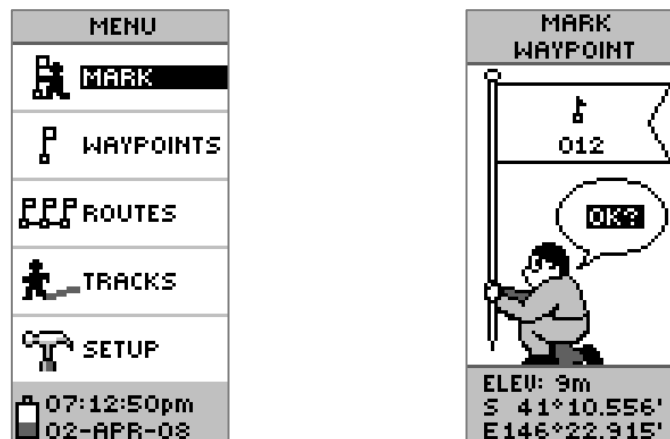


You will normally use two of the five pages: the main **SATELLITE** page and the **MENU** page. The **SATELLITE** page is the first page that appears after the unit has been switched on, the **MENU** page is the page we use most of the time. Press the **PAGE** button until you get to the **MENU** page.

**PLEASE NOTE:** If you get lost in one of the menus when using the GPS, simply press the **PAGE** button once or several times. This will take you back to one of the main **PAGE**'s.

The **MENU** page is typically used for marking a **WAYPOINT**. A **WAYPOINT** is quite often actually the point where you are standing right at that moment.

#### Step 4: Marking a Waypoint



Whilst on the **MENU** Page, ensure the **MARK** feature is highlighted. Press **ENTER**. You should see a man with a number on a flag. The number that appears on the flag is the waypoint identification number. Press **ENTER** to **SAVE** this **WAYPOINT**. If you **DO NOT** want to save the point, press the **PAGE** button.

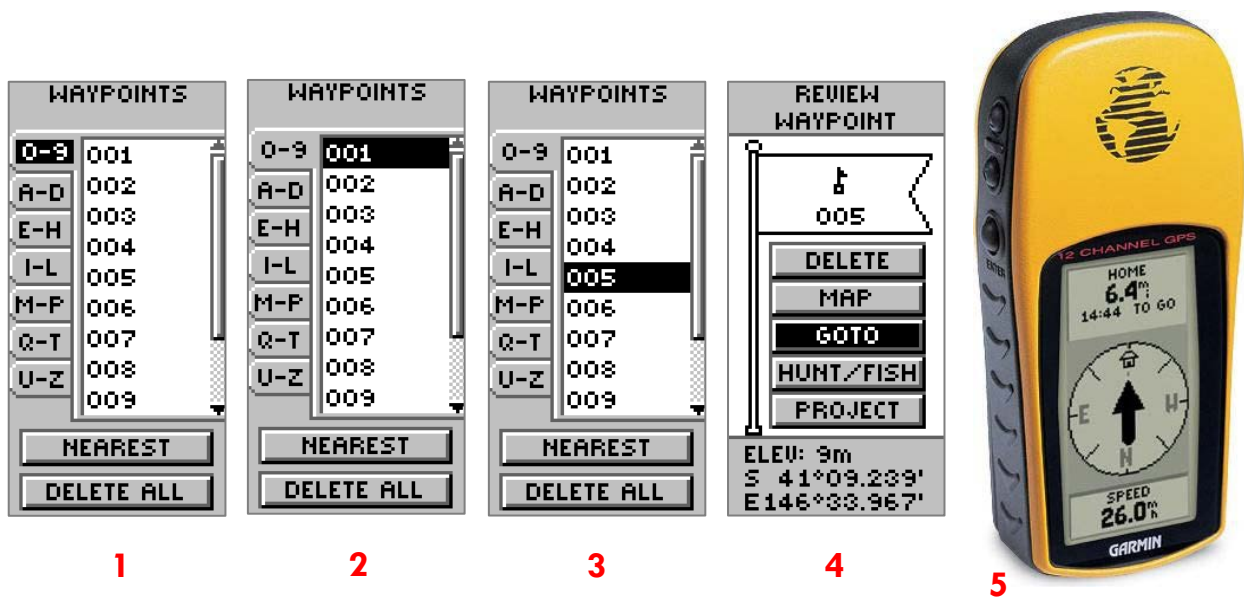
#### Step 5: Going to a Waypoint

Press the **PAGE** button until you get to the **MENU** page. Use the **DOWN** button to get to **WAYPOINTS**. Press **ENTER**.



**Selecting a waypoint:**

1. If the waypoint is identified as a number, then scroll until the cursor is on the **0-9** tab.
2. Press **ENTER** (this will swap the cursor to the right hand side of the screen).
3. Use the **UP/DOWN** buttons (if necessary) to navigate to your numbered waypoint. Press **ENTER**.
4. The **GOTO** Page should appear and the word **GOTO** should be highlighted (if not, toggle up or down).
5. Press **ENTER** and the GPS will tell you how far away you are from your waypoint and will give you directions how to get there.



**Please note** that you need to move around for a few metres before the compass arrow will settle and reliably point in the direction of the waypoint.

**Step 6: Using the GPS in the dark**

When using the GPS in the dark, a backlight can be switched on. Give the **POWER** button a quick 'dab' and the backlight should switch on.

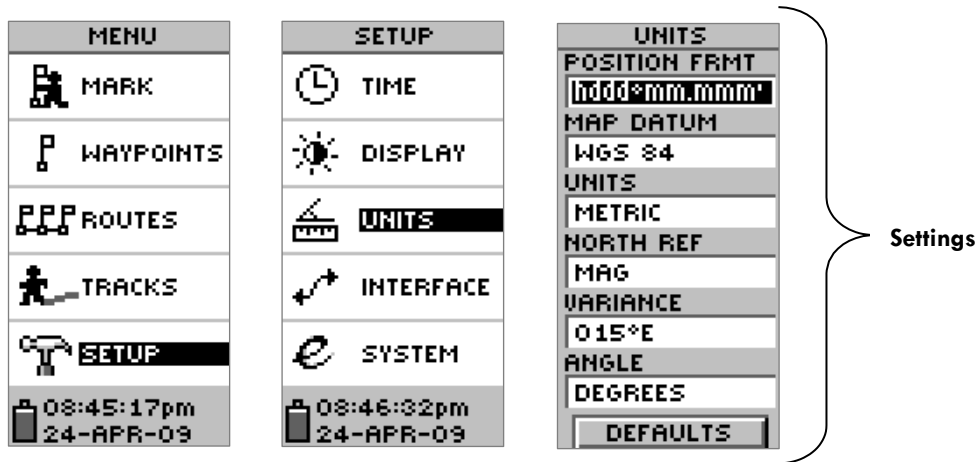
**Please note** that the battery consumption is GREATLY increased by the use of the backlight. This should be taken into consideration as you may find the GPS will stop working due to low battery levels. This could mean that navigation back to base/camp/home etc. may be without the aid of GPS!

**Step 7: Checking the reference or Datum for the GPS.**

The eTrex H allows you to specify a reference grid for your data points. This is called a Datum. The default Datum can be set/checked by the following process:

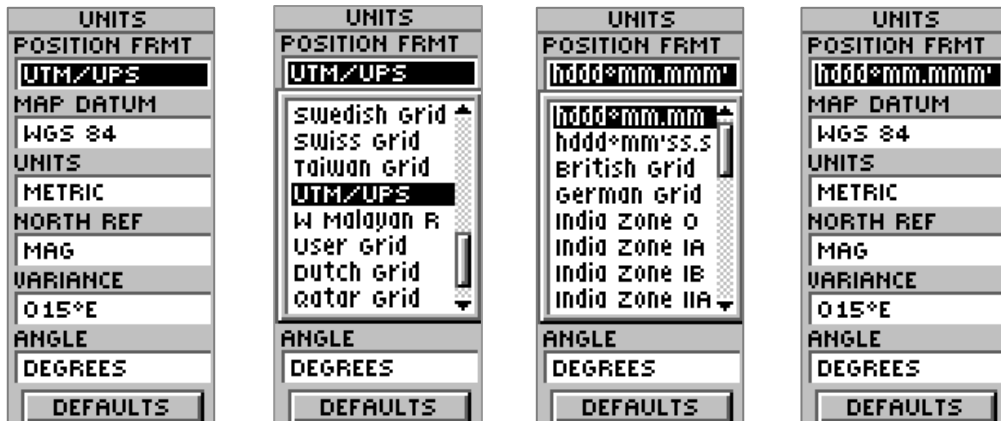
- Navigate to the **MENU** page.
- Scroll to **SETUP**, press **ENTER**.
- Scroll to **UNITS**.

- Press **ENTER**.
- You should then see the **UNITS** page.



The GPS should reflect the above settings. If a setting is to be changed, scroll over the incorrect setting, press **ENTER**, scroll to the correct setting, and press **ENTER**.

For instance, the steps to make a **POSITION FRMT** change would look like:

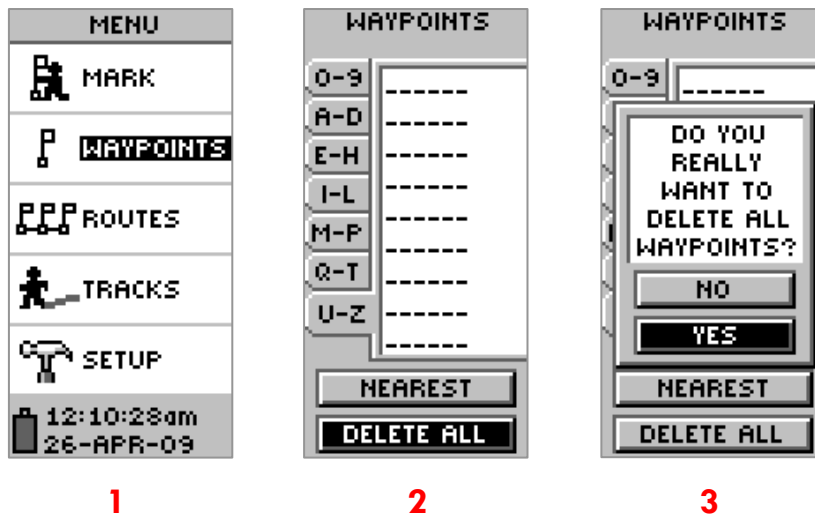


To **EXIT** - press the **PAGE** button until you reach one of the five **MAIN** pages.

**Step 8: Clearing the memory**

To clear the memory of any **WAYPOINTS**:

1. Press the **PAGE** button until the **MENU** screen is displayed, scroll to **WAYPOINTS**, then press **ENTER**.
2. Scroll to **DELETE ALL**, press **ENTER**.
3. Scroll to **YES**, press **ENTER**.



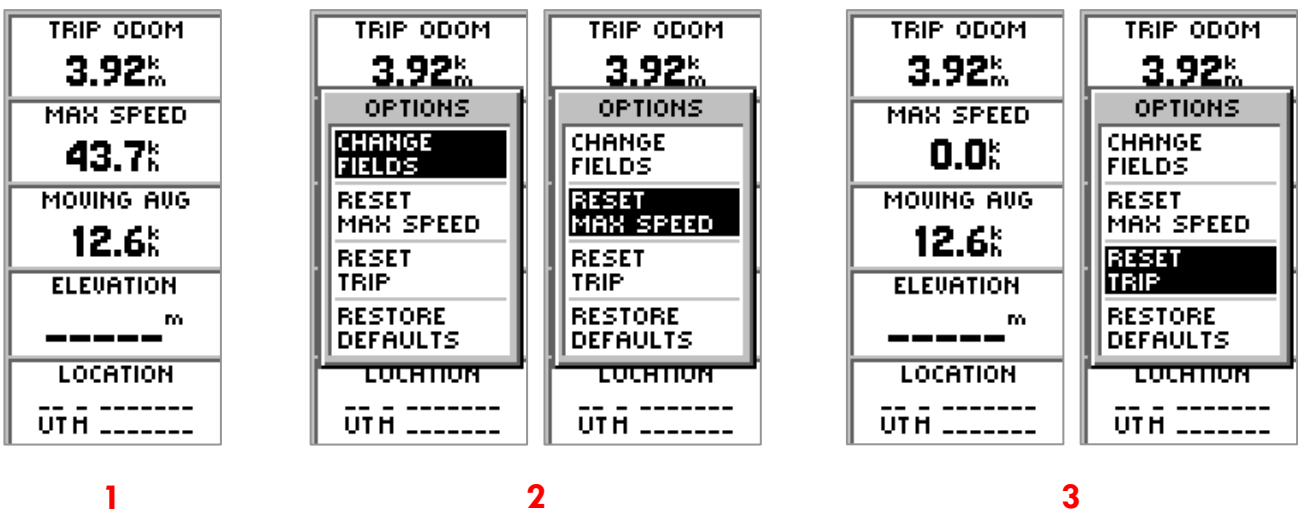
**Please note** that the DELETE ALL option tab will be 'greyed-out' (not useable) if there are NO waypoints stored in the GPS memory.

The eTrex H automatically stores information behind the scenes every time it is turned on and has satellite reception. This includes details like:

- Maximum moving speed.
- Average moving speed.
- Trip distance (odometer).

The procedure to reset the trip data is as follows:

1. Press the **PAGE** button until the **TRIP** menu is displayed, then press **ENTER**.
2. From the **OPTIONS** menu, select **RESET MAX SPEED**, press **ENTER**.
3. Press **ENTER**, scroll to **RESET TRIP**, press **ENTER**.



In addition, the eTrex H will store a 'breadcrumb' or **TRACK LOG**. This feature allows the user to back-track their journey (particularly handy if the user becomes disorientated in the bush). The procedure to clear the **TRACK LOG** is:

1. Press the **PAGE** button until the **MENU** screen is displayed, scroll to **TRACKS**, then press **ENTER**.
2. Scroll to **CLEAR**, press **ENTER**.
3. Scroll to **YES**, press **ENTER**.

**1****2****3**

## Setting up EasyGPS

**NOTE – Read this page carefully before proceeding. You may need to install a cable driver before you install EasyGPS!**



If you are intending to connect to a GARMIN GPS receiver that uses the above connector, you will most likely strike complications as these GARMIN leads generally come fitted with a Serial connector on the computer end of the cable (see below).



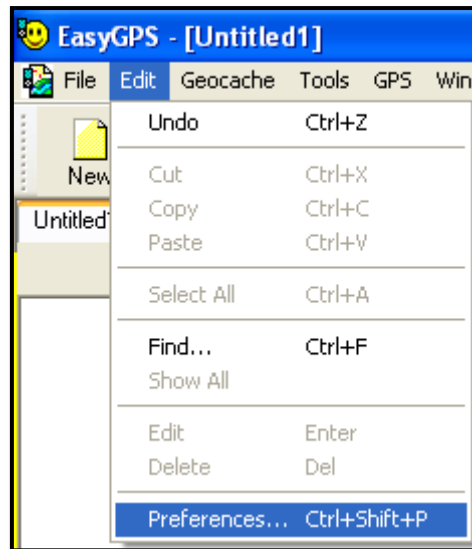
As many computers do not have serial sockets anymore (particularly laptops) you may need to use a Serial to USB adaptor. Alternatively, GPSOZ Sydney can supply an 'all in one' cable, which is designed for USB connections - code No. GAREUSB)

If you DO HAVE a serial socket on your computer and are using a cable with a serial plug (9 pins), then you DO NOT need to install any cable driver and can ignore this page and proceed straight to step 1.

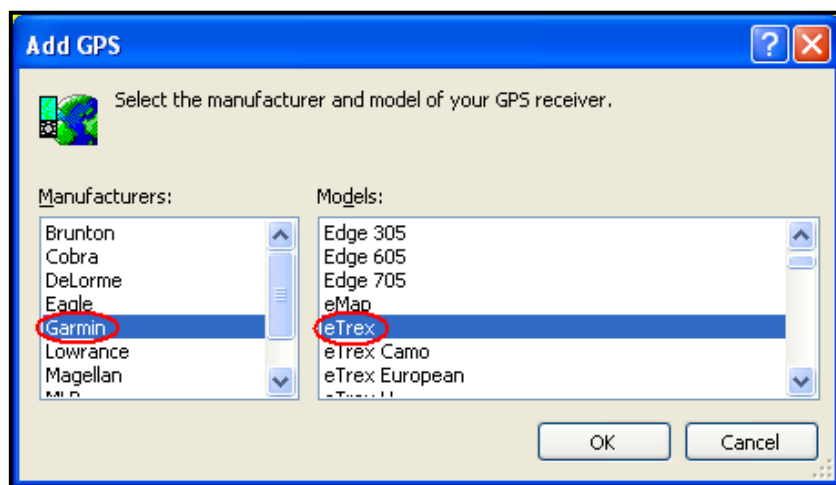
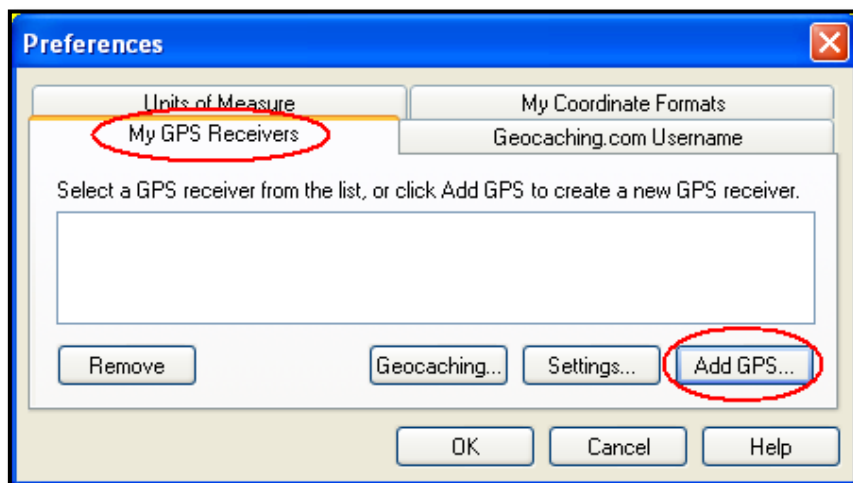
1. Plug the data cable into the computer.
2. Install the software.
3. Set-up the EasyGPS software preferences.

NOTE - For new installs, the preferences screen should automatically display (and will most likely only have 2 tabs available). Set those 2 preferences and then set additional settings using the pathway below.

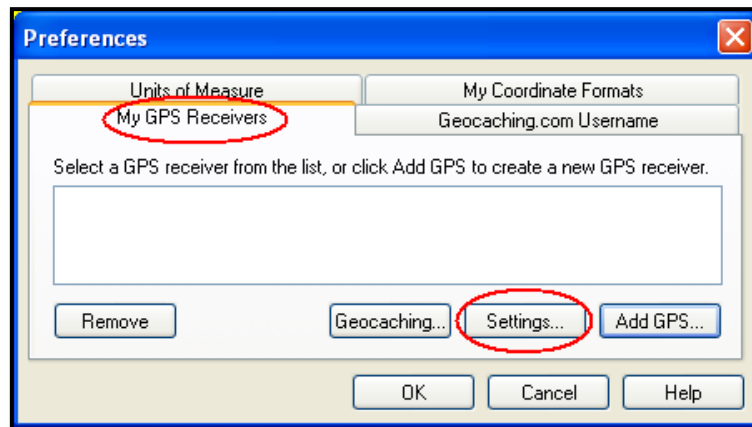
For existing installs, the preferences screen is found using the following path.



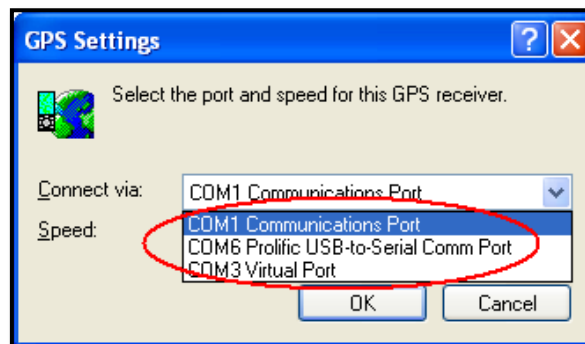
### Adding GPS Receivers



## Setting up the GPS Settings

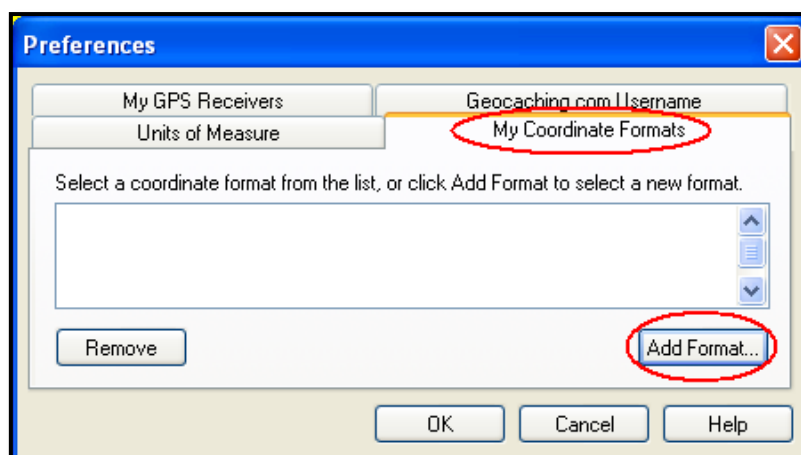


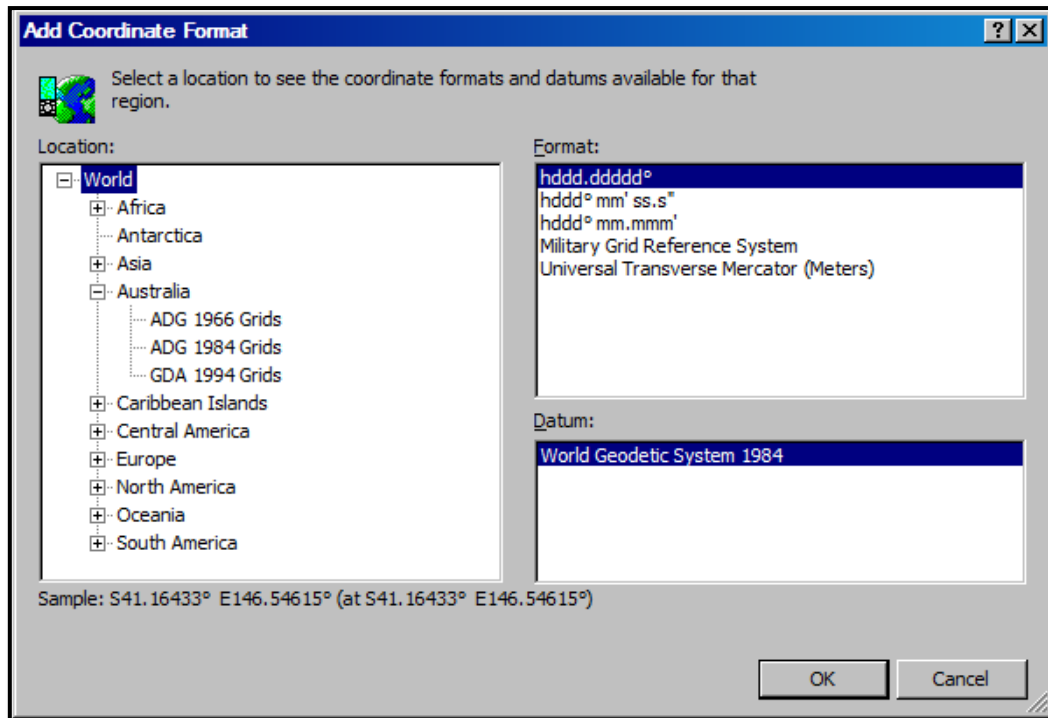
Set to USB for USB cable/adaptor options **OR** select communications port from the drop down menu. If you have multiple listings for communications ports, Select the port that has the wording against it **Prolific USB-to-Serial CommPort**.



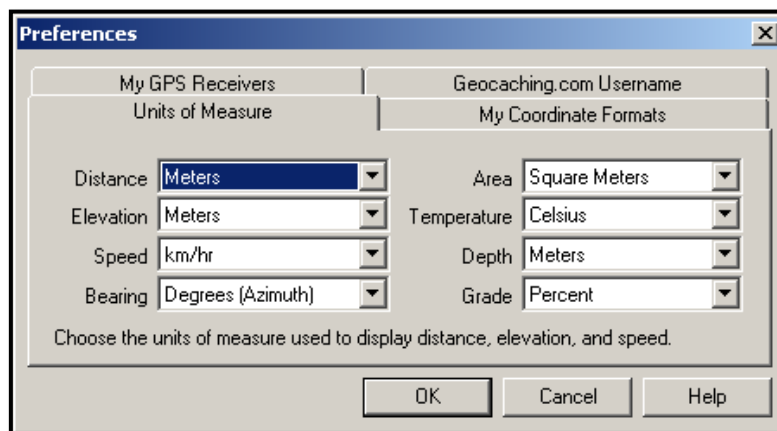
### Add the following coordinate systems

- World / hddd° mm' ss.s" / World Geodetic System 1984.
- Australia / Universal Transverse Mercator / Geocentric Datum of Australia 1994.



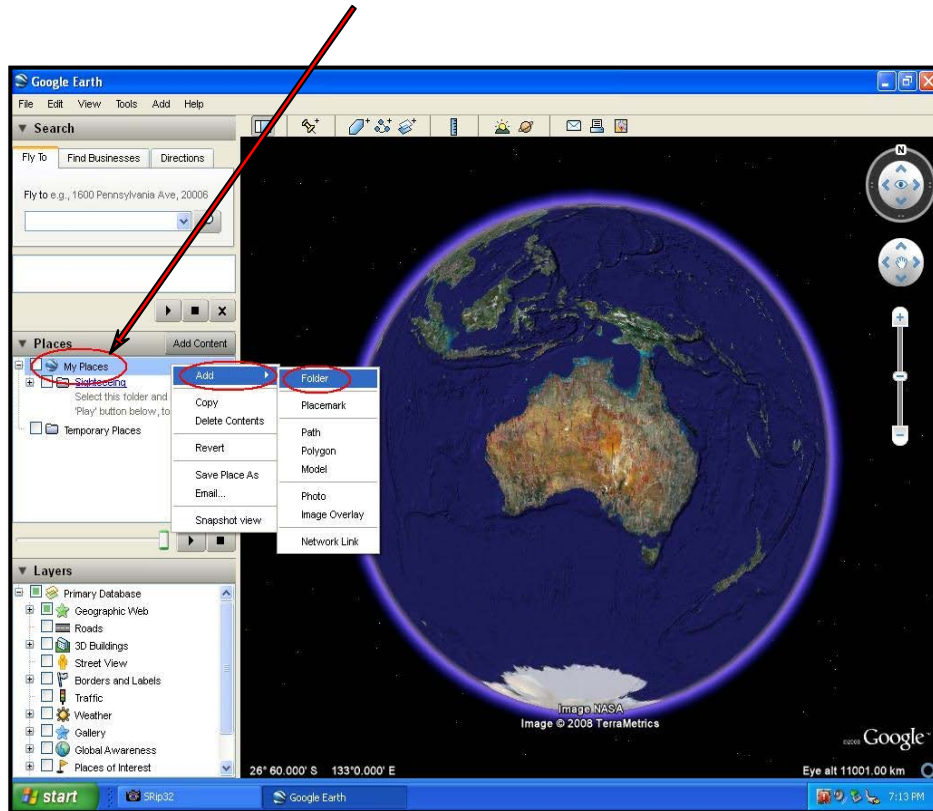


### Set the Units of Measure

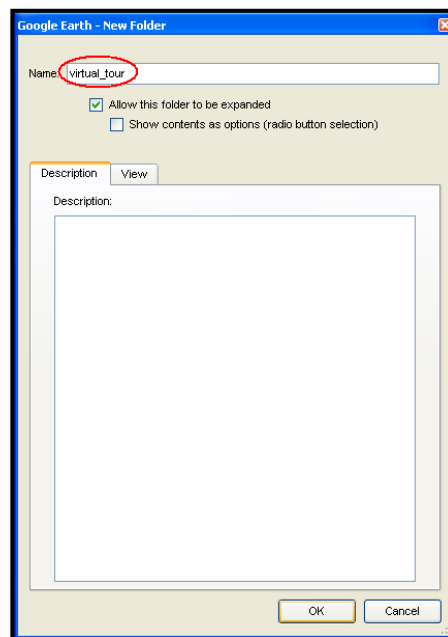


## Inserting Placemarks in Google Earth

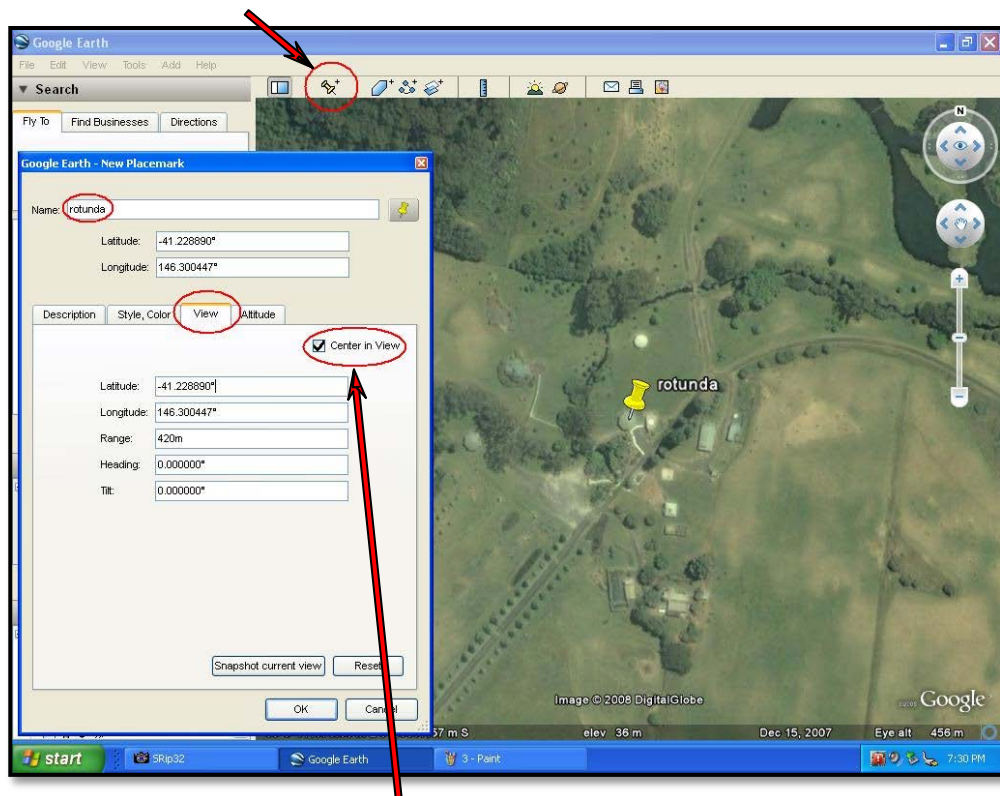
4. Open Google™ Earth.
5. Right Click on **My Places / Add / Folder**.



6. Give the folder a suitable name.

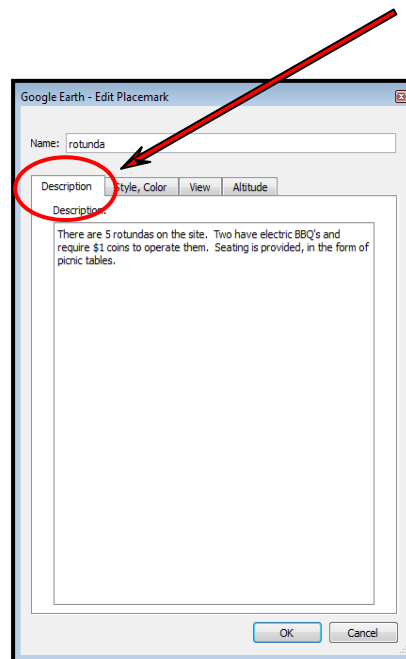


7. Click on **Add Placemarks**.

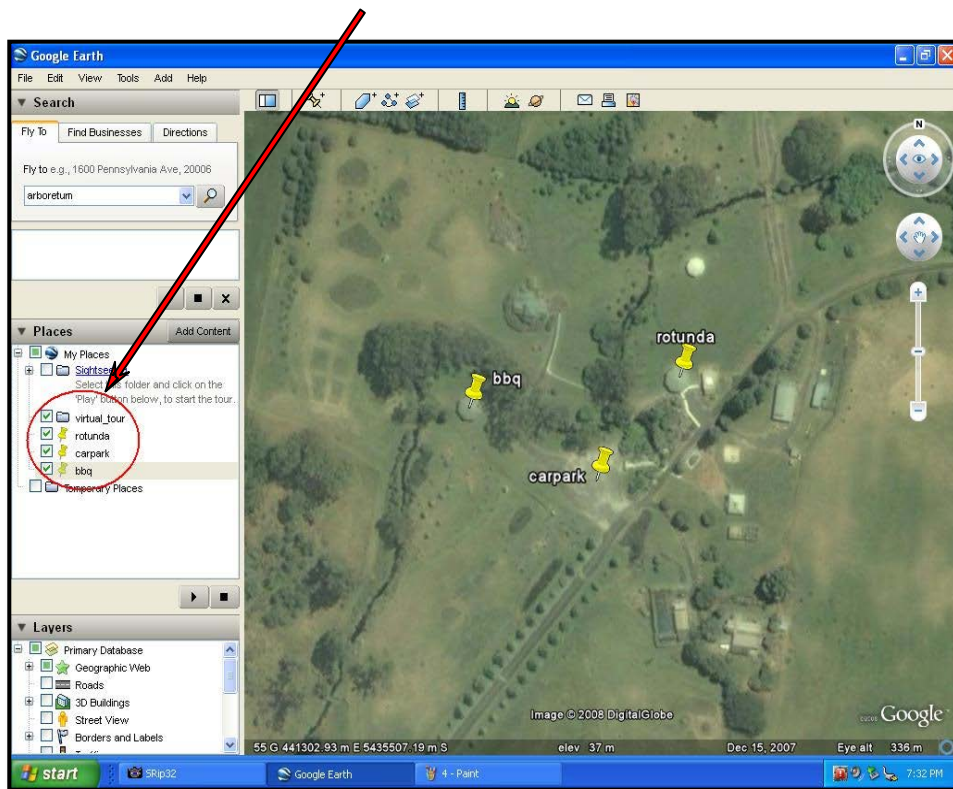


- Ensure that you select **Center in View**.
- Position the 'Pin' by left clicking + holding whilst moving the mouse over the aerial photo.
- Click on **Add Placemarks** for each point to be added.

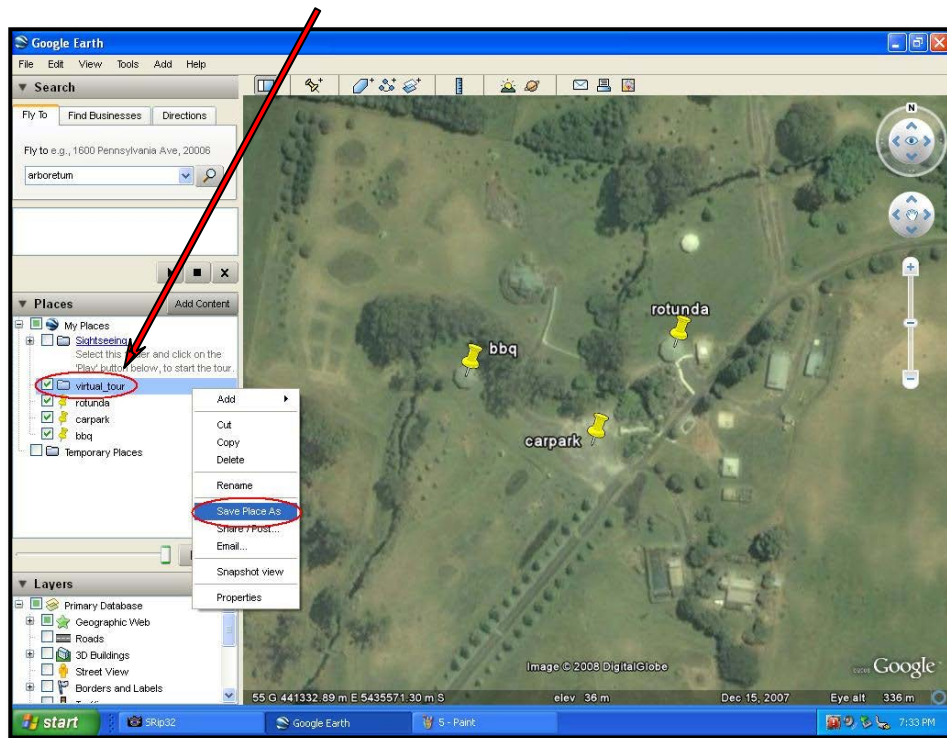
8. Add information about each point of interest under the **Description** tab.



9. Ensure that all Placemarks are in the folder you created. If not, drag and drop the Placemarks into the folder.

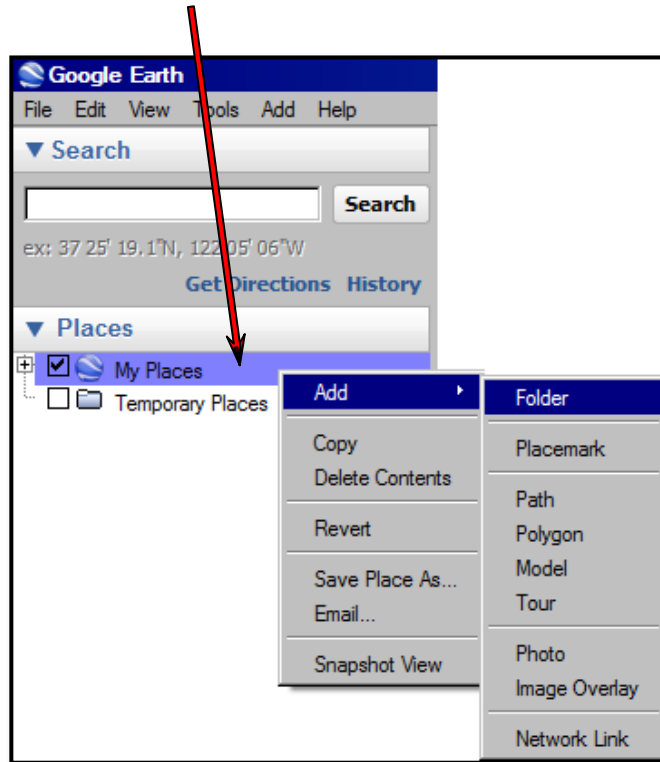


10. Right Click on the folder and choose **Save Place As**.

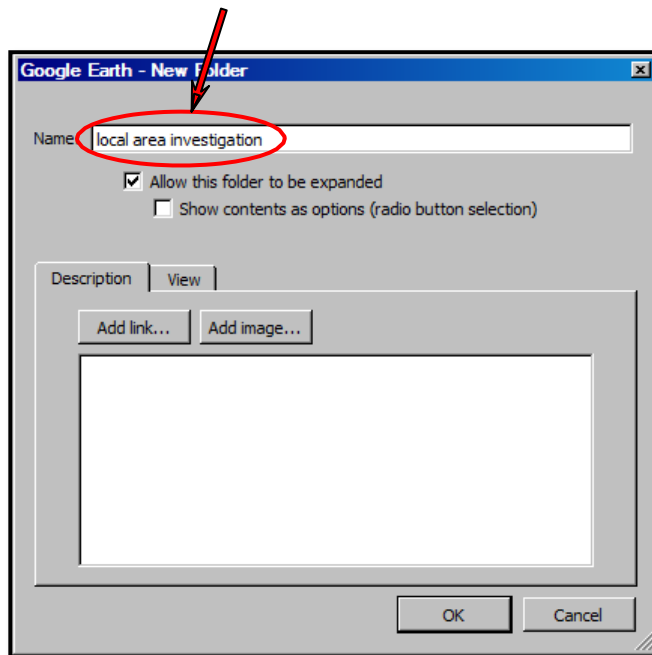


## Structuring Folders and Files in Google Earth

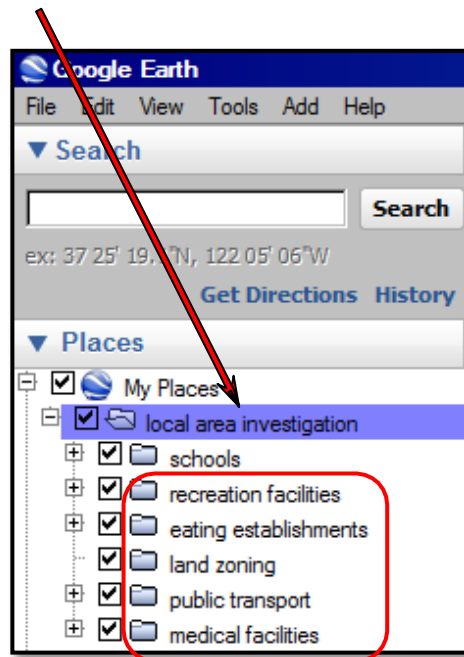
1. Open Google™ Earth.
2. Right Click on **My Places** / **Add** / **Folder**.



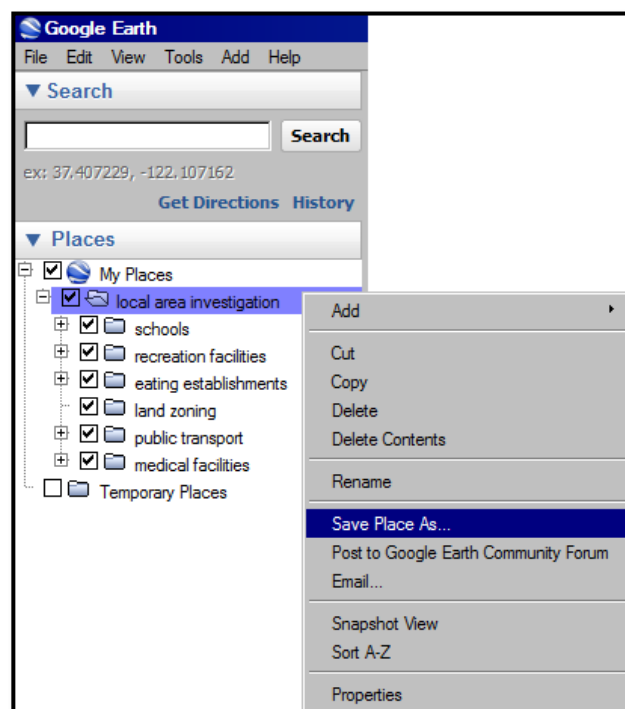
3. Give the folder a suitable name and click **OK**.



4. Add a series of sub-folders by right clicking on the newly created folder and choosing **Add → Folder → Enter the folder name → OK**.



5. When wanting to add a **Placemark, Polyline** or **Polygon**, select the relevant sub-folder by left clicking it, then proceed to place / draw in the feature. If you put a Placemark, Polygon or Polyline into an incorrect folder, you can left click/hold and drag it into the correct folder.
6. To save the project, right click on your primary folder and choose **Save Place As**.



7. Name the file appropriately and Save as type: KMZ.

