QGIS Beginners Manual
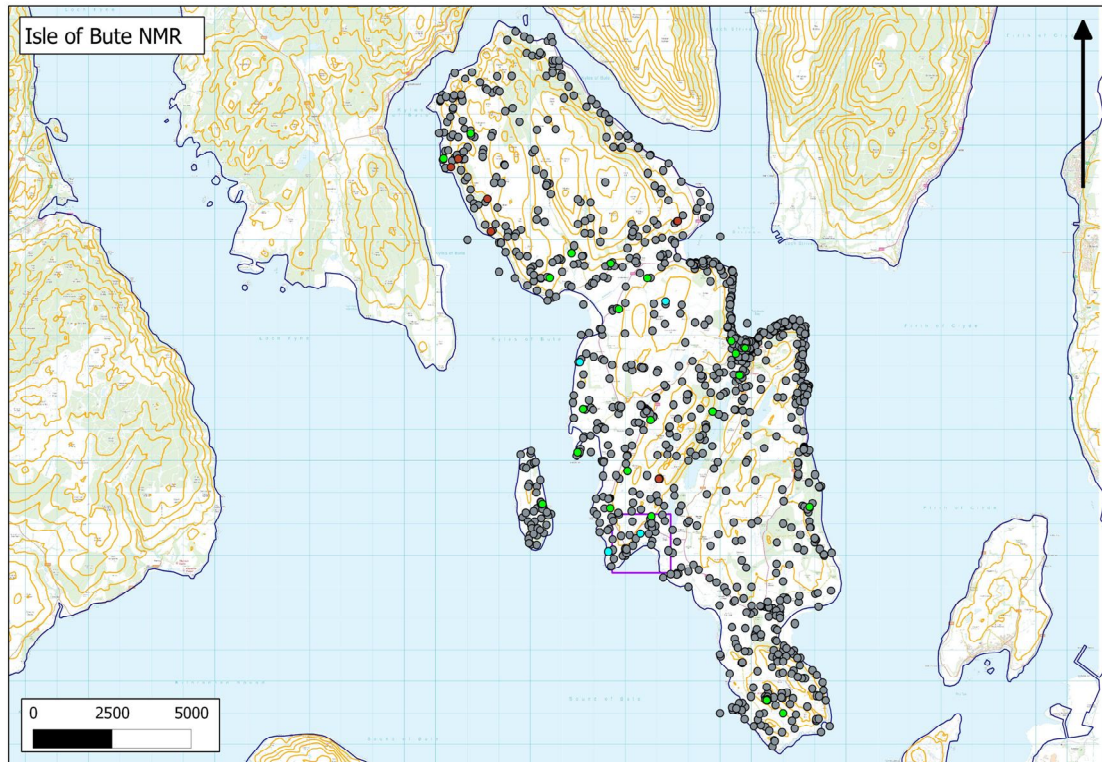
Tethys 1.5.0

v.1 November 2010

Cathy MacIver

Contents:

Downloading QGIS (1.5.0 Tethys)

QGIS can be downloaded online from:

http://www.qgis.org/wiki/Download

This website contains links to the current stable versions of QGIS, those still in development and archived copies of older versions of QGIS.

Alternatively you can download QGIS 1.5.0 Tethys from the file provided with the Bute Case Study Data. (QGIS-OSGeo4W-1.5.0-14109-Setup.exe)

Double click this .exe file and follow the instructions.
Allow/ignore any warnings about installing unfamiliar/harmful software onto your computer.

>A QGIS window will appear on your desktop, click Next.

>Click 'I Agree' to the License Agreement window

>Choose a destination folder (the default C:\ProgramFiles is a good location)

>Click Next

>Select Quantum GIS as the component to install (ignore the data sets unless you want to play around with other data)

>Click Install.

>Click Finish when it has completed the installation

You should now have QGIS and associated GRASS and Msys icons on your desktop.

Click QGIS icon to open a new project.

Setting up tools and toolbars

Not all of the toolbars and available tools for QGIS are loaded with basic installation. To install further tools and useful functions for QGIS you need to install several plugins. The figure below shows all the plugins used in this manual and there are more being developed all the time.

> Plugins (Main Menu Bar)
> Fetch Plugins: opens up a window with the currently installed plugins. The default status of this will only reveal approved QGIS plugins – these are the stable, signed off tools.

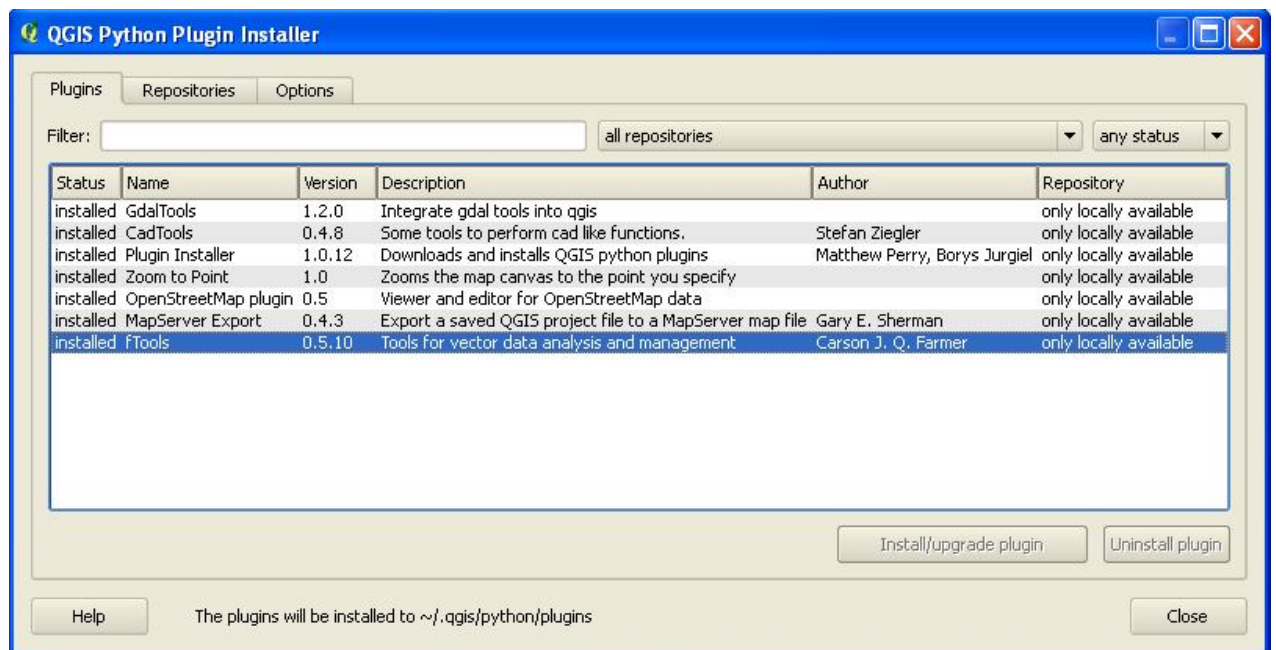

Fig.1. View of available and installed plugins used in this project

The tab labelled 'options' allows you to search and display the third party repositories and plugins – these are to be used with caution – some are in experimental stages and are not stable.
>Check the circle for 'Show all plugins except those marked as experimental' and other options will be made available for installation.

There is also a tab labelled 'repositories' – this shows the repositories where people upload their plugins available for installation into QGIS.

> To add these options click add third party repositories.

Tip: If they are all marked as unavailable this probably means you need to check your internet connection – if only a couple are the problem lies with the person who maintains the repository.

Setting Projections (Ordnance Survey Grid coordinates)

Before any work is started on a Project it is best to define the coordinate system or projection you are going to be working in. For the case study area and anywhere in the UK the projection is Ordnance Survey, Great Britain, 1936, or OSGB 1936.

>To do this in QGIS go the Main Menu bar
>Select Settings
>Project Properties
>Coordinate Reference System (CRS) tab
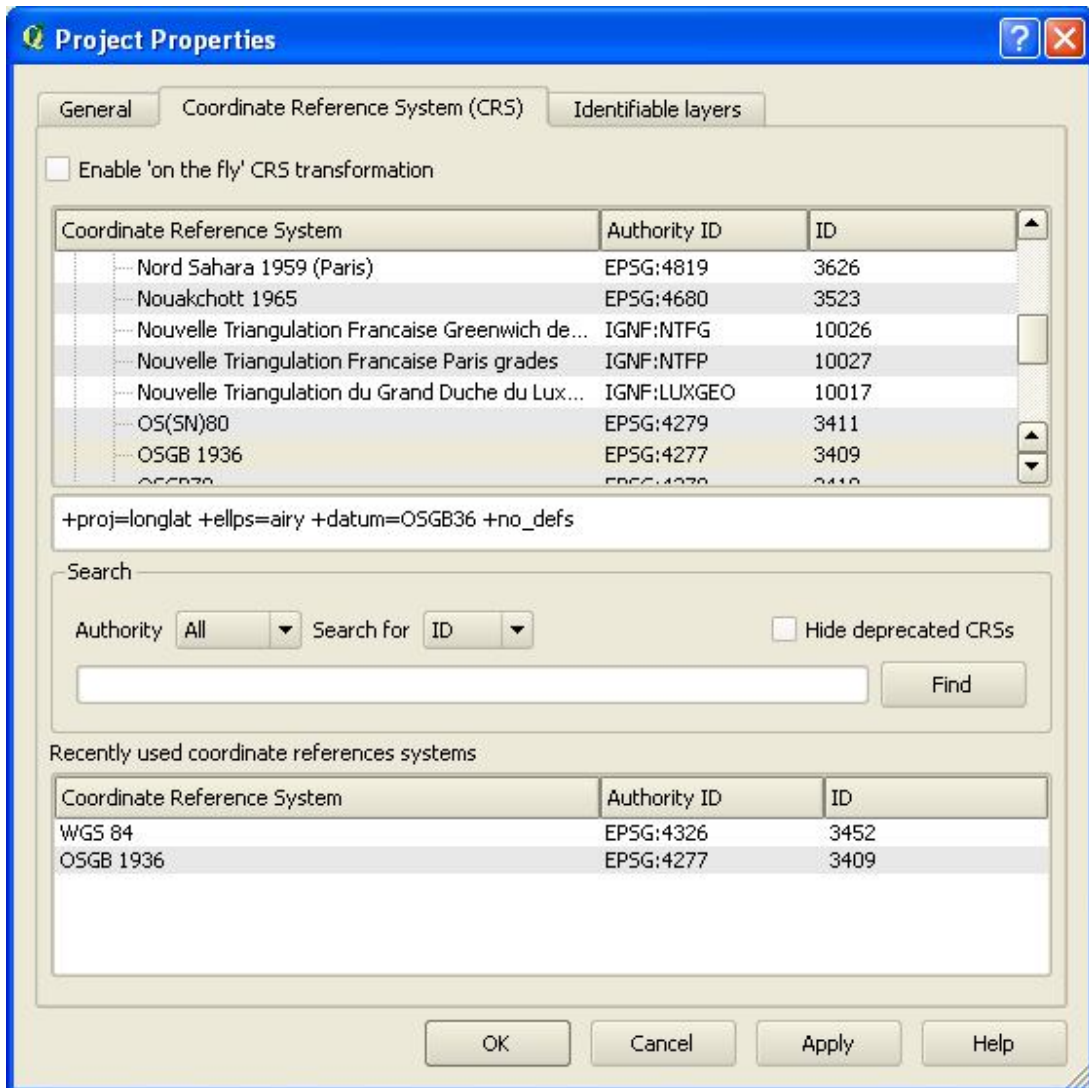
Fig.2. View of Project Properties CRS tab where you set projections

>Find the appropriate coordinate system and 'Apply'

This sets the Project to accept OS grid coordinates. It should remain constant as long as the Project is saved correctly after this change.

It also worth going to Settings/Options at this point and selecting the CRS tab

>Set to 'Global default CRS displayed below will be used'

>Go to 'select Global default' and choose OSGB 36 if it is not already the default.

All the toolbar icons have small descriptions if you hover the cursor over them for a moment – this makes it easier to become familiar with the different options and tools within the GIS.

Some windows also contain a help button (normally in the bottom left) this can sometimes provide helpful tips and information.

There are a variety of useful tools in QGIS for navigating around the map canvas. The toolbar shown below show the main zooming tools:

From left to right:

Pan: grab the map and move it about – good for small adjustments

Zoom in – once selected you can click to zoom in a preset amount on any area of the map

Zoom out – the same as above but the opposite direction

Zoom out on the map canvas a preset amount – good for getting a slightly bigger context

Zoom to Selection – once you have selected features this will zoom you straight to them

Zoom to Layer – select a layer and zoom to its extents (this can also be done by right clicking on the layer in the lefthand 'table of contents' and selecting 'zoom to layer'

Zoom Last – return to the last map canvas position

Zoom Next – go to the next canvas position

Refresh – reload the map canvas (good if it gets stuck or does not display correctly first time round)

 Zoom to Point – enter coordinates and zoom to specified point

The left hand menu is also known as the table of contents – layers you add will pop up in this and can be moved around (click and drag). You can also choose whether to display layers in the map canvas by checking or unchecking the box beside the layer name.

To rename a layer right-click and 'rename.'

Other useful tools:

From left to right:

Identify features: click this icon, click a feature and its attributes pop up

Select Features: either by clicking one or dragging a box round several

Deselect all features: does what it says on the tin

Open attribute table: of layers that have associated attributes

Measure line: good for quick measurements

Measure area: as above

Measure angle: as above

Map tips: should pop up with helpful tips but does not seem to work reliably in this version (avoid)

Show Bookmarks: shows a list of spatial bookmarks (see bookmarks section for more info)

New Bookmark: create new spatial bookmark

Labelling: Good for labelling point files, particularly for distribution maps. Select a vector layer, click icon, check 'label this layer'. Choose the field to label from the attribute table and decide on its positioning.

Text Annotation: annotate parts of map canvas, could be used if labelling an entire layer is not appropriate

The BUTE CASE STUDY DATA:

This manual has been organised to provide information on using various tools within QGIS rather than following through how to handle one specific set of data. This is to allow the manual to cover more detail than is necessary for some of the case study data manipulation and make it relevant for users trying to construct their own projects. However if you are constructing the Bute GIS from scratch using the dataset provided

Adding vector data: shp files, Ordnance Survey….

Summary: '*Vector data is composed of discrete coordinates that can be used as points or connected to create lines and polygons.*

The quickest and easiest way to add pre-existing vector data is to use the 'Add vector layer' tool. Just browse for the layer you want to add, one added it will appear in the left hand 'contents list/menu.'

This allows you to add vector data such as ESRI shape (.shp) files created in ArcMap or other software types.

Adding raster data: tiffs/jpegs, Ordnance Survey…..

Summary: 'In its simplest form, a raster consists of a matrix of cells (or pixels) organized into rows and columns (or a grid) where each cell contains a value representing information, such as temperature. Rasters are digital aerial photographs, imagery from satellites, digital pictures, or even scanned maps (ArcGIS Helpdesk Definition, 2010).

The quickest and easiest way to add pre-existing raster data into QGIS is to use the 'Add raster layer' tool. Just browse for the layer you want to add, one added it will appear in the left hand 'contents list/menu.'

Raster data comes in several formats such as image files (tiffs/jpegs) and Ordnance Survey data comes in ASCII format. QGIS supports several other types of data that could be useful for archaeologists (see QGIS manual for compatibility details.)

Layer Management:

It is important to manage the layers in the contents list, particularly as they grow in number. If you click on a layer and drag it you can move it up or down the menu. This means you can lay some layers over the top of others where necessary or group layers into sensible or related groupings.

Georeferencing (Locating) images/raster data:

(Data that can be used to explore this tool is found in the raw data folder, any of the geophysics or plane table graphics can be georeferenced)

When tiffs/jpegs are added into QGIS they need to be located. Raster images can come supplied with locational data – for example tiffs accompanied with .tfw files. These files should be kept together in the same folder and when the tif is added into QGIS the tif should drop into the correct location (assuming all projections are correct).

To create this locational information for rasters that are 'floating' uses a tool called geo-referencing.

There are several ways of going about this in QGIS.

>Select the georeferencer icon on the toolbar.

>Add the raster you want to georeferenced by clicking the 'Add raster layer' icon in the window that pops up.

Geo-referencing can take place using control points – i.e. points that the image and the actual location on the map have in common. These can be derived from features marked on the map that correspond to known features on the image. Or survey data from a GPS or Total Station marking the corners of grids or field boundaries.
The important thing is to have control points decided in advance of starting this process, depending on the number of control points that are suitable this will influence the transformation type you select (more detail on this below).

>Find out from the map background what the OS grid coordinates are where you want the control points of the image to locate to.

>Click the 'add control points' icon (it has three red points on it)
>Then click on the first control point on the raster image you want to locate – a window pops up.
>You can then choose to enter OS grid coordinates you have collected from the map background.
>There is the second option of determining this corresponding point by clicking on the map canvas – follow the onscreen instructions and click the pencil icon labelled 'From map canvas'. Then make sure to zoom in as close to this point on the map as possible and click on this point. (toggling between zoom function in main QGIS window and the second georeferencing window – it often reduces to the bottom left corner of the screen)
>Click OK and the first point appears in the panel below the raster.

>Repeat this for the rest of your control points – if you make a mistake at any point you can delete the control point and start it again or move the control point to the correct position using the icons on the georeferencing window toolbar.

>Click the green triangle icon for 'start georeferencing' and a window pops up asking you to set the transformation type – click OK.

>Transformation Type drop down menu gives you a choice – linear requires 2 control points, polynomials require more depending on the degrees of transformation. (Generally it is better where possible to go for polynomial transformation in terms of increased accuracy.)

>Leave resampling method and Compression on their defaults (see figure below).

>Choose a location and name for the output raster (clicking the browse button to the left of this field)

>There is the option to check a box to create a world (.wld) file – this saves the locational data and can be kept with the original raster to use as locational data in future projects.

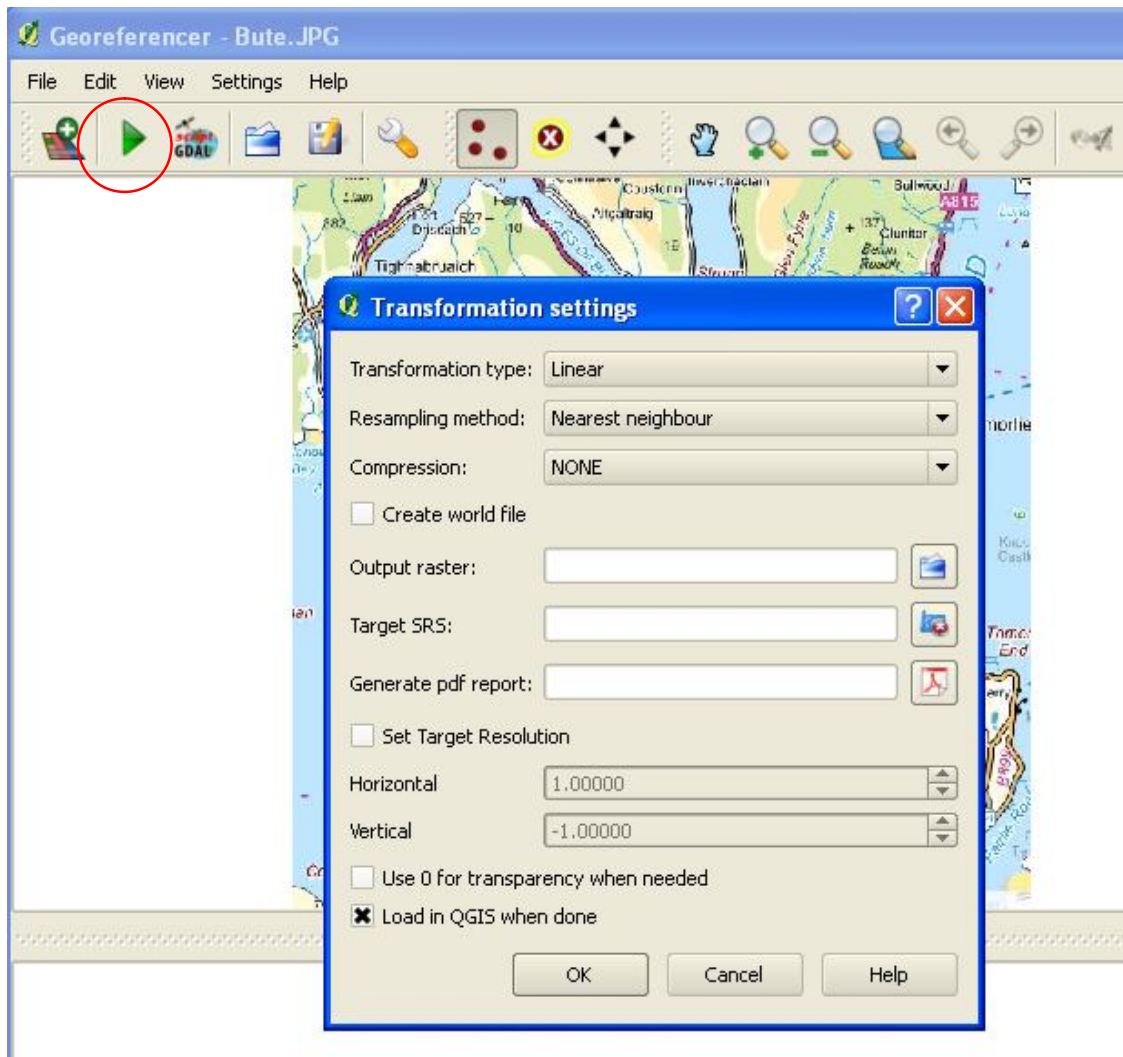>Check the 'load in QGIS when done' box to display the located layer

Fig.3. View of geo-referencer settings tab

You can also save your georeferencing control points (GCP) using the save icon in this window – this could be useful if you want to try different transformation types before deciding on the most useful one.

Tip: Keep the tif in the same folder with the corresponding world file to make sure you can retain the locational information for each specific raster you georeferenced. If you are moving data copy and paste these together. It is also good to give them the same name so that they are easily identifiable as linked files.

Handling and Preparing raster data: merging raster tiles, editing the symbology and transparency

>Add a raster layer; (Such as the tiles NR84, NR86, NS04 and NS06 from the raw data folder, Ordnance Survey panorama)

>These tiles are already located on the ordnance survey grid so should drop into the correct location.

>The tiles sometimes present as a blank grey square – if this is the case right click on the layer in the 'table of contents' menu and select Properties.

>A variety of options appear on the window that pops up – highlight the symbology tab and select the colour map drop down menu and change it to 'pseudocolour'

>Click Apply and the raster should now present as a colour symbology representing topography

You will notice that all the tiles join up at the edges but are still separate layers. To make a more useful single layer incorporating all this data you can use the 'merge' function.

>Go to the raster tools menu (GDAL Tools plugin) and click merge.

>Browse for the raster tiles you want to join and select them all at once by holding down (ctrl) and selecting them. (For this make sure all the relevant tiles are in the same folder for convenience)

>Select output file – choose the folder to save the merged file to and give it an appropriate name.

>Check the box next to 'No data value' and make sure the value is 0 (this will assign all areas of no data a value of 0.

>Check the box to load into canvas when finished

>Click ok and give the process time to run its course – sometimes it takes several minutes depending on the speed of your computer and the number of tiles.

>A message will pop up saying 'elaboration completed' and the new layer should load into your canvas and be saved to the folder you selected (a copy of this result 'Buterast' is available as part of the completed case study dataset).

(You may have to right click, properties and change the symbology colour map to pseudocolour again)
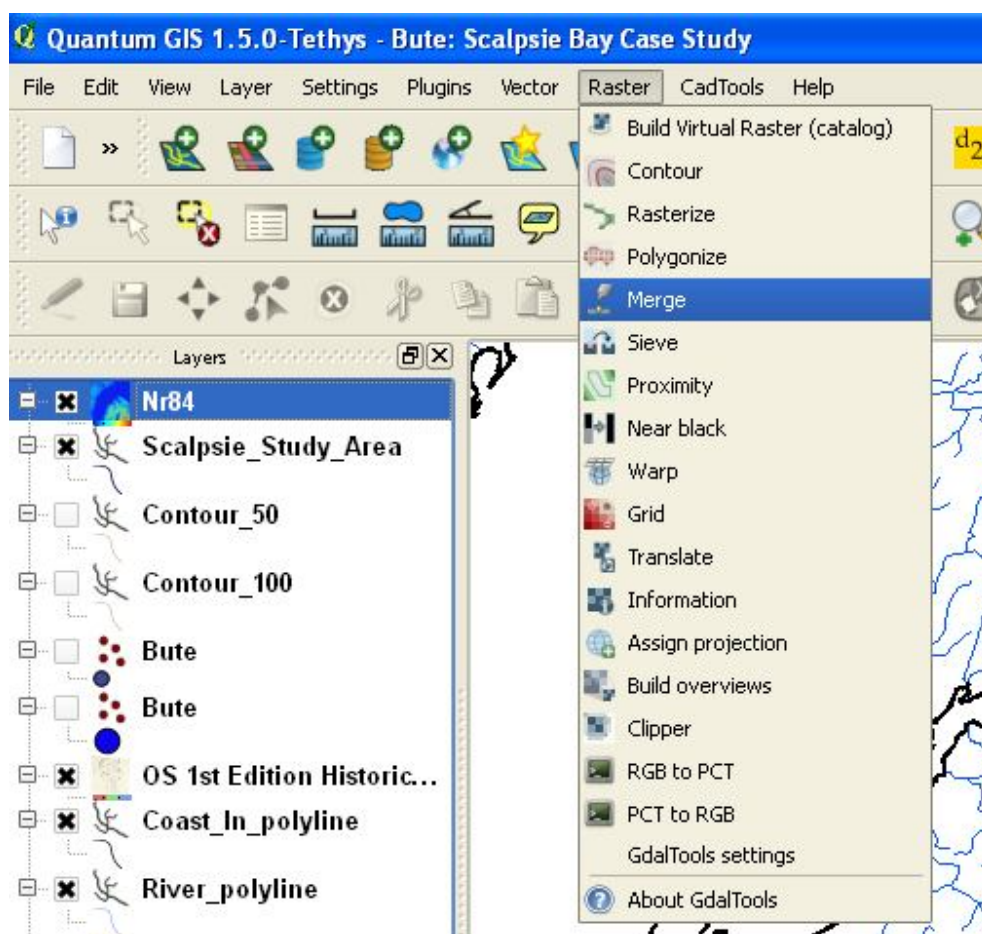

Fig.4. View of Raster tools highlighting location of merge function

Tip: Transparency – if you are overlaying layers you might want to make the upper layer transparent to be able to see through to the layer beneath. To do this right click on the layer, go to properties and select 'Transparency' tab. There is a sliding scale you can

adjust to alter transparency. In the region of 30% is a good starting point but it will depend on each layer what is the best level.
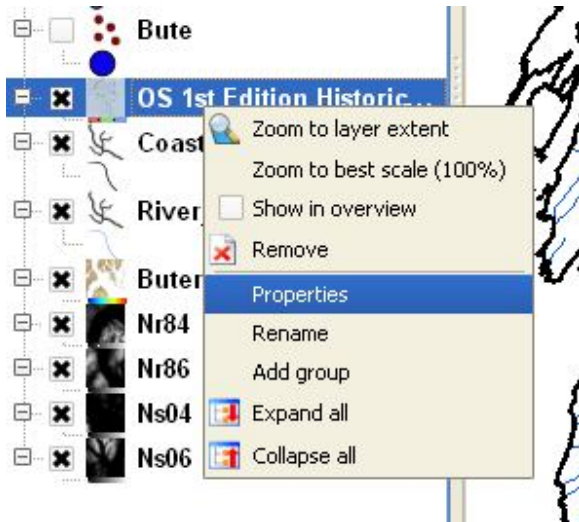

Fig.5. View demonstrating how to get to layer properties

Colormap Symbology:

The standard colormaps provided in QGIS are not very suitable for archaeological purposes. They are garish and don't represent topography that well.

You can create your own colormap.

>Properties, colormap tab.

At the bottom it allows you to choose the number of entries and if you add this, these appear in the pane above.

You can then click on the entries to edit – either the colour or the value band it represents. (they are all automatically created at equal intervals)

This can be a very time consuming process to get the right mix of colours and shades, after you have created it you can save it by choosing the 'export colormap' icon in the top right. Next to this icon is another that allows you to load a colormap, this means you can apply it to other layers.
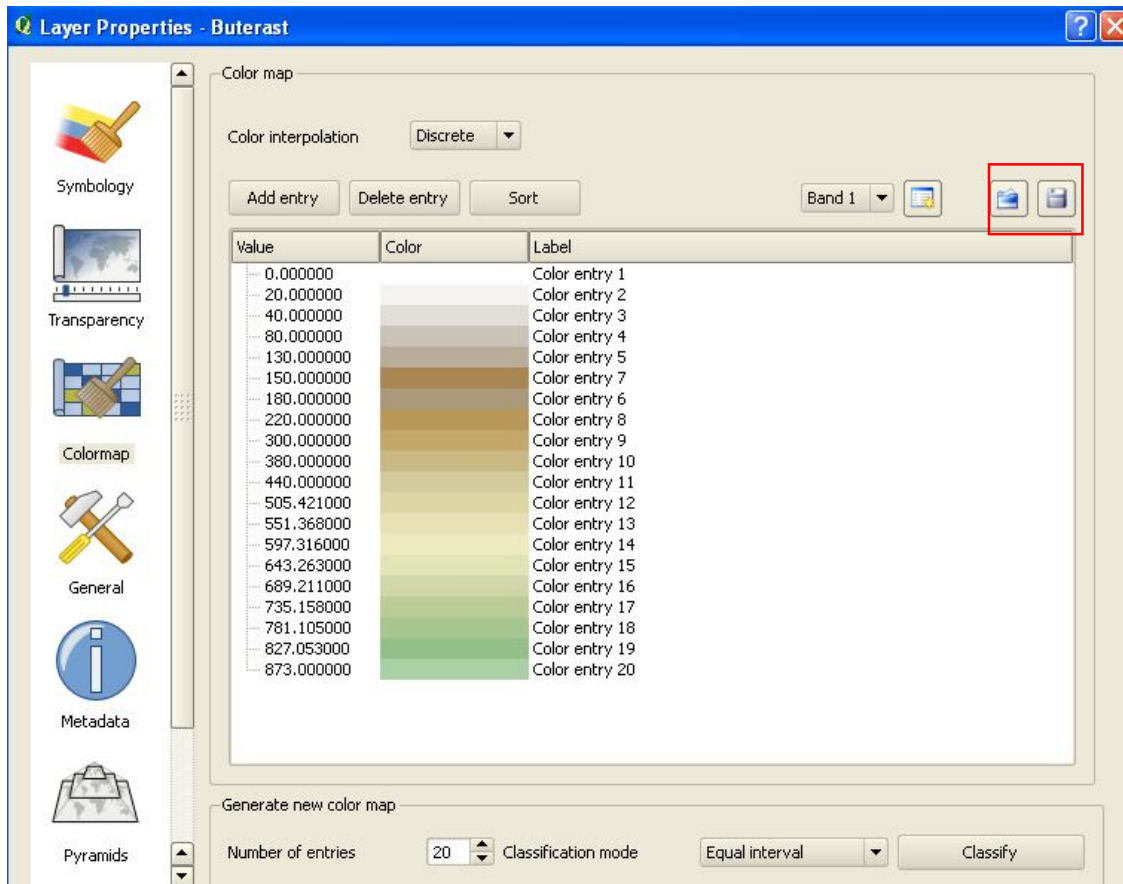
Fig.6. Layer Properties menu, colormap tab

Interpolation:

(Data that can be used to explore this includes the shp files found in the raw data folder, topographic surveys of the Cairn, Barrow and Quien.)

Interpolation can be used to convert height data to a TIN (triangulated irregular network) surface or a DEM (Digital elevation model).

This can be used to convert height data from a survey into a useful representation of the landscape/site.
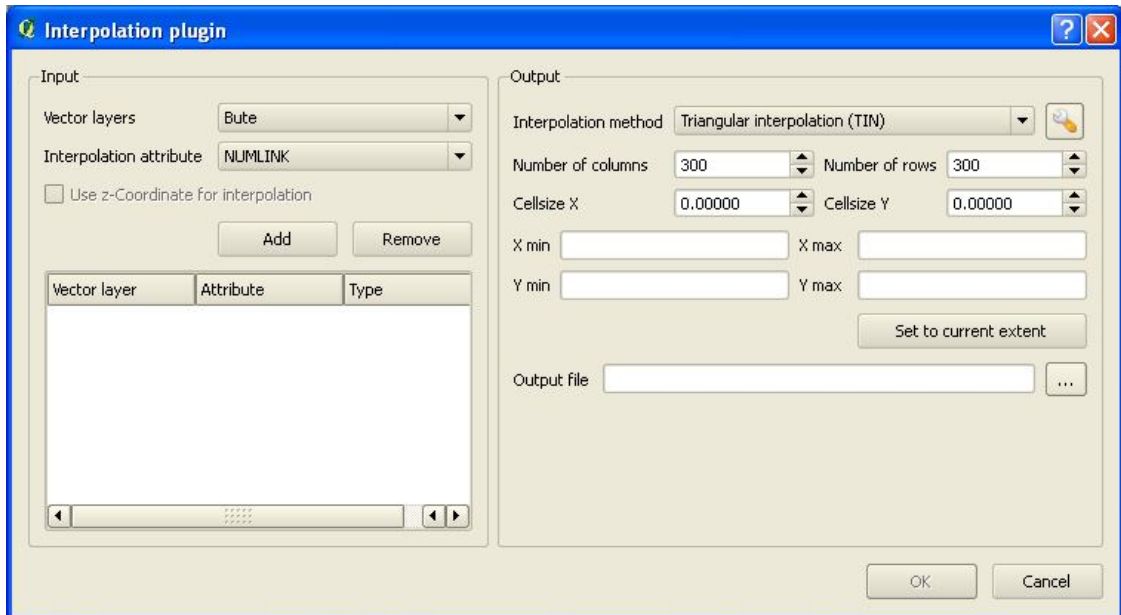
Fig.7. View of Interpolation options window

>Specify the input vector layer containing your height data (shp file with points in it)

>Specify the 'interpolation attribute' (or field containing height data in the attribute table of your layer)

>Check the box 'Use x-Coordinate for interpolation

>In the output section – choose IDW (raster) or TIN (vector) interpolation

>Browse and name location it will save to

With TIN and IDW you cannot specify a barrier to limit the vector/raster production to the surveyed area. This limits the usefulness of the tool as it only creates a rectangle of raster or a stretched tin rather than something representative of the surveyed area.

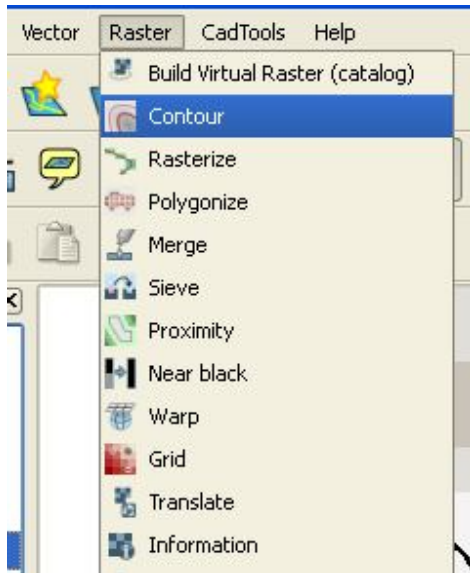Creating Contours to help emphasise topography:

Fig.8. View of Raster tools menu, highlighting contour function

Contours can sometimes help emphasise topography and make things clearer to someone viewing the data.

>To create contours go to the raster drop down menu and select 'contour'

>Select the input raster (e.g. the raster you created of Bute in the previous section)

>Select the location to save it and name the contour layer

>Select the interval between contour lines (try not to make the interval tiny as the surface will get very 'busy'

>You can opt to load this directly into the canvas when finished

Handling and Preparing vector data: creating, editing and deleting shp files:

(Add vector data layers such as the coastline and the lochs and rivers shp files from the Ordnance Survey Meridian and Strategi map data).

These can be used in conjunction with other data sources to produce location maps of sites etc.

New Shapefile:

Shp files can also be created by clicking the 'New shapefile' icon

Choose the type of shape file you want to create; a point, polyline (line) or polygon (area).
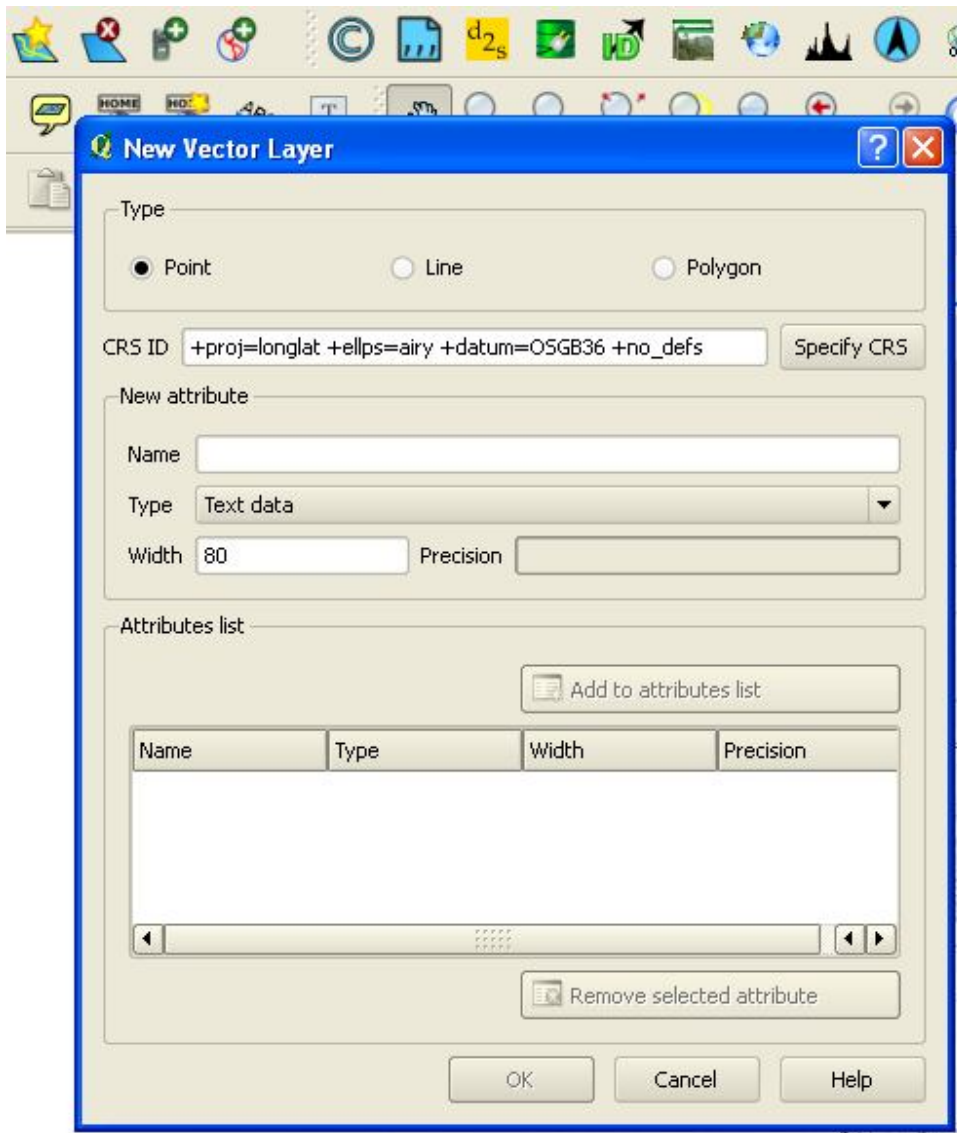

Fig.9. View showing the creating a new shp file options window

>Specify the OSGB 1936 coordinate system in the CRS field

>Give the file a name and 'add to attributes list'

>Save as the same file name in an appropriate folder

Editing shapefiles:

You can then edit this shape file, either by right clicking the layer and 'toggle editing' or highlighting the layer and choosing the 'edit' button in the toolbar (see below).

>You can then edit the shape file – if you want to add to the shape file (either more points, more lines or more polygons) you click the 'capture' button next to the save button on the above toolbar.

You can also move it and delete parts using the tools on this toolbar.

To save your edits right click once you are done and click OK on the window that pops up. You can then toggle editing off. It will prompt you to save changes if necessary.

Extracting parts of vector data (Clip):

Sometimes with larger datasets (such as the meridian data provided for all of GB) it can be useful to extract smaller areas of interest for the region you are working on. This can be done by creating a new shp file – polygon. Drawing a polygon over the area you want to extract then choosing the clip function in the Vector tools menu.

(e.g. the bute_region meridian data extracts used in the case study, also a clip polygon for the Bute region is included to practice with)

Snapping:

The vector files you create can snap or join to other shapes files – this can be useful if you are trying to create a complete shape or tracing a feature directly.

>To set the snapping options first go to Settings/project properties/general tab.

>At the bottom of the tab there is a button labelled snapping options. This leads to another screen with all the possible snapping layers in it. Check the box against those you want to snap and to snap to.

> Set the snapping tolerance to pixels – there is a bug with this plugin that mens that map units does not always work. Choose a tolerance suitable for the work (5 is a good starting point).

>Set the layers to nap to vertex/segment/or both as it suits.

>Once this is done right click on the layer itself and go to the digitizing tab.

>Again edit the fields to set the default snapping mode, snapping tolerance to suit your work.
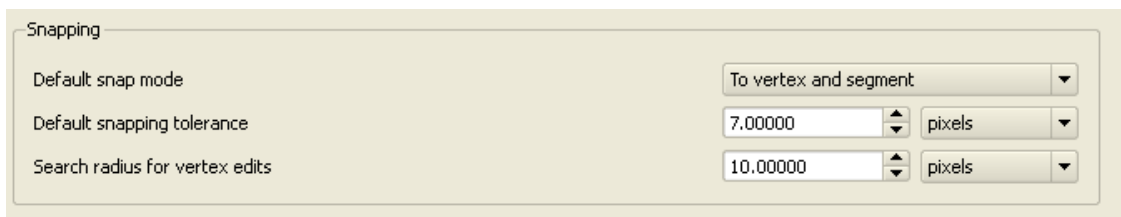

Fig.10. View of snapping options to set your project to in the digitising tab.
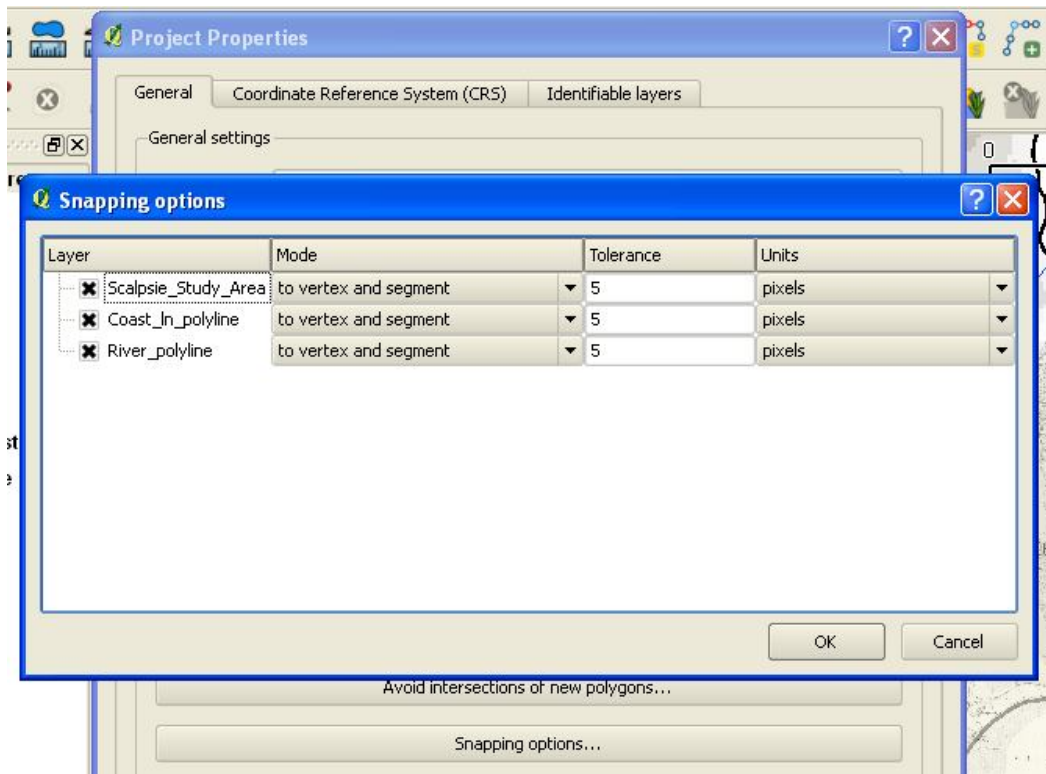
Fig.11. View of snapping options tab found through project properties

Adding tables (csv to shp):

(Use the Bute.csv table to try out the following process)

If you have a set of data from a survey detailing coordinates or any other tables you would like to add into the GIS it is best to have them in a csv format. This can be achieved in Excell, saving as .csv (Comma Delimited).

>Click the 'add delimited text' layer

>Browse for the table

>Name the layer

>Specify the delimiter string – in the case of csv it is comma ','

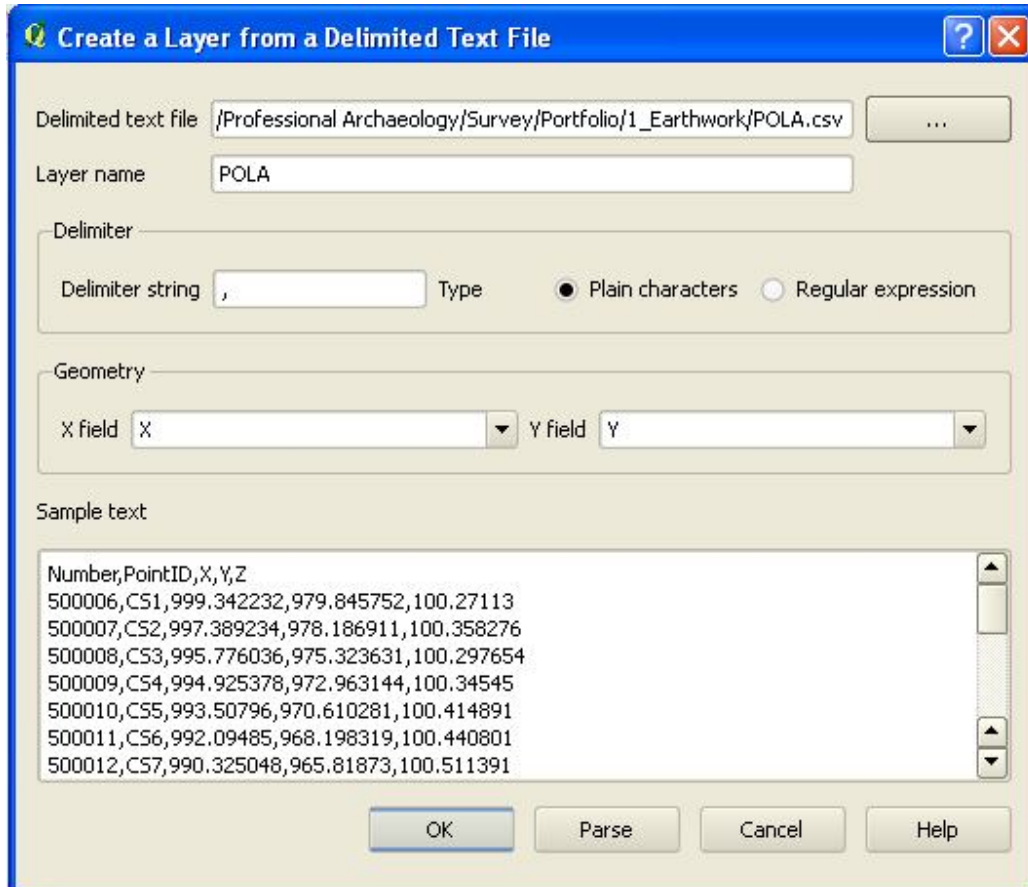>X field is your Easting column, Y field is your Northing column if they are coordinate related entries.

Fig.12. View of shp file creation from csv database tab

The points should drop into the map canvas – you can check their location by right clicking on the layer and 'zoom to layer'.
If the point coordinates are those of a local rather than the Ordnance Survey grid you will need to geo-reference them (see Georeferencing section for details).

Spatial Bookmarks:

Spatial bookmarks are and easy and quick way of navigating around different areas of the map canvas that you are working on.

If there is a particular area you need to keep revisiting it is best to create a bookmark for this location.

>Zoom in on the area you want to bookmark

>Click the 'New bookmark' icon

>Name the bookmark

>To revisit this click the 'Show Bookmarks' icon and select the one you want

>You can delete bookmarks in this directory when they are no longer useful

Metadata:

Metadata: '*Metadata describes other data. It provides information about a certain item's content. For example, an image may include metadata that describes how large the picture is, the color depth, the image resolution, when the image was created, and other data (TechTerms Definition 2010).*'

To view the metadata of a file right click on the layer, Properties, select the Metadata tab. In QGIS there is currently no way to add to or edit metadata on a specific tab the way you can in programs such as Arcmap.

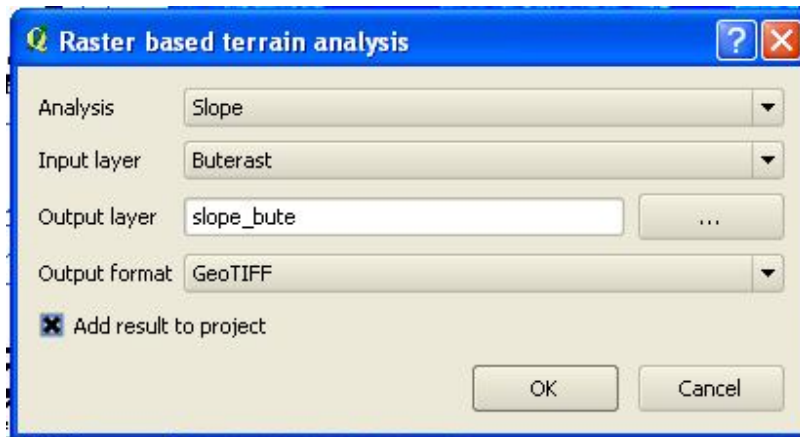Analysis:

Aspect and Slope (gradient):

Fig.13. View of options chosen for slope analysis

>Click the terrain analysis button

>Choose the type of analysis to perform

>Input the raster to analyse (e.g. Buterast)

>Name and locate the output

>Choose format (GeoTIFF is quite a standard format)

>Check the box to add the layer to the canvas

>OK

You then need to adjust the symbology to show what you want to represent. For example if you have done an aspect of slope and want to show a different colour for North, South, East and West you will need to create 6 classes.

The first class will be 0 = none

Second will be 0.1 – 45 = North

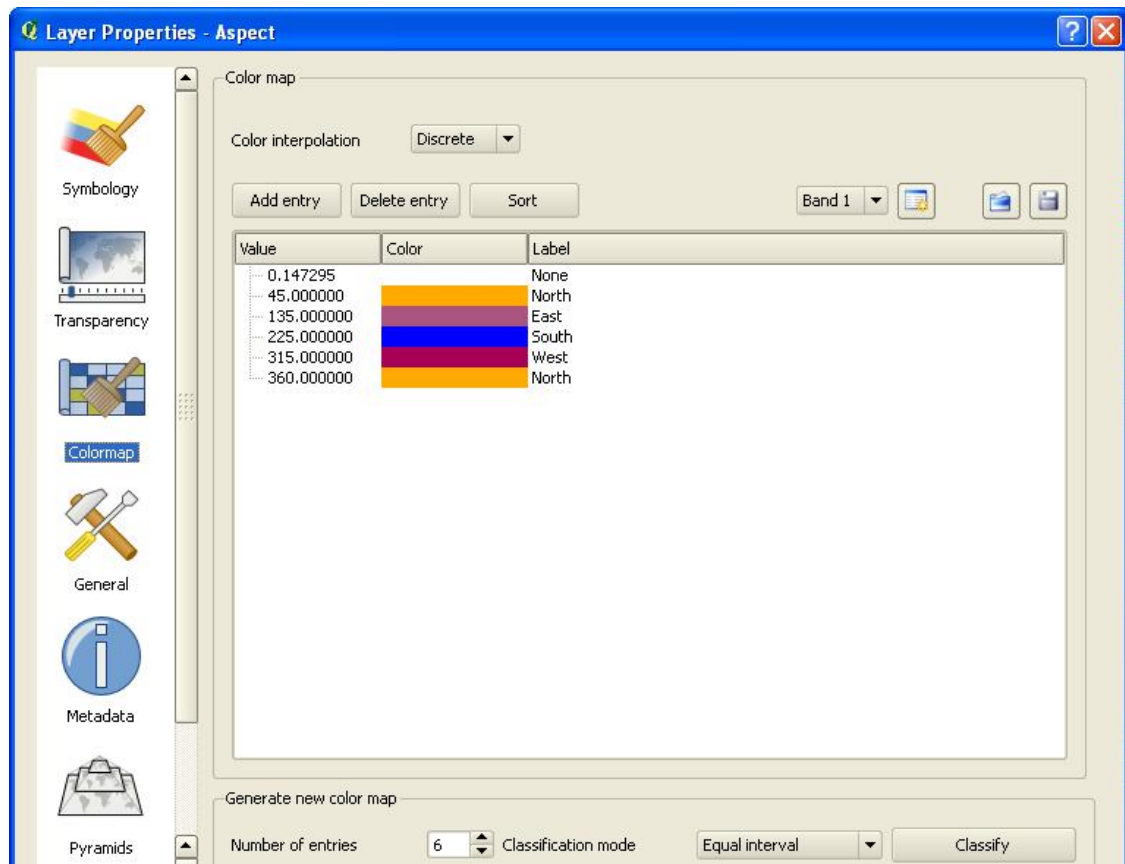Third class will be 45.1 – 135 = East…and so on.

See example:

Fig.14. View of layer properties showing example of colormap created for aspect analysis

The same process is necessary to classify the slope analysis. Gradient of slope can be broken up into categories of Gentle, Steep, Very Steep etc.

While this analysis gives a good indication of where steep ground is or where North facing slopes are at a glance it would be better to perform more rigorous analysis related to specific sites or groups of sites.

This would ordinarily be done (in Arcmap and other programs) by converting the raster to a vector format which would allow it to be spatially joined to the site shapefiles. This could then be used to provide information on where particular sites are located or to provide information on specific site types to try and create a predictive model of location.

Unfortunately the function to convert raster to vector data provided in QGIS did not perform properly and despite a great deal of effort to troubleshoot this problem it remained impossible to perform in this version of QGIS.

This highlights another weakness of the analysis side of QGIS and users would have to look elsewhere (GRASS) for this function.

So although analysis can be performed in QGIS it is limited and mainly of use for those wanting to see at a glance where sites are located, while still useful it does not fulfil the needs of most GIS users.

Info on Viewsheds and Kernal Density Analysis:

Users familiar with Arcmap and other GIS programs will be aware of processing tools that create density maps and viewsheds, both of which can be useful on archaeological projects. At this time neither of these functions are available within QGIS, but are in the pipeline for development and may appear in future versions.

Querying Data:

Data added into QGIS can be queried; this can be a powerful tool for analysis of archaeological sites or data.

Basic querying can take place using the 'Identify features' icon

You can click on individual features or drag a box over several at once. This prompts a table to appear with the related attributes.

On a more analytical basis you can query whole layers at once.

>Right click layer, open attribute table (waive any error messages that appear)

You can then scroll through the attributes manually or query them. The tools at the bottom help with this. A basic query consists of entering the value you want to search in the field you want to search.

For example searching for all the 'CIST' entries in the CLASSUB field.

The tools on the bottom left give a variety of options about displaying these selections – all at the top etc
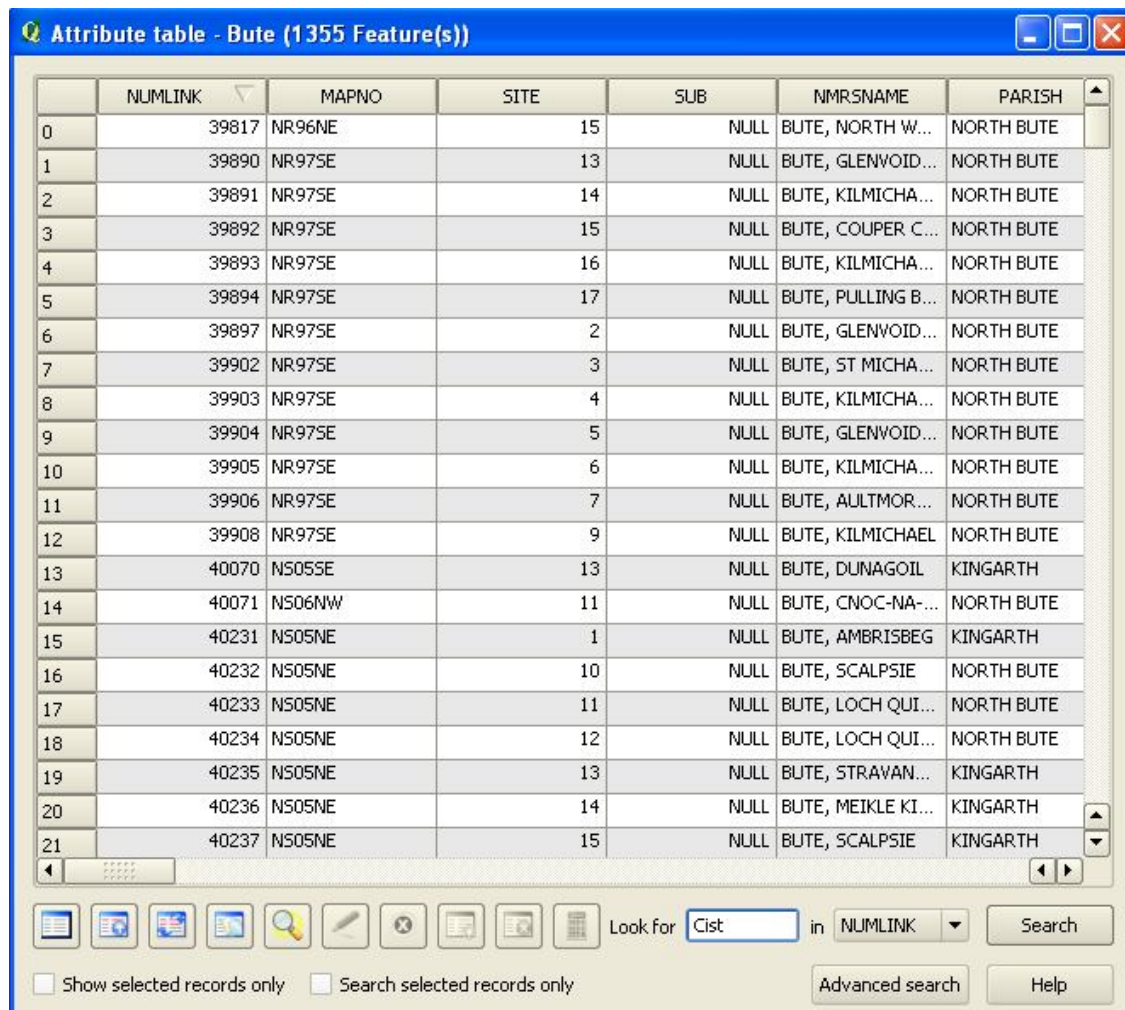

Fig. 15. example of attribute table window with basic query for 'cist'

Advanced querying is accessed through the 'Advanced search' button on the bottom right of the window.

Here you can build a much more complicated query:

>Choose the field from the left menu

>Add an operator such as LIKE or =

>Click all or sample to reveal the values found in this field

>Choose your value (this can be edited or typed in but must have quotation 'marks' around it)

>You can test this to see if it returns any results or just press OK and view the selected features in the table or layer.

Examples of more complicated query formats:

The above query only returns entries with the value CIST – to make this query more comprehensive put in wildcards on either side of the word within the quotations.

To find all values with the word CIST in them:
CLASSSUB LIKE '%CIST%'

It could also be useful to find sites of a particular type within a bounded area.

To find CISTS in a particular parish:
CLASSSUB LIKE '%CIST%' AND PARISH LIKE 'KINGARTH'

There are many different queries that can be performed – try out a variety to get familiar with the capabilities.

Sometimes it is useful to make selections into their own separate layer.
Once you have queried successfully and the features are still selected right click on the layer.

>Save selection as

>Browse for appropriate location and name, saving it as a new shape file

This can then be added into the map canvas showing the specific distribution of the features (see examples of chambered cairns, duns and chapels in the case study dataset).

Managing Data:

It is important to keep track of all the data you use, particularly where a large number of layers are involved and it is impossible to document new or edited metadata for layers.
At the start of the project create a folder solely for the GIS, keep data in separate folders within this (for example all map data in one folder, survey data in another etc). An alternative would be to keep all rasters in one folder and all vector files in another but this can often end up 'cluttered'.
As mentioned throughout the manual, keep related files together. Particularly those with locational data attached, if these files are separated it could become a problem later.

Producing Figures/Screengrabs of Data for reports and presentations:
There is a quickprint option in QGIS but it is not recommended for publication style figures. It can be useful for a quick glance or copy of data to show someone else.

Always use the scale bar and north arrow icons to augment the drawing.
These are found:

After adding these you go to the adobe style icon (red triangle) and a window appears allowing you to add a title and other information.

It can then be saved as a pdf however the formatting is basic.

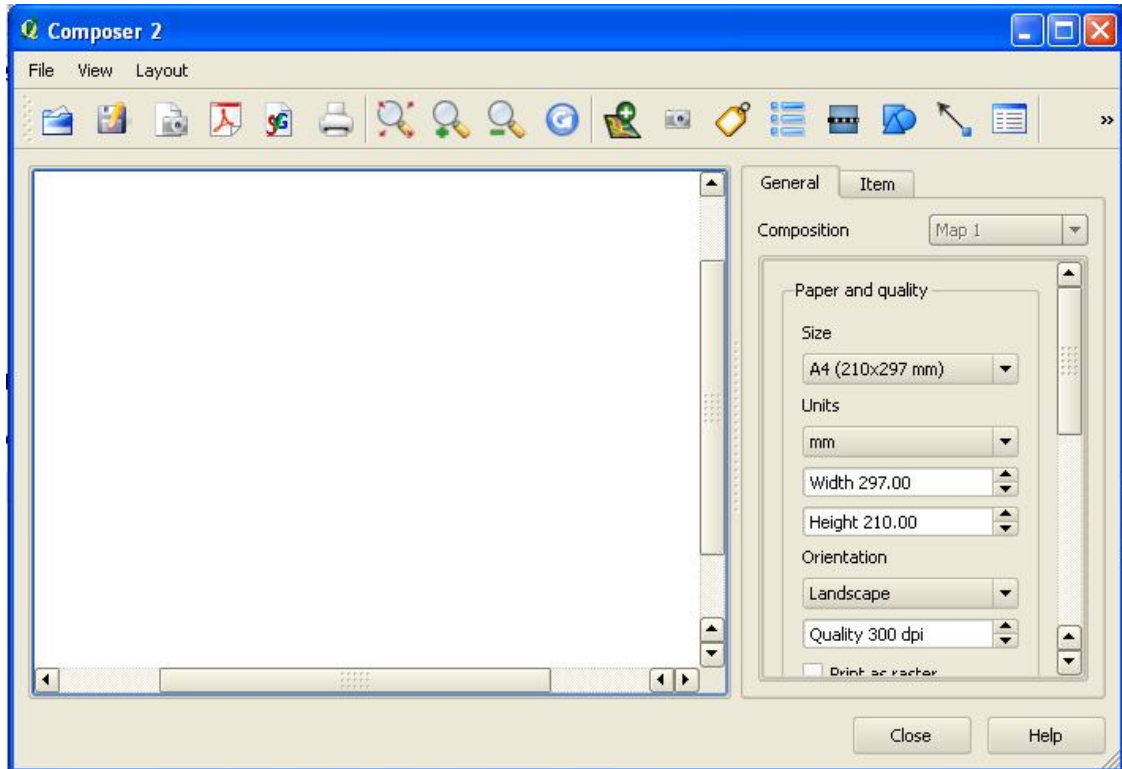A more useful tool is the print composer:

>File/New Print Composer

Fig. 16. View of print composer and associated options

In the map canvas first of all turn on the layers you want to incorporate in the image, then zoom into the scale, making sure all the features you want to show are visible within the frame.

>In the composer select the icon 'Add new map'

>Then click on the composer canvas and drag a box where you want the map to go.

>This can be moved as required.

>Add in north arrow, scale bar, legend, labels or shapes in the same way until the figure is complete

>To edit the individual features you add to the canvas such as scale bar and labels go to the tab on the right 'item'. This gives options to change the text or scale etc.

The right hand menu 'general' also contains some useful set out options, including a drop down menu allowing you to toggle between landscape and portrait.

If you will be using a similar template for many figures or want to save this for future additions save the template.

You can export this as an image, pdf or print it. All icons are in the top left of the screen.

Tip: Once you are happy with a box right click it and that part will become locked to editing as you compile other features around it. To unlock merely right click again.

Saving to a CD/DVD/Pendrive:
Save the QGIS map canvas and ALL associated data and files in one action. It is best for them to all be located in one folder and this 'container' is saved or burnt to pendrive/disc as one entity. This limits the chance that important data will be missed out or saved in the wrong place.
When you are saving the data:
>go to Settings
>Project Properties
>General Tab
>Make sure the 'save paths' setting is on **relative** not absolute this will allow the project you save to 'remember' where all the files are (if you open the project on another computer or from another directory and it comes up with an error saying it can't locate the layers this is probably the problem).

Also remember to save a copy of the QGIS installation package so that the version you have used for the construction of the GIS is the same as the one people are trying to view

data on – this is important as subsequent versions of QGIS may not recognise data or change the formats.

Check the disc and the connection to the data before handing it over to other users.

References:

- Raster Data Definition:
  http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?TopicName=What_is_raster_data%3F
- Vector data definition:
  http://www.fpa.nifc.gov/Library/Documentation/FPA_PM_Reference_Information/Output/GIS_overview.html
- Metadata Definition: http://www.techterms.com/definition/metadata