WORKING WITH QGIS
Looking at Lidar

Chapter 1   Getting started

This is a simple and basic guide for downloading and using QGIS for beginners. For those with a reasonable grasp of computer skills I apologise that this may be too basic but having started at a very basic level myself I found it extremely difficult to find any literature that I could understand. I am therefore aiming this guide at those of us who need a more simple step by step approach.

{L} means left click or left hand side of screen
{R} means right click or right hand side of the screen

Before you do anything you need to know what "bit operating system" is running on your computer:

If you are running Windows 7 or 8
Click on "**Start**"
{L} **Computer**
{R} **Properties**

If you are running Windows 10
Click on **"Settings" > System>About**

 About half way down the screen you will find System Type. It will either be 32 or 64 bit. Make a note of this for later use.

Download QGIS

You are now ready to down load QGIS onto your computer.

- Go online and in search type **QGIS**. It will bring up the official QGIS site which you click to open. There is a lot of information on this site including "how to" pages that you can access at any time.
- Locate the "Download" page. You will see 4 different options: QGIS 32 bit and QGIS 64 bit and OSGeo 32 bit and OSGeo 64 bit.

I suggest you opt for the QGIS option, choosing the correct bit option that you found earlier on your computer.

- Allow it to download and install. Follow the prompts that it gives. **This takes quite a long time so go away and have a cup of coffee!**

Eventually once installed you will find a number of new short cut icons on your desktop screen:

QGIS Browser, QGIS Desktop, GRASS GIS, OSGeo-4W, MSYS, SAGA GIS

- The only one that you will be using is the **QGIS Desktop** icon

If you are running on Window 10 you will find the QGIS icons in the menu under which ever version of QGIS is currently running (at the moment it is QGIS Lyon)

You now have the QGIS programme ready to run but before you start you will need to download some mapping and Lidar to use.
For this you will need to go online and request and then download the necessary data.

Set up folder

It is very useful to have a folder set up specifically for all your QGIS associated data. You can put it anywhere that you want but I found it was easiest to make a dedicated folder in your "Documents". Call it something like QGIS (or whatever your project is called)
 Inside that folder make separate files for Lidar, Raster and Vector. When it is all new to you this is a simple way of finding the correct format and data once you start working in QGIS.

Download Lidar

You can download Lidar files for free by going to

environment.data.gov.uk/ds/survey#/download.

- You will see a map on this page. Pull (drag) the map so that the area you want is in the centre of the screen. Using the **+** on the top {L} of the screen, enlarge the map area as far as it will go. By enlarging and moving a number of times your chosen area will become more like an OS map that you will be familiar with.
- You will notice the area is divided into squares. Click onto an area that you want data for and the square will turn into a solid green line.
- Below the map area you will find details of what Lidar data you can access. In the "Product" column make sure that you select Lidar Composite **DTM.** Your options will be data at 1m or 2m spatial resolution.
- Click the buttons under the "Coverage" column to "On". If there is data for your chosen area, in **DTM** format at either 1m or 2m resolution, the map will shade over. The data at 1m is more detailed and clearer than the 2m data. So if you have the choice, choose the 1m data.
- On the {R} you will see the "Download" column with a large green arrow and details of how large the file will be against either choice. Click **download** for your chosen data.

Zipped / Compressed files

The file will be downloaded as a "zipped / compressed" file. On the bottom {L} of your screen you will see the file being downloaded.

- Once it is fully downloaded click inside the box to open it.
- Come out of the internet
- You will now have a long list of "tiles". They will be **ASC.** type files and they will still be compressed / zipped. Each tile will be data relevant to a small area of the larger square that you originally chose.
- Look at the grid reference on each tile – if you know which ones you want just select those ones, otherwise extract all of them. You can always delete the unwanted ones at a later date.
- You should find a box near the top of the screen that says **"Extract all"**. Click on this.
- You will be asked where the files will be extracted to. This is why you have already set up a specific QGIS/Lidar folder.

- Click on **"Browse"** and navigate to this newly set up folder. You will probably need to navigate to Documents > QGIS (or whatever your new folder is called).
- Once you have your correct folder then click on the Lidar file. This is where your Lidar data will be stored once it has been extracted.
- Make sure that there is a **tick** in the small box next to "Show extracted files when complete".
- Click on **"Extract"**. Your data is now in a place and a form that you will be able to work with once you start working in QGIS
- Close all windows.

Depending on what version of Windows you have installed, this "Unzipping" process will be slightly different but in each case you will be looking to place the unzipped data in the newly made folder.

There is another place where you can access free lidar data which MTMTE actively promotes. This is via the "**Tellus SouthWest Project**". The data is of no better quality than the Environment Agency data but it does have data for a **small** amount of the missing EA areas. It is however quite a cumbersome system to download data and you will need to check you have sufficient computer storage space.

The main site is http://www.tellusgb.ac.uk/
Here you can access the map viewer to see available data - it allows you to open up layers to see what data is available for your area. This is only useful to show the extent of the data available.

http://mapapps2.bgs.ac.uk/tellussw/home.html
This is where you can download the data- it requires a good internet connection and you will need to use a FTP file service to get the data. The data is broken down into 5km squares or tiles. You will be asked to create an account, you then request the data set and you are emailed a link from which to download them. It tells you to use a FTP file service such as **filezilla** to complete the download. You then select the tiles you want and download and wait….
Link to DTM https://catalogue.ceh.ac.uk/documents/e2a742df-3772-481a-97d6-0de5133f4812
The data is hosted by CEH

<u>Download mapping data</u>

It is useful to have some form of regular mapping to use in conjunction with the Lidar. Sometimes it can be a bit confusing looking at a Lidar image but if the roads and rivers are added you get a better idea of the area you are looking at.

Go to www.ordenancesurvey.co.uk/opendata

There are quite a few different types of map data that you can order. They are also in 2 format types – Raster and Vector. You will become very familiar with these 2 formats once you start to use QGIS.
As a basic guide a Raster image is a bit like a photo – enlarge it on your screen and it goes into blurred squares
A Vector image does not blur on enlargement. It is either
 1) A specific dot on the map (such as a church or phone box)
2) A set of dots that join up to make a line (such as a road or river or wall)
3) A set of dots that joins up to make a shape (such as a lake)
There will be more detailed explanation later once we start working with the maps.

A couple of maps that I have found useful are OS Open Map Local. This is a vector format. Choose the **ESR**I Shape file. OS Street View which is a Raster format is also useful. Vector map District and Miniscale are also useful.
If you use this Open Data site you do not have to pay for any of the downloads so choose what you think would suit your project.
You will usually have to wait up to 24 hours for an email confirming your order. Once this arrives click on the link and follow the instructions to download the data.
The mapping you have chosen will be in a downloadable format direct from the email. The downloaded data will arrive in a zip format which you will need to open.
Follow the instructions that you have already used for unzipping your Lidar data.
 When asked where you want to store it make sure that your Vector data goes into the Vector file and the Raster data goes into the Raster file.

It is a good idea when you are choosing your mapping data to make a note of what you are ordering and whether it is in a Raster or Vector format. Then, when you are unzipping it you can place each part in the correct file. This makes it much easier to access the data once you start using QGIS.

There is another option to access map information which we will cover later once you have everything up and running.

You have now got everything set up ready to start working with QGIS.

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Chapter 2   Understanding terminology

Before we open QGIS it is worth taking a bit of time to understand what basic terms mean.

QGIS stands for Quantum Geographic Information System

Lidar is a remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light. When you download data you will have the option of **DTM or DSM**. The DTM data has all the trees / buildings ect removed – showing just **T**erain whereas the DSM data still has all the vegetation and buildings left in. This is why you choose the D**T**M data.

Vector data is similar to map data that you will be familiar with. Vector layers are the "features". It is information showing a number of fixed locations and comes in 3 different types;
  1)   Points – ie; an object like a phone box, electricity pylon
  2)   Lines –joined up points making a line from A to B   ie; a road or river
  3)   Polygon – a series of points and lines that form a shape   ie; a field or a lake.
Vector data does not go out of focus when zoomed into.
You are able to alter the "attributes" in a Vector map - change colour and width of features such as rivers, roads and woods plus other symbols. There are many options in the attribute table.

Raster data is satellite data which comes in "grids or blocks" similar to a photo. It becomes out of focus when zoomed into.
It is geo-referenced which means that the data can be "earth referenced" – a process of defining exactly where on the earth's surface an image / Raster data set was created thus placing it correctly on a Vector map.
There is a limited amount that you can alter in the attribute table – the most useful in working with Lidar will be altering the brightness and transparency.

Chapter 3   Working with QGIS

OPEN AND WORK WITH QGIS

Click on the "**QGIS Desktop**" icon and allow the program to open. It can take a few minutes. You will know when it is ready because a window comes up with hints which you can close. When you first open QGIS the screen shown below is how it will look – there will be no imaging until you start to add it.

It is now time to familiarise yourself with the layout of the screen.
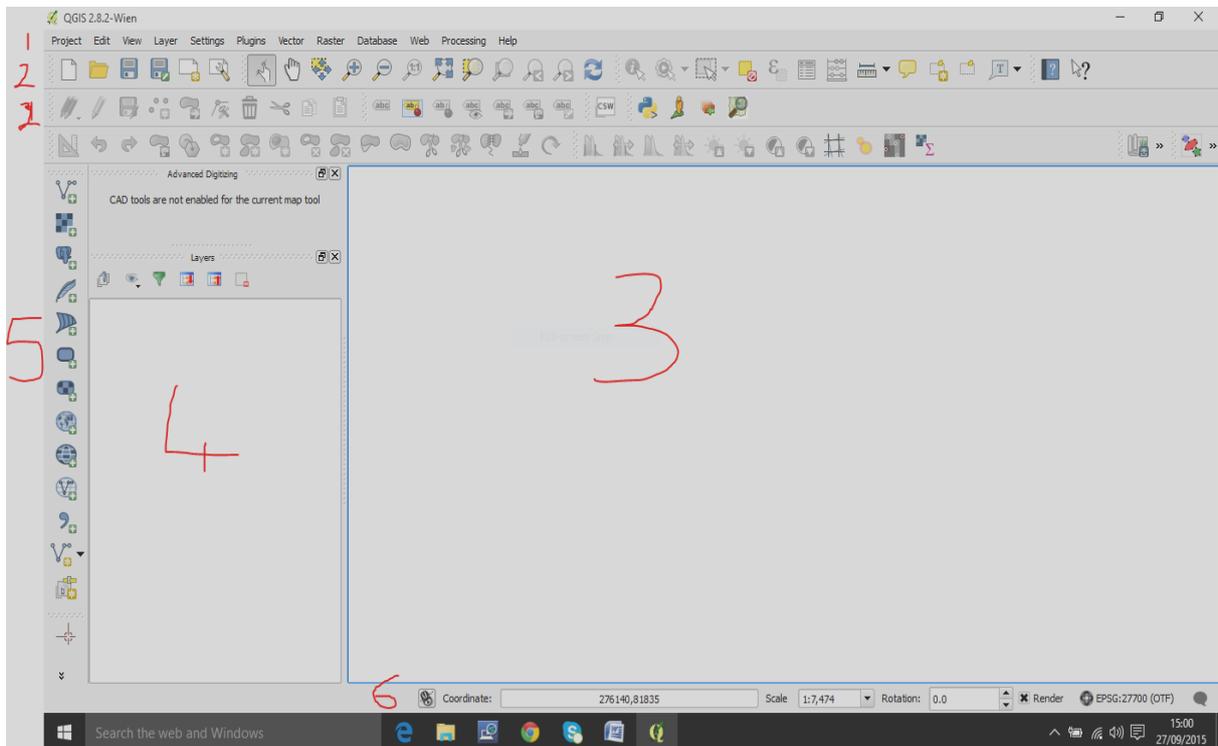
1   At the top you will find the **menu bar.** This is similar to other programs such as Word.

2   Below this are the **tool bars.** These provide a multitude of functions such as pan (hand), zoom in/out, (+/_) and many more.

3   The large box on the right side is your main **map view.** This is where you will see all your hard work gradually take shape!!

4   On the left side is a **layers** box which will show you all the data as you load maps and Lidar into your project. This will be where you can alter the attributes of each layer.

5   On the far left side going down the screen is the **data source toolbar.** This is used to add new data to the map. This toolbar works in the same way as some of the **menu bar** tools which will be explained when we start adding data.

6   At the very bottom is the **status bar.** This shows your map scale, projection and coordinates.

Setting parameters

The first time you open QGIS you will need to set a number of parameters so that when you import maps and Lidar it will open with the correct coordinates. Once you have set these you will not need to repeat this part each time you open QGIS.

- Click **Settings** > **Options** > **CRS**
- In the 1st box select "**Enable on the fly reprojection by default**"
- In the 1st box "**Always start new projects with following CRS**" – Click on the little diamond type icon to the right of the box and type in **27700**
   Select **EPSG:27700,OSGB 1936 / British National Grid**
- In 2nd box select "**Use a default CRS**" and make sure it is the same as the previous one selected
- Press "**OK**"

Installing plugins

- On the **Menu bar** click **Plugins** > **Manage and Install Plugins.** There are many different plugins with a brief description for each when you click on it. You will find that when you downloaded QGIS the most important ones were automatically added. You can add any you want but make sure that the following are installed;

Raster terrain analysis	**ArcheoCAD**	**DxF2sh Converter**	**GDAL tools**
Import layers from project		**OpenLayers plugin**	**Co-Ordinate capture**
DB Manager	**ftools**	**GPS tools**	

If any of these do not have **X** next to them they will need to be installed by clicking on the "install" button and waiting for a few seconds until you are prompted that it is installed.

Ready to start

You are ready to start work.

We will now load a single Lidar tile. Once you are familiar with the process you can load multiple tiles but remember that for EACH tile you will need to treat it individually when setting the image up to view. You can then work them as a "whole".

- On the **menu** bar click **Layer**
- Hover over **Add layer** and click on **Add Raster Layer**
- This will bring up your folder that you set up at the beginning (if it does not then click on "Documents" on the far left. This will bring up all your document files. Select your newly created one, then select the Raster folder. You will probably only need to do this the first time.
- You will now need to select the Lidar with **asc** at the end (such as *SX7779_DTM_1M.asc*

Depending how far you opened your folder when unzipping it, you might find that you will need to click through a number of parts until you reach the correct file.

- You will now notice a yellow bar at the top of the **map view** section showing that it is loading your Raster Lidar tile. Once it is loaded you will see a fuzzy non-descript image in the map view area – don't panic ..this is correct!! You will also now see your 1st layer details in the **Layer list.**
- Click on the small left hand box to change it from **–** to **+** in the **Layers** list. This hides all the details leaving you with just a single line detailing the name of your tile.
- In the **menu** bar click on **Raster > Terrain Analysis > Hillshade**
- A small box comes up. In the **Elevation Layer** should be the name of your Raster image.
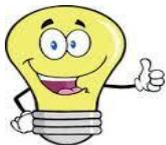
Once you bring in other tiles you will need to remember to select the correct tile that you are manipulating otherwise you will manipulate and lose the wrong part or tile.

- **Output Layer** – click on the small right hand box. In **File name** type a name that you will recognise for that tile. (eg. *7779hillshade*)
- **Z factor** set at 4.0   You can experiment with this setting once you are familiar with the program
- **X** Add result to project
- **Illumination** Leave these at Azimuth 300.00 and Vertical angle 40.00 (default settings) for the moment. Again these can be experimented with once you are comfortable with manipulating images.
- Press **OK**
- Gradually a new image will appear in your Map view area.

Notice a blue bar on the lower {L} of the screen which moves as the image focus is adjusted – this happens when ever you alter the image size. This is your workable Raster Lidar image

- You can now do the same with Slope, Relief and Aspect. ***Make sure that in the Output Layer you choose the correct tile (DTM.1M)*** I suggest that when you name each one in the Output Layer> File name that you follow a similar pattern to the hillshade eg. *7779slope / relief / aspect*. This makes it very much easier to find later when you turn the sections on and off. When you start experimenting with different values in the Z factor, Azimuth and Vertical angles use a file name such as *7779slope1 / hillshade1* ect. ***If you used the same as your original name you will lose the original manipulation***.
- Notice the Layers List is adding your new data details.
- In order to see the different images that slope / relief and aspect create, click off the **X** next to each one in the layers list then click each one back on individually. The layer **above** is always the dominant layer when it is clicked on, so you can drag and drop the order or simply turn off the parts that you do not want at the moment.

Now you can try bringing in some Vector data such as rivers, woods, and roads. This can help you visualise where you are on the Lidar

- In the menu bar click **Layer > Add Layer > Add Vector layer**
- A small box comes up. For the moment check the Source type is set for **File**
- In the 2nd (Source) section click on **Browse** . You may need to go into your newly set up document file and locate the Vector folder.
- Depending on what data you have ordered you will find full maps or a long list of items that can be added to your map – buildings, rivers, roads, woods and much more. Vector works with Shape files so when you have found something to add to your map click on the relevant item with the ending **.shp**
- This will appear in the **Dataset** box. Click **Open**
- Your map will now have all the roads ect added to your Lidar image and you will see the data also displayed in the Layers box. Make sure that this vector data is placed <u>above </u>the raster data in the layers box so that it shows on your map.
- **<u>Save your work.</u>** First time it will ask for a name – give it something that you will recognise (such as 7779 Master)
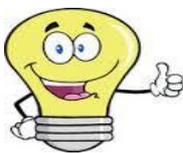
 It is really important to keep saving your work as you add or change things – there is nothing worse than spending hours on your masterpiece only to hit the wrong button and loose the lot !!

Changing the attributes

- With Vector imaging you can alter the appearance in many ways. Supposing you have loaded the rivers – {R} click the Vector data line (rivers) in the Layers box and click on **Properties** near the bottom of the list.
- On the {L} side you will find a number of Option menus. If you click on **General** you will see that the Coordinate reference system is the one you set at the start – EPSG:27700. This means that both your Raster and Vector images are working on the same coordinates.
- Now look at **Style**. This is a very useful menu. You are able to change the colour of your rivers and whether you want them more transparent. Try pulling the transparency slider at the top of the properties box to see the difference it makes to the coloured box to the {L}. When you have the depth of colour you want, click **Apply** at the bottom of the screen. You can also alter the transparency of the layer when it is placed over the Lidar map by altering the Layer transparency at the bottom of properties box. Move the slider whilst watching the map view. Once you have it as you like, click **Apply > OK** . There are different options to how you portray your map so try experimenting.

  You can keep changing the colours ect and pressing apply until you have it as you want. It is only saved to memory once you press OK

- Raster images can also be altered in the exact same way by going into **Properties** but you will not be able to make as many alterations.

Take a look at the **Data source toolbar** on the {L}. The first 2 images will become very familiar.

The 1st one is a Vector button that you can use to load your vector data instead of going into Layer section in the Menu toolbar. It works in exactly the same way.

The 2nd is a Raster button. This can also be used in the same way as in the Layer section of the Menu bar.

There are many option buttons in the Data source toolbar and Toolbar. As you experiment you will start to use some but some you may never use.

Chapter 4   Adding to your image

Now you have a basic working Lidar image with mapping you can start to study it in more detail.

On the **Toolbar** click on the "hand" symbol. This allows you to move the map around so that you can position it to the area of interest. Also in the toolbar are the **+ / -** symbols. These allow you to pan in (enlarge the image) or out.

It is a good idea to get into the habit of clicking on the "hand" symbol when you are doing anything on your map. If you are on one of the other buttons and click, it is very easy to totally loose where you are and not so easy to get back to the correct area of the image.

Adding grid co-ordinates

- Maybe you would like to add grid coordinates. On the **Menu** bar click **View > Decorations > grid**
- This opens a Grid Properties box. Click **Enable grid** so there is a **X**
- Set **Interval X and Y** to 50. You can change this later once you know what grid interval you want. (I find 5 or 10 useful for archaeology)
- Click on **Line symbol.** This gives you various options for how your grids will be displayed. (I find it useful to set the transparency between 50-60% so that the lines do not obscure the mapping beneath.)
- Select **X** for **Draw Annotation**. This is how your grids will be numbered. **Choose your preferred option**. (I like the combined Vertical and Horizontal option with numbers inside the map)
- Make sure the **Coordinate precision** is set at **0**
- Click **Apply** and check that you are happy with it on the map view. Then click **OK**

Get to recognise your QGIS screen layout. You can see the precise grid reference of any given spot. Click on the "hand" symbol in the menu bar and slowly run it around on the map view. If you look at the **Status bar** at the very bottom, you will see the grid coordinates changing. This is very useful if you see something of interest on the Lidar image that you would like to visit in the field.
You will also notice that in the status bar area the EPSG:27700 CRS (Coordinate Reference System) that you initially set.

Importing mapping

You can import mapping such as "OpenStreetMap", Google and Bing into your project. For this you will need to be online. (Mapping previously downloaded at the start of this tutorial can be used without being online)

- Go to **Plugins** and download "**OpenLayers Plugin**"
- In the menu bar click on **Web** > click to select the **OpenLayers plugin** > **OpenLayers overview**
- In the bottom [L] under the Layers list there will be a new box. Select the **Enable** box and choose which mapping you want to use from the dropdown menu. Click on your lidar so a red **X** shows. This enables the OpenLayers to place the correct mapping over your lidar
- Click on the add raster button in the openlayers overview [L] and it will be added to your Mapview box.
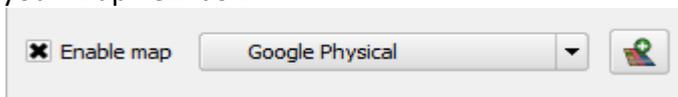
- Dont forget to alter the transparency of your work so that it merges .

This has given you the **basic** set up for your lidar imaging. There are many ways you can change it to suit your needs – by experimenting you will learn what various terms mean and how varied you can make your images.

When you come back to QGIS after closing the programme down, you can access the work you previously did (providing you saved it) by clicking on **Project > open recent.** This gives you a list of your saved work which you can click on and it appears in your **Map view** area. Now you can continue working on it. Dont forget to save as you go along.

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<u>Chapter 5</u>   <u>How to print</u>

You have now got your image as you want it and have **saved** it ready for printing. QGIS does not have a print facility on the main page. You need to open a secondary window.

- **Project > New Print Composer**
- A small flip up box comes up for the name you want to give the map
- **OK**

A new window comes up. Notice in the top left hand corner the name you have just given your map. The {L} side is the window where your map is going to be imported. The {R} side gives you various options for finalizing how your printed version will look.

- On the far {L} click on the icon which says **Add new map** (hover over the icons to find it)   Your cursor becomes a **+** and a white square is added to the {L} area.
- Place the **+** in the top {L} of the new white square and **holding down** the mouse, pull the **+** down to the lower {R} of the square. Notice a red line being made as you pull the curser down.
- Release the mouse once you have positioned the newly drawn box within the white square.

The image on your main QGIS page appears in this new area.

You now have various options / enhancements that can be added before printing. These can be accessed from the {R} menu

Composition tab
- Allows you to set the paper size and orientation
   Make sure there is an **X** in the **Print as Raster** option if you are using any raster imaging (lidar)

Items properties tab
This is a useful tab allowing you to make quite a few enhancements
- Make sure there is an **X** for **Draw map canvas**

- Scroll further down to **Grids.** You will see a box with symbols. Click on the green **+** This allows you to set different grid intervals and map units. For the **Interval and Offsets** (X / Y) choose what you want. Depending on the magnification of the map to be printed, I find 5.000 or 10.000 are good.

- **Line style.** Click on this button to alter the colour / width / transparency of the grid lines. You do not want them so thick and dark that they mask the map features.

- **Draw Coordinates.** Make sure there is an **X** then set the options that you want for how the grid coordinates will appear on the printed map.

As you experiment you will notice that the image on the {L} will alter so that you can see what each function does.

You will see that there are various other options that you can set. You will need to experiment with the various options in the print composer menu to add things like a legend / title / direction arrow ect

Once you are completely happy with your map, choose whether to save as **PDF**, an **Image** or **Print** (at the top of the page)

There are a number of useful web pages giving details on how to personalise your mapping. A good place to start searching for help is on the main QGIS web site that you originally went to for your QGIS download. There is a very comprehensive help link to be found there.

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